FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION (SSTE)
P.M.B 65, MINNA, NIGER STATE, NIGERIA

10TH SSTE HYBRID INTERNATIONAL CONFERENCE

THEME:

EMERGING TECHNOLOGY AND INNOVATIVE PEDAGOGY FOR ENTREPRENEURSHIP AND ECONOMIC DEVELOPMENT

DATE: Monday 7th to Friday 11th October, 2024.
VENUE: CPES Complex, FUT Bosso Campus, Minna, Niger State

PROCEEDINGS

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

10th

INTERNATIONAL CONFERENCE OF SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION (SSTE)

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10th INTERNATIONAL CONFERENCE OF SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION (SSTE)

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ACKNOWLEDGEMENTS

The Local Organizing Committee of the 10th International Conference of School of Science and Technology Education (SSTE), Federal University of Technology, Minna, appreciates the Management of the University for the Unflinching Support given to the team which led to the success of this Conference. We also wish to express our profound gratitude for the assistance rendered by the University Management especially in disseminating information relating to this Conference using the University website, Campus News, and FUT Search FM.

We thank the Dean, School of Science and Technology Education (SSTE) for hosting this Conference despite the economic situation in the country. His encouragement, advice, and moral support gave the Local Organizing Committee the strength to complete this task and make sure the Conference is successful.

We also, sincerely thank the academic staff of the School and University Community for their essential roles played towards the success of the Conference. We thank the non-teaching staff for their roles which contributed to the success of this Conference.

The efforts of the Editorial Board are commendable for making sure that the Book of Proceedings was ready. We appreciate the efforts of the Keynote presenter, Lead Paper presenters, and others for attending this Conference despite their tight schedule.

We also commend the undergraduate and postgraduate students of the School for sparing their time to participate in all the events. Above all, we thank God Almighty for the strength given to the LOC members to discharge their enormous tasks.

PREFACE

Emerging Technology and Innovative Pedagogy for Entrepreneurship and Economy Development is about giving students the skills they need to succeed in this new world and helping them develop the confidence to practice those skills.

Hence, the theme of this conference is apt and provides opportunities where experts brainstorm so that international communities can benefit from one another and also respond to Emerging Technology and Innovative Pedagogy for Entrepreneurship and Economy Development. It is worth noting that, proper implementation of the Emerging Technology and Innovative Pedagogy for Entrepreneurship and Economy Development would have a greater influence on the quality of manpower injected into the labour market which may determine the economic growth of any nation.

The theme and sub-themes of this conference, "Emerging Technology and Innovative Pedagogy for Entrepreneurship and Economy Development" are based on the prevailing circumstances in education sectors in developing nations. I am sure this conference has provided an avenue for researchers and educators to share their ideas on the theme and sub-themes of the conference that can enhance quality education, self-reliance for entrepreneurship in underdeveloped and developing nations across the world. I hope the theme and sub-themes meet the needs of the stakeholders in education.

The sub-themes are:

- Innovative Pedagogy for STEM and TVET
- Artificial Intelligence (AI) and new Technology for Enhancing STEM and TVET
- Artificial Intelligence (AI) for Embedded Learning Pedagogy
- Artificial Intelligence (AI) and Inclusive Learning for People Leaving with Disabilities
- Emerging Technologies for Language, Cultural, and Economic Development
- Language, Culture and Entrepreneurship for Economic Development
- Emerging Technologies for STEM and TVET Instruction
- Emerging Technologies for Entrepreneurship in STEM and TVET
- Emerging Technologies in STEM and TVET for Economic Development
- AI for Creativity and Innovation in Library and Information Science
- Digital Transformation and Internet Crime
- Emerging Technologies and Climate Change for Economic Development

The Local Organizing Committee is thankful to the participants of 2024 conference for their contributions.
God bless you all

Prof. Abubakar Mohammed Idris
Chairman LOC

WELCOME ADDRESS BY THE VICE CHANCELLOR, PROFESSOR FARUK ADAMU KUTA AT THE OPENING CEREMONY OF THE 10TH INTERNATIONAL CONFERENCE OF THE SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION (SSTE), FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA HELD AT THE CPES HALL, BOSSO CAMPUS, FUT MINNA. 7th-11th OCTOBER, 2024

On behalf of the Governing Council, Management, Staff, and Students of the Federal University of Technology, Minna, I am delighted to welcome you to the 10th International Conference of the School of Science and Technology Education. A warm welcome to all our distinguished speakers, especially our Keynote Speaker, Prof. Stephen Jobson Mitchual, Vice Chancellor of the University of Education, Winneba, Ghana, as well as our Lead Paper presenters, Prof. Benjamin A. Ogwo from the Department of Career and Technical Educator Preparation, State University of New York, USA, and Prof. Mudashiru Olalere Yusuf from the Department of Educational Technology, University of Ilorin, Kwara State, Nigeria. To all participants joining us from near and far, we are pleased to welcome you to this annual conference which has long served as a platform for scholars to come together and share their research on issues of critical importance for the advancement of human society.

This year's conference theme is "Emerging Technology and Innovative Pedagogy for Entrepreneurship and Economic Development." For economies aiming to compete globally**,** embracing technology and entrepreneurship is essential. This is why conferences like this can help policymakers, educators, and entrepreneurs exchange ideas on how to harness the latest technological advancements for long-term economic gains.

The focus on emerging technologies is timely, as cutting-edge innovations like artificial intelligence (AI), blockchain, robotics, the Internet of Things (IoT), and other digital developments are not only transforming industries, enhancing business efficiency, and creating new markets but also reshaping various aspects of our daily lives. Undoubtedly, the discussions here will center on how to integrate new technological advancements and creative teaching approaches to promote entrepreneurship and drive economic growth.

By combining emerging technologies with innovative teaching methods, learners will acquire the knowledge and skills essential for success in today's fast-changing economy. This approach not only prepares them to excel as entrepreneurs but also empowers them to contribute to broader economic development by fostering innovation, enhancing productivity, and driving growth in various sectors. This university is especially dedicated to nurturing entrepreneurial abilities in our students, enabling them to create job opportunities, launch businesses, and actively support Nigeria's overall economic growth.

The concept of this tenth Conference of the School of Science and Technology Education is truly commendable. It serves as a vital platform for discussing the integration of education, technology, and entrepreneurship, which will shape future economies and drive sustainable growth. This is why I would like to express my sincere appreciation to the Dean, the Conference Organizing Committee, and the entire staff of the school for their tireless efforts in ensuring the success of this event.

Finally, to our distinguished invited guests, resource persons and participants, I wish you all a successful and productive conference, as well as an enjoyable and pleasant stay with us here in Minna.
Thank you for your attention.

WELCOME ADDRESS BY THE DEAN, PROFESSOR AMOSA ISIAKA GAMBARI, SCHOOL OF SCIENCE AND TECHNOLOGY EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGER STATE, NIGERIA AT THE OPENING CEREMONY OF THE 10TH INTERNATIONAL CONFERENCE OF THE SCHOOL ON 9TH OCTOBER, 2024

Protocol

First and foremost, I thank the Almighty for bringing us safely to this occasion of the School of Science and Technology Education (SSTE) Tenth International Conference. I warmly welcome you all on behalf of the School to the Conference.

I sincerely welcome and appreciate the Chief Host, our hardworking Vice-Chancellor and his management team for providing a conducive environment that facilitates the hosting of this conference at its usual time of the year.

On behalf of the School, I welcome the **Registrar/Chief Executive, National Examinations Council (NECO), Professor Ibrahim Dantani Wushishi** for the honour and his immense contributions to the school.

Mr. Chairman, Distinguished Ladies and Gentlemen, the Keynote speaker is a friend of the school, an erudite scholar and stimulating speaker, in person of **Professor Stephen Jobson Mitchual** the Vice-chancellor, University of Education, Winneba, Ghana. We are very proud to have him as a conference partner. We want to further the partnership by collaborating with your institution. Sir, you are very welcome to Nigeria and to our great institution.

I also especially welcome the Lead Paper presenter I, a great academic and researcher, an international acclaimed speaker, **Prof. Benjamin A. Ogwo** of the Department of Career and Technical Education, State University of New York, Oswego, USA, you are highly welcome Sir.

It is my pleasure to introduce our second Lead Paper presenter **Prof. Mudasiru Olalere Yusuf** of Educational Technology Department, Faculty of Education, University of Ilorin, Kwara State, Nigeria who has graciously accepted our invitation to share his expertise with us today. As my PhD supervisor he has been a valuable mentor and guiding light in my academic journey. You are highly welcome Sir.

I particularly appreciate the presence of **Deans and Directors, Professors, Heads of Department and other colleagues** who have graciously honoured this invitation. I say thank you for being part of this great occasion.

Our School (SSTE) has a commitment to pursue excellence in teaching, learning, and research with widening globalization and rapid growth in knowledge, the School is committed to staying at the forefront of developments in education and to sharing knowledge and expertise in ways that will most effectively prepare our students for the future. The School's International Conference is growing in stature each year and is an excellent opportunity to share the latest expertise in transnational education and to take new ideas to our various institutions.

Distinguished guests, esteemed colleagues, and valued participants, both present here and joining us virtually, I am delighted to welcome you all to the 10th Faculty of Education International Conference. This year's theme, "Emerging Technology and Innovative Pedagogy for Entrepreneurship and Economic Development," is not only timely but also crucial as we

come together to delve into the intersection of education, technology, entrepreneurship, and economic growth.

The conference theme seeks to address the challenges of integrating cutting-edge technologies and innovative teaching methods into entrepreneurship education. It aims to explore how digital tools, AI, and other technologies can enhance the teaching and learning process, fostering creativity, critical thinking, and problem-solving skills among students. The conference also seeks to address the need for adaptive educational frameworks that equip learners with the necessary skills to drive economic growth, entrepreneurship, and sustainable development in a rapidly changing global economy.

The sub-themes of this conference were carefully extracted from the main theme. It covers, among other areas, artificial intelligence, embedded learning pedagogy, and also artificial intelligence for enhancing STEM and TVET. The theme is quite strategic and very relevant to the present time. It is hoped and believed that the international and national scholars gathered here for this conference will arrive at developmental breakthroughs in the course of their deliberations.

We are in an era where technologies like artificial intelligence, Internet of Things, virtual reality, and cloud computing are transforming society, especially education. These advancements provide new learning opportunities and essential skills for success in today's fast-paced world. Integrating these technologies into education is crucial in preparing future entrepreneurs who will drive economic growth and create jobs.

Ladies and gentlemen, emerging technologies such as artificial intelligence have come to stay; it is better we embrace modernity and shun archaism. "Where the heart is willing to change, it finds a thousand ways. Where it is unwilling, it finds a thousand excuses. Frankly speaking, there is no excuse for the non-integration of technology in our schools and workplaces. "Technology would not replace the teachers, but those teachers who use technology will probably replace those who do not".

In essence, the central theme of this conference prompts us to explore how we can leverage technology, creative teaching methods, and entrepreneurial spirit to nurture meaningful and enduring economic progress. I urge each and every one to actively engage in the discussions, share your perspectives, and collaborate on ideas that have the potential to transform our education systems and economy.

Chairman, Ladies and Gentlemen, I am convinced that these stimulating speakers of this conference will meet everyone's expectations. I believe this conference will be another great success.

I congratulate the staff and students of the School of Science and Technology Education and others who contributed to the success of the 2024 International Conference. I offer my warmest congratulations and best wishes to the organizing committee for a successful and meaningful gathering of great minds. It is my hope that the dialogues and exchanges here will ignite fresh collaborations and initiatives that will make a lasting impact on our collective future.

Once again, I express my heartfelt gratitude to the Vice-Chancellor of this great and dynamic university and his management team for their contributions to our conference.

Finally, to our distinguished invited guests, resource persons, and participants, you are all welcome to this great institution and to the city of Minna. Please do have a pleasant experience as you take time out of your busy schedule to visit places of interest in the university and Minna City. Please enjoy our serene environment.

We look forward to your being part of the 2025 International Conference. I wish you fruitful deliberations and a safe journey to your various destinations.

Thank you for your attention.

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EMERGING TECHNOLOGY AND INNOVATIVE PEDAGOGY FOR ENTREPRENEURSHIP AND ECONOMIC DEVELOPMENT

Prof. Stephen Jobson Mitchual, PhD
Vice Chancellor, University of Education, Winneba, Ghana

1.0 Salutation

- Chairman;
- Deans, Directors, Heads of Departments and Units;
- Members of Faculty;
- Other Members of Convocation;
- Industrious Participants;
- Distinguished Guests;
- Ladies and Gentlemen;

2.0 Welcome

I am deeply honoured to be here today to deliver the keynote address on "Emerging Technology and Innovative Pedagogy for Entrepreneurship and Economic Development". Speaking before such a distinguished audience can be quite intimidating, but as Buckingham (1928) once humorously remarked, "There are two types of speakers: those who are nervous and those who are liars."

I must admit, I am in the former category, but I'll do my best to make this engaging and worthwhile for all of us.

Before I proceed to the heart of today's keynote address, I want to express my gratitude to the organisers of the conference for inviting me. With so many distinguished experts around, I must admit, I was beginning to think my invitation got lost in the mail! Nonetheless, here I am, thrilled to share insights on such an exciting and impactful topic.

Thank you for the privilege - I'll do my best to prove that the right mailman was on duty that day! I appreciate your hard work and dedication in making this conference possible. I know that putting together such an event is no small feat. You need a perfect mix of expertise, patience, and a bit of luck to get it just right! Your efforts remind me of the words of Alexander Graham Bell, who said, "Before anything else, preparation is the key to success" (Bell, 1907). Your meticulous planning and execution have set the stage for what promises to be an insightful and inspiring conference.

Today, we are gathered here to explore the intersection of emerging technology and innovative pedagogy, focusing on how these elements can drive entrepreneurship and economic development. This is a crucial topic, not just for our academic pursuits but for the broader societal impact it holds. As the great educational theorist John Dewey once stated, "Education is not preparation for life; education is life itself" (Dewey, 1938). As academics, we must ensure this life is vibrant, forward-thinking, and inclusive. I hope you are all ready for a journey through the exciting realms of technology and pedagogy.

We'll laugh a little, learn a lot, and hopefully leave here with a renewed sense of purpose and possibility. After all, in the words of Albert Einstein, "It is the supreme art of the teacher to awaken joy in creative expression and knowledge" (Einstein, 1954).

3.0 Purpose of the Address

Ladies and Gentlemen, today, we find ourselves at the intersection of emerging technologies, innovative teaching methods, entrepreneurship, and economic development - four pillars that have the potential to transform our societies. The World Economic Forum projects that by 2025, 50% of the global workforce will require reskilling due to technological advancements (World Economic Forum, 2020). It is evident that our approach to education and technology integration can either propel us forward or leave us trailing behind.

Emerging technologies such as Artificial Intelligence (AI), blockchain, the Internet of Things (IoT), and big data analytics are transforming industries worldwide. They enable personalised learning, provide access to vast digital resources, and enhance collaboration through virtual platforms. In Africa, the potential for these technologies to transform economies is significant. According to African Renewal, AI and related technologies could contribute up to $15.7 trillion to the global economy by 2030, with a significant portion of this growth coming from Africa (African Renewal, 2024).

For example, the fintech sector has experienced remarkable growth, with $1.6 billion invested across 153 deals in 2022, doubling the value of 2020, with Nigeria being a key market (KPMG, 2022).

Innovative pedagogy involves rethinking traditional teaching methods to incorporate active learning, problem-solving, and real-world applications. This not only enhances student engagement but also equips learners with critical thinking and entrepreneurial skills. A study in Ghana by Dzogbenuku, Amoako, and Kumi (2020) found that social media information, innovation, and entertainment significantly enhance social media knowledge generation. Gamification-based teaching practices positively influence student achievement (Yildirim, 2017). These suggests that integrating technology and innovative pedagogy into the educational processes can lead to improved academic performance among students.

Integrating technology and innovative pedagogy is crucial for nurturing entrepreneurs. Entrepreneurs drive economic development by creating jobs, stimulating innovation, and improving productivity. Small and medium enterprises (SMEs) contribute more than 50% of most African GDP and an average of 60% of employment (Muriithi, 2017). In Kenya, tech hubs like Nakuru Box in Nairobi provide essential resources for startups, creating a vibrant ecosystem for innovation and job creation (UNDP, 2023). It is evident that the integration of emerging technologies and innovative teaching methods can significantly boost economic development.

Animashaun, Familoni, and Onyebuchi (2024), highlight the potential of educational technology to greatly enhance access to quality education in emerging markets, leading to improved educational outcomes, and supporting sustainable development goals.

Therefore, emerging technologies are not just tools; they are catalysts reshaping industries and creating unprecedented opportunities. Digital technologies are seen as a significant opportunity for Africa to achieve rapid and equitable economic growth. These technologies can help create jobs and improve living standards across the continent (Mlambo et al., 2024). When seamlessly integrated into our educational systems, these technologies foster innovative teaching approaches that equip students with the skills necessary to thrive. By fostering an entrepreneurial mindset, education becomes a driving force for economic development,

encouraging the creation of new businesses, generating employment, and stimulating innovation.

4.0 Reshaping Educational Delivery Methods and Curriculum Design

The next ten years will be redefined by emerging technologies, impacting the business landscape and society — including education. AI, IoT, and blockchain are not just tools; they represent a revolution that can individualise learning using the most advanced assimilative methods.

Artificial Intelligence (AI)

AI can customise educational content, providing tailored feedback and resources to meet the specific needs of individual students, ultimately boosting engagement, and improving learning outcomes (Abbas et al., 2023). Furthermore, AI is revolutionising teaching by automating grading, creating interactive lessons, and offering real-time feedback, allowing educators to focus on developing critical thinking skills (Onesi-Ozigagun et al., 2024).

Internet of Things (IoT)

A bright classroom is undoubtedly a space for optimal learning. IoT devices are instrumental in creating smart classrooms that enhance the overall learning experience. Smartboards and IoT sensors contribute to improved student engagement, collaboration, and real-time feedback. These positively impact teaching methodologies (Meylani, 2024).

Blockchain

Blockchain technology ensures secure and verifiable academic credentials, effectively addressing data theft and counterfeit documents. Additionally, it facilitates the development of decentralised lifelong learning platforms, enabling students to track their progress over time (Masrek, 2024).

Case Studies of Successful Integration in Fostering Entrepreneurial Skills

Numerous educational institutions and programmes across Africa have successfully integrated emerging technologies to foster entrepreneurial skills among students.

These case studies testify to the transformative potential of such technologies in education. For instance, MEST Africa in Ghana leverages emerging technologies to train entrepreneurs, resulting in successful tech startups that drive Africa's digital economy (MEST Africa, 2021). Similarly, the African Leadership University (ALU) integrates AI and project-based learning, leading to the creation of startups founded by students, and showcasing the power of emerging tech in nurturing entrepreneurship (Mzyece et al, 2021). Meanwhile, iLab, Liberia provides AI and blockchain training, supporting startups and promoting economic development in Liberia (iLab Liberia, 2024).

These technologies also play a pivotal role in fostering entrepreneurial skills among students, as evidenced by successful case studies from various institutions across Africa.

In embracing these advancements, educational institutions can adequately prepare students for the future job market and empower them to drive economic growth through innovation and entrepreneurship.

5.0 Active Learning Strategies

Ladies and Gentlemen, are you excited to transform your teaching methods and kindle enthusiasm in your students? Innovative pedagogies like hands-on learning, project-based learning (PBL), and collaborative learning are essential for unlocking critical thinking and problem-solving skills in your students (Sujatmika, 2024). Let's delve into some pioneering teaching methods that leverage the latest technologies to enrich the learning experience:
Flipped Classrooms have revolutionise traditional learning by utilising technology to engage students with interactive problem-solving during class time (Tiwari & Dalal, 2024).

Virtual Reality (VR) and Augmented Reality (AR) immerse students in dynamic learning environments, amplifying engagement and practical skill development (Afiya, 2024).

Gamification infuses lessons with captivating game design elements to enhance motivation and perseverance (Hardianti, 2024).

Online Learning platforms such as Coursera, edX, and Khan Academy provide interactive online courses that empower students to learn at their own pace, integrating technology with traditional teaching methods through forums, quizzes, and projects, delivering a comprehensive learning experience (Vic et al, 2024).

Chairman, students must develop various skills to succeed in the modern workforce. This includes technical skills, soft skills, and an entrepreneurial mindset.

The modern educational approach should assist students in gaining technical expertise in coding, data analysis, and digital tools, as these are essential for lucrative careers in various industries. Alongside technical skills, it's important to cultivate skills in communication, teamwork, problem-solving, critical thinking, risk management, and strategic planning. These skills are vital for navigating the complexities of the modern workplace, fostering effective collaboration with peers, and inspiring innovation and drive.

Educational initiatives such as the African Leadership Academy (ALA), Ingressive for Good (I4G), and Ashesi University in Ghana are leading the way in shaping future leaders and fostering entrepreneurship through hands-on projects, practical tech training, and a fusion of liberal arts, technology, and entrepreneurship.

To prepare our students adequately, educational institutions should integrate technical education with entrepreneurship, combine coding with business planning, and embrace project-based learning (PBL). Hackathons, innovation competitions, entrepreneurship boot camps, university-led incubation centres, mentorship, internships, and industry partnerships are also crucial. They provide practical experience, promote creativity, and teamwork, and adapt academic knowledge into market-ready innovations.

6.0 The Role of Universities in Promoting Entrepreneurship

Universities play a crucial role in nurturing entrepreneurship by providing the necessary infrastructure, resources, and support to transform innovative ideas into successful ventures. They accomplish this through incubators, accelerators, and entrepreneurship centres, which act as hubs for innovation and economic development. University-affiliated incubators such as Kenya's iHub offer startups office space, mentorship, and funding opportunities, enabling entrepreneurs to refine ideas and develop prototypes (Chirchietti, 2018). Accelerators like Ghana's MEST provide intensive, time-limited support, culminating in opportunities to pitch

to investors, significantly aiding startups in scaling rapidly (MEST Africa, 2021). Entrepreneurship centres like the Bertha Centre at the University of Cape Town bring together students, faculty, and industry experts to promote social innovation through education and practical engagement (Bertha Centre, 2020). The Center for Entrepreneurship, Philanthropy, and Ethics (CEPE) at Heritage Christian College, Ghana (HCC) empowers students, faculty, and staff with entrepreneurial skills and financial support to pursue viable ventures (CEPE-HCC, 2024).

The success of university-supported entrepreneurial ecosystems is evident in ventures like Flutterwave, Andela, FarmCrowdy, and Yoco. These startups, founded by university alumni, have significantly impacted fintech, software development, agriculture, and point-of-sale solutions.

For example, Flutterwave, co-founded by an alumnus of MIT and the University of Lagos, has processed billions in transactions, demonstrating the transformative potential of university-nurtured entrepreneurship (Flutterwave, 2021). Similarly, Andela and FarmCrowdy have trained thousands of developers and empowered farmers, contributing to economic growth and food security across Africa (Andela, 2020; FarmCrowdy, 2019).

Universities are pivotal in driving economic development and promoting entrepreneurship through dedicated support systems.

The success stories of alumni-led startups underscore the substantial impact of these ecosystems, emphasising the need for continued investment in university-driven innovation to create sustainable economic opportunities across Africa.

Improving the Quality and Accessibility of Education

Innovative teaching techniques, such as blended learning and flipped classrooms, can potentially enhance the quality of education by creating a more interactive and engaging learning environment. These methods can also expand access to education in remote areas through online platforms, addressing the issue of limited access to high-quality education (Chakawodza et al, 2024). For instance, the African Virtual University (AVU) leverages e-learning technologies to provide higher education across the continent, reaching students who may not otherwise have access to tertiary education (World Bank, 2021).

Enhancing Productivity in Agriculture

Cutting-edge technologies like precision agriculture, IoT, and mobile applications can transform agriculture, a vital sector for many African economies. These technologies offer real-time data and analytics, assisting farmers in maximising crop yields, efficiently managing resources, and increasing productivity. For example, the Hello Tractor platform in Nigeria uses IoT to connect farmers with tractor owners, improving access to mechanised farming (World Bank, 2020).

Promoting Health and Well-being

Innovations in health technology, such as telemedicine and mobile health applications, can help address healthcare accessibility challenges in rural and underserved areas. These technologies enable remote diagnosis, monitoring, and treatment, reducing the strain on healthcare facilities and enhancing health outcomes. For instance, the mPharma platform in Ghana utilises data analytics and AI to oversee pharmaceutical supply chains and ensure the availability of essential medicines (mPharma, 2020).

Facilitating Inclusion in the Financial Sector

Financial technology solutions can advance financial inclusion by offering banking and financial services to unbanked populations. Mobile money platforms, like M-Pesa in Kenya, have transformed the financial landscape by enabling secure, convenient, and affordable financial transactions.

These platforms assist individuals and small businesses in saving, borrowing, and investing, promoting economic empowerment (Jack & Suri, 2014).

Interdisciplinary Collaboration and Community Engagement for Sustainable Development in Africa

Addressing the multifaceted socio-economic challenges in Africa requires promoting interdisciplinary collaboration and engaging local communities. Universities can play a vital role by forming partnerships across different sectors and involving residents in development projects. For example, the African Center of Excellence in Data Science at the University of Rwanda brings together expertise from areas like agriculture, health, and education to address pressing issues. Local engagement ensures that solutions are tailored to meet specific needs, as demonstrated by the participation of residents in housing improvements through Kenya's Participatory Slum Upgrading Programme.

Moreover, public-private partnerships (PPPs) reinforce these endeavours by leveraging resources from both the public and private sectors. An excellent illustration of this synergy is seen in the collaboration between the University of Nairobi and IBM to establish the Nairobi IBM Research Laboratory, which focuses on innovations in water management and urban planning.

African universities can significantly contribute to sustainable development by integrating innovative teaching methods and emerging technologies, promoting interdisciplinary collaboration, and engaging with local communities.

These approaches are essential for improving education, boosting agricultural productivity, enhancing health, and furthering financial inclusion across the continent. By nurturing partnerships and involving local communities, universities can drive sustainable development and make meaningful contributions to the socio-economic advancement of the region.

7.0 Future Directions and Recommendations

Adapting to Rapid Technological Advancements

Strategies for Continuous Adaptation of Educational Practices

As AI, blockchain, and IoT rapidly reshape the world, Africa must prioritise continuous learning and innovation to stay competitive. Embracing these technologies and upskilling the workforce will transform challenges into opportunities, driving economic growth across the continent (World Bank, 2020).

Embracing Lifelong Learning

Educational institutions should encourage lifelong learning for students and faculty by promoting continuous professional development and providing access to the latest resources and training programmes.

Incorporating Flexible Learning Models
I highly recommend considering flexible learning models, such as blended learning and online courses, as they enable educational institutions to quickly adapt to technological advancements (UEW, 2022).

Leveraging Data Analytics
Utilising data analytics can help educational institutions understand student performance, identify learning gaps, and tailor educational interventions accordingly. Learning management systems (LMS) that integrate data analytics tools enable educators to track progress and personalise learning experiences. Business intelligence (BI) and analytics are vital for improving student success and institutional effectiveness in higher education (Chaushi et al, 2024). This study compares BI and analytics implementation and perceptions across public and private universities.

Fostering Industry Collaboration
Partnerships with industry leaders ensure that educational content remains aligned with current technological trends and market needs. Collaborations can include guest lectures, internships, and joint research projects.

The partnership between Carnegie Mellon University Africa and ICT companies in Rwanda illustrates how industry collaboration can enhance the relevance of educational programmes (Carnegie Mellon University Africa, 2021).

Proposed Initiatives for Faculty Development and Curriculum Reform
To effectively integrate emerging technologies, faculty development and curriculum reform are essential. These initiatives ensure that educators are well-equipped to teach with new technologies and that curricula are aligned with industry standards.

Faculty Development Programmes
Continuous professional development programmes for faculty members are crucial for keeping them current with technological advancements. These programmes may comprise workshops, certifications, and training sessions on emerging technologies.

The Faculty Development Programme at the University of Cape Town offers courses in digital pedagogy and technology integration to help faculty improve their teaching practices (University of Cape Town, 2021).

Curriculum Reform
It's important to update educational curricula regularly to incorporate emerging technologies, ensuring that educational programmes stay relevant. This includes integrating subjects like artificial intelligence, blockchain, and cybersecurity into existing courses. The African Institute for Mathematical Sciences (AIMS) has updated its curriculum to include data science and machine learning, helping to prepare students for careers in technology-driven fields (AIMS, 2020).

Establishing Technology Integration Centers
Creating centres dedicated to the integration of technology in education can support both faculty and students. These centres can provide resources, training, and technical support.

Encouraging Interdisciplinary Learning
Promoting interdisciplinary learning helps students develop a broad skill set that is adaptable to various technological contexts.

Programmes that combine technology with other disciplines, such as business and social sciences, adapt innovation, and creativity. The interdisciplinary approach in higher education integrates innovative methods to create practical, real-world curricular experiences. Some curricula emphasise a creative focus, where identifying problems and finding solutions often lead to novel, useful, and non-obvious outcomes (Moore et al, 2022).

8.0 Summary and Reflection

Throughout this address, we've examined how emerging technologies and innovative teaching methods are impacting entrepreneurship and economic development. Incorporating advanced technologies such as AI, IoT, and blockchain, various sectors like education, agriculture, healthcare, and finance can be transformed, leading to improved efficiency and accessibility (Chandra & Vani, 2024). We've discussed how these technologies are changing the delivery of education and curriculum designs thereby, preparing students for future challenges (Chaushi et al, 2024).

We have emphasised innovative teaching methods such as active learning and hands-on experiences to prepare students with the technical skills and entrepreneurial mindset needed for success in a rapidly changing world. Additionally, we stressed the significance of establishing an entrepreneurial environment within universities through incubators, accelerators, and entrepreneurship centres, and showcased successful stories of startups and businesses founded by university alumni (ALU, 2021; MEST Africa, 2021).

We highlighted tackling socio-economic challenges by leveraging emerging technologies and innovative teaching methods. We delved into how these approaches could enhance the quality of education, increase agricultural productivity, improve health and well-being, and promote financial inclusion (mPharma, 2020; Jack & Suri, 2014). The significance of interdisciplinary collaboration and community engagement in driving sustainable development was also highlighted, with successful initiatives that integrate expertise from different fields and involve local communities in development processes (UN-Habitat, 2015).

Looking to the future, we proposed strategies for continuous adaptation of educational practices to keep pace with technological advancements. This includes promoting lifelong learning, incorporating flexible learning models, leveraging data analytics, and fostering industry collaboration. We also highlighted the need for faculty development and curriculum reform to effectively integrate emerging technologies into educational programmes (AIMS, 2020).

Vision for the Future
In the foreseeable future, the integration of cutting-edge technology, inventive teaching approaches, entrepreneurial spirit, and economic expansion holds the potential to propel sustainable development and societal progress.

Picture a future where education is not just a means to an end, but rather a dynamic force that continually adjusts to meet the needs of society.

In this future scenario, universities lead in pioneering innovation, equipping students with the knowledge and skills to thrive in an increasingly technological world.

This vision encompasses educational institutions embracing lifelong learning, swiftly adapting to technological advancements, and ensuring that faculty and students are consistently at the forefront of knowledge. It involves a curriculum deeply integrated with real-world applications, preparing students to tackle complex problems and create value in their communities. Additionally, we envision a robust entrepreneurial ecosystem within universities that supports startups, drives economic development, and transforms ideas into impactful solutions.

Moreover, this vision prioritises interdisciplinary collaboration and community engagement, acknowledging that sustainable development relies on the combined contributions of various stakeholders. Through collaboration, technology utilisation, and innovation, we can tackle important socio-economic challenges and generate inclusive growth that positively impacts all members of society. Let us wholeheartedly embrace this vision with optimism and determination.

We can shape a brighter future where education drives not only economic development but also social progress and environmental sustainability by harnessing the power of emerging technologies and innovative pedagogies. Let us commit to this transformative journey, confident in the knowledge that our efforts today will pave the way for a more prosperous and equitable tomorrow.

9.0 Closing Remarks

Ladies and gentlemen, esteemed guests, faculty members, participants, and the media, I want to express my sincere appreciation for your attention and participation. Your presence and engagement at this conference demonstrate our shared dedication to leveraging emerging technologies and innovative teaching methods to promote entrepreneurship and economic development.

At the University of Education, Winneba, we are deeply committed to advancing educational excellence and fostering global citizenship through innovative practices. We believe that by embracing the latest technological advancements and pedagogical approaches, we can equip our students with the skills and mindset needed to thrive in an ever-evolving world.
Together, we can create a future where education is a catalyst for sustainable economic growth and societal progress. Let us continue to collaborate, innovate, and inspire one another as we work towards this shared vision.

Thank you once again for your attention and participation. I am eagerly anticipating the exciting discussions and collaborations that will arise from this conference. Let's move forward with determination and optimism, confident in our ability to shape a brighter future for all.
Thank you.

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LEAD PAPER I EMERGING TECHNOLOGY AND INNOVATIVE PEDAGOGY FOR ENTREPRENEURSHIP AND ECONOMIC DEVELOPMENT

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Abstract
This paper examines the critical importance of continuing professional development (CPD) and innovative pedagogical approaches for practitioners in STEM, TVET, and information science amid rapid emerging technology. The paper highlights how emerging technologies, including artificial intelligence, necessitate continuous upskilling and innovative teaching methods such as experiential learning, service-learning, and simulation-based instruction. It explores how Learning with Production programs, Universal Design for Learning (UDL), and digital platforms enhance practical skills development and student engagement. Drawing from recent literature, the paper examines the evolution of STEM and TVET instruction beyond traditional methodologies, emphasizing inquiry-based learning, project-based approaches, and blended learning methodologies. The findings address implementation challenges while highlighting online learning platforms and emerging technologies as solutions. The paper underscores the importance of collaborative approaches between individual faculty members and institutions in fostering effective professional development, concluding that proactive engagement in CPD and adoption of innovative pedagogies are essential for maintaining relevance in technology-driven educational environments.

Keywords: continuing professional development, STEM education, TVET, innovative pedagogy, emerging technology, experiential learning, inquiry-based learning, service learning.

Introduction
The rapid advancement of emerging technologies and innovative pedagogical approaches has become increasingly critical for developing countries, particularly Nigeria, as they strive to enhance their educational systems and foster economic development. This transformation is primarily driven by technologies such as artificial intelligence (AI), virtual reality (VR), augmented reality (AR), and blockchain, alongside pedagogical frameworks in STEM

education (Science, Technology, Engineering, Mathematics), STEAM which is described as STEM plus arts and Technical and Vocational Education and Training (TVET). The integration of these elements presents both opportunities and challenges for Nigeria's educational landscape and economic growth trajectory.

At the foundation of this technological transformation lies TVET and STEM education, which has emerged as a cornerstone of national development in Nigeria and other developing countries. Recognizing their fundamental importance, policymakers are actively advocating for their integration across all educational levels to nurture a generation of innovators and problem solvers (Oyeniran, 2023). However, the implementation faces significant challenges, including inadequate funding, outdated curricula, and a shortage of qualified teachers (Bello, 2023). These obstacles must be addressed to ensure Nigerian students can effectively compete in the global job market and contribute to the country's economic development (Abdulraheem-Mustapha, 2021).

Building upon this STEM foundation, the integration of artificial intelligence (AI) in education presents transformative possibilities for personalizing learning experiences in Nigeria, for example. AI-driven platforms can analyze student performance data to identify learning gaps and suggest appropriate interventions (Muhammad et al., 2023), a capability particularly crucial in a resource-constrained environment. For instance, intelligent tutoring systems provide real-time feedback to students, creating more interactive and responsive learning environments (Abdulraheem-Mustapha, 2021). Furthermore, AI enhances administrative processes within educational institutions, streamlining operations such as admissions, grading, and student support services (Ajah & Chigozie-Okwum, 2019).

While STEM and AI focus on theoretical and technological advancement, TVET complements these approaches by addressing Nigeria's immediate skills gap. These practical programs provide students with workforce-applicable skills, thereby enhancing employability and reducing graduate unemployment rates (Muhammad & Kamin, 2019). Although the Nigerian government has initiated reforms to improve TVET quality and accessibility (Bello, 2023), familiar challenges persist, including insufficient funding, inadequate facilities, and limited industry partnerships (Akindele, 2013). Consequently, strengthening connections between TVET institutions and the labor market remains essential for aligning graduate skills with employer demands (Odia & Odia, 2013).

To enhance both STEM and TVET education, virtual reality (VR) and augmented reality (AR) technologies have emerged as powerful tools for creating immersive learning experiences (Tawbush et al., 2020). These complementary technologies bridge the gap between theoretical knowledge and practical application through real-world scenario simulations. For example, medical students can benefit from VR simulations that allow them to practice surgical procedures in a risk-free environment, while TVET and engineering students can engage in virtual labs that replicate real-world occupational challenges (Moyosoore et al., 2021). Nevertheless, much like other technological implementations, the widespread adoption of these technologies requires substantial infrastructure investment and educator training, which remains challenging for many Nigerian institutions (Barakabitze et al., 2019).

Alongside these educational technologies, blockchain technology offers promising solutions for systemic issues in Nigerian education and governance. It provides a transparent and secure method for managing records, crucial for combating corruption and inefficiency in public service delivery (Abodei et al., 2019). In the educational context, blockchain creates immutable

academic credential records, reducing certificate forgery and enhancing institutional credibility (Obamehinti & Eguavoen, 2022). This technological innovation facilitates smoother graduate transitions into the workforce by ensuring qualification verifiability (Lekan, 2023).

The technological transformation extends into library information science, where Nigerian libraries are increasingly adopting digital resources and services to enhance information access and support learning (Moyosoore et al., 2021). Specifically, cloud computing enables libraries to offer online databases and digital archives, facilitating remote access to information (Tella & Amuda, 2022). However, as with other technological implementations, this digital transformation requires investment in infrastructure and staff training, along with efforts to promote digital literacy among users (Barakabitze et al., 2019).

Underlying all these technological advancements, innovative pedagogy serves as the fundamental catalyst for fostering creativity and critical thinking among Nigerian students. This approach emphasizes student-centered learning, incorporating project-based activities, collaborative work, and technology-enhanced instruction (Kola & Kehinde, 2019). Such methodologies align with global trends in preparing students for a rapidly evolving workforce, particularly in TVET and STEM fields where adaptability and continuous learning are essential (Dele-Ajayi et al., 2021). Most significantly, the impact of these technologies and pedagogical approaches extends beyond education and permeates into entrepreneurship and economic development. As Nigeria seeks to diversify its economy, digital technologies provide essential tools for aspiring entrepreneurs. AI assists in market analysis and customer segmentation, enabling data-driven decision-making (Muhammad et al., 2023), while blockchain facilitates secure transactions and builds consumer trust, crucial for small and medium-sized enterprises (SMEs) growth (Idehen & Mayor, 2021).

Given these interconnected developments, this paper addresses the effects of technology apathy on career advancement, job satisfaction, and continuing professional development among STEM and TVET practitioners, librarians, and information scientists in Nigeria. It explores how emerging technologies, and innovative pedagogy can catalyze entrepreneurship and economic development, with particular attention to the context of developing countries in Sub-Saharan Africa. While the integration of these elements holds significant promise for addressing Nigeria's educational challenges, substantial barriers remain, including funding constraints, infrastructure limitations, and the need for comprehensive educator training programs.

Overview of Emerging Technologies and innovative Pedagogy in STEM, TVET, and Information Science

The integration of emerging technologies and innovative pedagogical approaches is imperative in transforming Nigeria's educational landscape, particularly in STEM, TVET, and Information Science disciplines. These emerging technologies, including Artificial Intelligence (AI), Cloud Computing, Internet of Things (IoT), and Blockchain, offer significant potential for enhancing instructional delivery and learning outcomes. AI facilitates personalized learning experiences, adapting to individual student needs and learning patterns, while Cloud Computing provides scalable resources for educational institutions, enabling broader access to learning materials and collaborative projects. IoT creates interactive learning environments through connected devices and real-time data collection on student engagement, and Blockchain technology enhances the integrity of academic credentials and streamlines administrative processes, contributing to a more efficient educational ecosystem.

In Nigeria, STEM education encompasses a comprehensive range of fields designed to equip students with essential skills for careers in science, technology, engineering, and mathematics. The scope extends beyond theoretical knowledge to include practical applications that prepare students for real-world challenges. Engineering programs focus on civil, mechanical, and electrical, electronics, metallurgical, computer, etc. disciplines, while science programs cover biology, chemistry, and physics. As noted by Kola & Kehinde (2019), initiatives such as specialized science and technology schools and the integration of robotics and coding into the curriculum have been implemented to enhance students' technical skills and foster innovation in the educational sector.

TVET plays a crucial role in developing practical workforce skills across various trades and professions, including carpentry, plumbing, electrical installation, and hospitality management, etc. The National Board for Technical Education (NBTE) oversees these programs, ensuring alignment with industry standards and labor market needs (Bello, 2023). Polytechnics and vocational schools often combine classroom instruction with hands-on training, preparing students for immediate workforce entry (Alabi, 2023). Information Science, focusing on information management and dissemination, has become increasingly vital in the digital age. According to Irele (2021), the field emphasizes integration with IT skills, particularly in cloud computing and data management. Nigerian universities have begun adopting cloud-based library management systems, improving resource accessibility and information retrieval (Adeleke et al., 2020). Programs often include training in artificial intelligence and data analytics, preparing graduates for diverse career paths across education, healthcare, and business sectors (Abdullahi et al., 2020).

Innovative pedagogy is transforming traditional teaching methods through various approaches designed to enhance educational effectiveness. Project-based learning engages students in real-world problem-solving, fostering critical thinking and collaboration skills (Zhang et al., 2020). The integration of technology through online platforms and interactive tools has improved student engagement and learning outcomes in subjects like computer programming (Omeh et al., 2022). Blended learning, combining traditional and online instruction, provides greater flexibility and accessibility for students while maintaining educational quality (Oluwatumbi, 2017).

Experiential learning through internships and cooperative education enables students to develop practical entrepreneurial skills in real business environments. This approach is complemented by service-learning initiatives that connect academic knowledge with community development projects, addressing local economic challenges while building students' entrepreneurial capabilities. The Business Development Centre (BDC) programs across 11 TVET institutions in Nigeria, funded by the African Development Bank, exemplify curriculum integration with occupational scenarios for enhanced skills development which is referred to as Learning with Production. Universal Design for Learning (UDL) and simulation-based learning have revolutionized entrepreneurship education through multiple engagement methods and virtual reality platforms for business scenario modeling and decision-making processes.

The digital transformation of education has been further enhanced through MOOCs, webinars, and gamification strategies that increase student engagement through competitive elements such as points systems and leaderboards. The flipped classroom model has proven particularly effective in entrepreneurship education, allowing students to engage with theoretical content independently while focusing on practical applications and collaborative problem-solving

during class time. Design thinking methodology, combined with crowdsourcing and open innovation approaches, enables students to develop user-centered solutions to economic challenges while engaging with external communities for idea generation and refinement. Mentorship programs and social entrepreneurship projects facilitate valuable connections between students and industry professionals, fostering knowledge transfer and real-world application of entrepreneurial concepts. Global learning experiences have further expanded these opportunities by facilitating international collaboration on economic development projects, thereby preparing students for participation in the global economy while addressing local developmental challenges.

This adoption of innovative pedagogy will represent a critical shift from traditional methods characterized by passive learning and rote memorization. These contemporary strategies ensure practitioners maintain currency in professional practices while integrating emerging industry standards and technological advancements into their teaching methodologies. The alignment between educational delivery and workplace requirements is particularly crucial in STEM and TVET fields, where rapid technological evolution demands continuous adaptation of skills and knowledge. The implementation of innovative pedagogy facilitates workplace readiness by simulating real-world scenarios and challenges, ensuring compliance with current industry practices and expectations. This creates a positive feedback loop where improved instruction leads to better-prepared graduates who contribute more effectively to Nigeria's entrepreneurial ecosystem and economic development, while simultaneously enhancing job satisfaction among educators who witness improved student achievements and increased client satisfaction in professional settings.

Emerging Technology, and Artificial Intelligence (AI): Enhancing Information Science, STEM, and TVET Education

The 21st century has witnessed a remarkable transformation in instructional technologies, with artificial intelligence (AI) emerging as a pivotal force in education. AI, characterized by computer systems' ability to emulate human-like thinking and learning processes, encompasses various subfields including machine learning, natural language processing, and robotics (Haenlein & Kaplan, 2019). The classification of AI into artificial narrow intelligence (ANI - having a narrow range of abilities), artificial general intelligence (AGI - on par with human capabilities, including text-to-text, text-to-image, text-to-video, text-to-3D, and text-to-task functions), and artificial superintelligence (ASI - surpassing human capabilities) provides a comprehensive framework for understanding its diverse applications and potential impacts on educational practices (Kerzel, 2020).

The integration of AI into STEM and TVET educational settings has facilitated the development of intelligent tutoring systems (ITS), which enable personalized learning experiences by adapting to individual student needs (Karacı et al., 2018). These systems leverage AI to provide tailored feedback and guidance, promoting self-directed learning and enhancing student engagement (Zekaj, 2023). The emergence of generative AI tools, such as ChatGPT, Gemini, and Claude, has further enhanced instructional support by creating more engaging and interactive learning environments (Grassini, 2023). Unlike search engines, generative AI systems utilize complex neural networks and machine learning algorithms to create new content based on training data, processing and responding to various inputs in contextually appropriate ways. The potential for AI to revolutionize education is underscored by its ability to foster adaptive teaching approaches and improve educational outcomes (Ruiz-Rojas, 2023).

The ethical implications of AI integration in education warrant careful consideration. As these technologies become more prevalent, concerns regarding plagiarism, data privacy, security, and algorithmic bias have emerged (Nie, 2023). Addressing these challenges is crucial for ensuring AI serves as a beneficial tool rather than exacerbating existing inequalities in educational access and outcomes (Ayodeji et al., 2021). The development of robust legal and policy frameworks is essential to regulate AI's use and promote its sustainable development in education, particularly in protecting student data and ensuring equitable access to AI-enhanced learning opportunities (Nie, 2023).

AI's role extends beyond personalized learning to encompass information science and administrative efficiencies. Its application in curriculum development and assessment streamlines processes and enhances overall educational experiences through automated grading systems and content generation (Yu, 2023). As institutions increasingly adopt AI-driven solutions, educators must adapt through professional development and training to effectively integrate these tools into their teaching practices (Liu, 2023). The implementation of differentiated instruction through AI-driven systems enables tailored feedback and fosters self-directed learning, allowing students to progress at their own pace while maintaining high educational standards (Provost & Fawcett, 2013).

Immersive learning experiences are enhanced through augmented reality (AR) and virtual reality (VR), creating engaging environments for interactive exploration of complex concepts and scientific phenomena (Huang, 2022). Embedded learning, facilitated by mobile devices and adaptive learning systems, provides continuous learning opportunities with real-time feedback, enabling students to learn effectively beyond traditional classroom settings (Cushing & Osti, 2022). AI also promotes inclusive learning through speech-to-text technologies and accessibility tools, making education more accessible to students with diverse learning needs. Data-driven decision-making in curriculum development enables educators to optimize educational strategies based on empirical evidence (Du, 2022), while AI-powered information retrieval systems enhance digital archiving and resource accessibility, revolutionizing how educational materials are stored and accessed (Forrester, 2019).

The integration of AI in education presents both opportunities and challenges that require careful consideration and strategic planning. Key concerns include mitigating biases in AI-based learning systems and addressing ethical considerations regarding plagiarism, copyright issues, and intellectual property rights in AI-generated content (Popenici & Kerr, 2017). Privacy concerns in AI-driven library systems necessitate careful protection of user data and the implementation of robust security measures (Gray et al., 2022). Effective IA utilization entails proficiency in prompt engineering for accurate AI outputs and establishing governance structures to address implementation barriers such as resource constraints and cultural resistance. Continuous professional development remains critical for equipping educators with the necessary skills to navigate AI integration successfully and leveraging on these tools to enhance student learning outcomes (Pucchio et al., 2022).

Integrating Technology, Language, Culture for Entrepreneurship and Economic Development

Technology significantly impacts culture and business practices by enabling innovative approaches to cultural expression and entrepreneurship. For instance, the integration of virtual reality (VR) and augmented reality (AR) in cultural tourism allows for immersive experiences that attract visitors and promote local heritage (Han et al., 2019). Furthermore, digital platforms facilitate the dissemination of cultural content, making it accessible to a global audience and

creating new markets for local artisans and entrepreneurs (Xu, 2023). The use of digital tools in promoting Indigenous languages not only aids in language preservation but also opens avenues for economic development through cultural tourism and educational initiatives (Galla, 2016).

Promoting culture in the context of digital technology usage and development is essential for ensuring that technological advancements do not overshadow local identities. By embedding cultural values into digital products and services, businesses can foster a sense of community and belonging, which is crucial for sustainable economic development (Huimei, 2023). This approach also encourages the creation of culturally relevant content that resonates with diverse audiences, thereby enhancing market reach and impact (Adane et al., 2019).

The Prognosis of Technology Impact, Transformation of Society, Information Science, STEM and TVET Education

The current landscape of the global workforce is marked by a significant skills gap, particularly evident in the manufacturing sector, where an estimated ten million jobs remain unfilled due to insufficient technical expertise (Jetha et al., 2023). This gap is primarily attributed to the rapid digitalization across various sectors, presenting both opportunities and challenges. The digital transformation acts as a double-edged sword; while fostering innovation and efficiency, it simultaneously challenges job security and necessitates a fundamental reimagining of workforce training and development strategies. As this evolution continues, certain occupations face obsolescence, while others require substantial retraining, and entirely new roles emerge in response to technological advancements (Jetha et al., 2021; Kong, 2023).

The integration of automation and artificial intelligence (AI) into workplace processes has dramatically shifted the demand for skilled labor. Many existing roles are being transformed or replaced, compelling professionals to undergo retraining to maintain relevance in the evolving job landscape (Paolillo et al., 2022). While the adoption of digital technologies enhances productivity and creates opportunities for highly skilled labor (Wu et al., 2023), growing concerns exist regarding technological overreliance. This dependence can lead to increased internet crime, global reputational damage, and heightened risk of systemic organizational failures, particularly in sectors heavily dependent on digital infrastructure (Lee & Cook, 2019; Acemoğlu & Restrepo, 2020). The urgency of retraining is particularly emphasized by Osiwalska, who highlights the necessity for workers in high-risk automation occupations to transition into less vulnerable roles to technological displacement, ensuring sustainable career pathways in an increasingly automated economy (Osiwalska, 2023).

The implications of digital technology dependence extend beyond job displacement into the realm of cybersecurity and institutional integrity. The proliferation of digital platforms correlates with rising internet crime rates, posing significant risks to both individuals and organizations. This is particularly concerning in regions with high cybercrime prevalence, highlighting the need for comprehensive digital ethics and security frameworks that protect both organizational assets and personal data (Adhikary, 2022). Institutions must cultivate an ethical technology use culture, ensuring employees develop both technical capabilities and ethical awareness. This thoughtful redesign of ethical practices is essential to combat indifference toward technology and prevent the misuse of digital tools (Victor, 2023). Such changes will ultimately serve clients, students, and the wider community by ensuring technology is implemented and managed responsibly (Hickok & Maslej, 2023; Attard-Frost et al., 2022).

The transition to a new economic order, where data and AI parallel crude oil in the energy economy, demands a paradigm shift in our understanding of work, skills, and technological integration. Dauth and Lang emphasize the essential role of continuing professional development (CPD) in adapting to evolving skill demands, particularly during economic uncertainty and rapid technological change (Dauth & Lang, 2023). While research indicates that CPD participation enhances individual employability and economic resilience through skill development and adaptation (Bratsberg et al., 2021), this technological evolution underscores the need for ethical reengineering and business practice re-evaluation in an increasingly digital workplace (Fujii & Managi, 2018). In sectors experiencing rapid technological advancement, learning agility becomes paramount, recognizing that while technology augments human capabilities, it cannot replace human judgment, creativity, and ethical reasoning in complex decision-making processes (Meng, 2023).

The concept of "meaning fixedness," explored by Jiang, illustrates how occupational role perceptions influence adaptation and retraining willingness in the face of technological change (Jiang, 2023). Individuals viewing their skills as transferable more readily engage in proactive career management and continuous learning, while those with fixed mindsets may resist change, limiting their employment prospects and career advancement opportunities. This highlights the importance of cultivating a growth mindset within the workforce, encouraging individuals to embrace change as integral to professional development and long-term career sustainability.

Institutional leadership plays a crucial role in facilitating retraining and upskilling initiatives through the integration of AI and digital human resource management (HRM). These sophisticated tools streamline the identification of skill gaps and enable targeted training delivery across diverse faculty and staff population (Sova et al., 2023). By leveraging data analytics and machine learning capabilities, organizations and educational institutions can customize training programs to address specific workforce needs, enhancing retraining effectiveness while maintaining competitiveness in an increasingly automated landscape. This strategic approach to workforce development ensures that organizations and educational institutions remain agile and responsive to technological changes while supporting employee and student growth and adaptation.

The transition to a digitally driven economy presents significant social equity challenges that require careful consideration and proactive solutions. The potential for automation-induced job displacement necessitates comprehensive public policy and labor relations reevaluation to protect worker interests and promote inclusive economic growth (Adhikary, 2022). Policymakers must address technological unemployment implications and develop robust strategies supporting displaced workers to ensure equitable distribution of digitalization benefits across all segments of society.

Organizations and educational institutions must establish clear technology use guidelines and governance frameworks, promoting responsibility and accountability while recognizing technology's potential to exacerbate existing inequalities in the workforce and educational settings. Ensuring equitable access to resources, training opportunities, and digital tools is essential for workplace success in an increasingly digital environment. By incentivizing positive technology use and ethical practices, institutions can foster innovation and ethical engagement, enhancing their reputation, operational effectiveness, and long-term sustainability in the digital age (Victor, 2023). This comprehensive approach, encompassing individual responsibility, institutional support, and ethical considerations, is crucial for navigating the

challenges and opportunities presented by digitalization and automation while preparing the workforce for the demands of an evolving technological landscape.

Upskilling Notes for Professionals in Information Science, STEM, and TVET Education

In the rapidly evolving landscape of technology and education, professionals in STEM, TVET, and information science face an imperative to continuously update their skills and knowledge. The advent of artificial intelligence (AI) and other emerging technologies has created a dynamic environment where job dissatisfaction becomes a significant risk for those who fail to keep pace with their students or clients. The potential consequences of being outpaced by learners extend beyond professional satisfaction to impact career longevity, making ongoing professional development crucial for maintaining competence and relevance in an increasingly competitive educational landscape.

The necessity for continuing professional development (CPD) in the 21st century encompasses a broader conceptualization that goes beyond formal education. As noted by Rowland et al. (2021), effective CPD includes learning through practice, participation in quality improvement initiatives, and knowledge sharing within communities of practice. This comprehensive approach enables STEM, TVET, and information science practitioners to adapt to rapid changes and maintain their competitive edge in an evolving job market, where technological competence and pedagogical innovation are increasingly valued.

The landscape of professional development is transforming with the emergence of innovative methods for delivering tutorials and workshops. Adefuye et al. (2020) emphasize that compliance with CPD requirements is crucial for maintaining and updating professional competence, particularly in resource-constrained settings as in developing countries. This highlights the importance of developing proactive individual CPD plans rather than relying solely on employer-provided training, allowing professionals to take charge of their learning journeys and adapt to changing educational needs.

Saleem and Ashiq (2020) further underscore the significance of individual responsibility in professional development, especially in environments with limited institutional support. This self-directed approach fosters ownership over professional growth and promotes lifelong learning, essential qualities in an era of rapid technological advancement. The ability to learn and adapt has become a critical skill that significantly influences job satisfaction and career prospects, particularly in technology-driven educational environments. Educational institutions and organizations play a vital role in facilitating CPD by creating supportive learning environments and providing necessary resources for professional growth. There should be units established in every educational institution to facilitate peer-to-peer knowledge sharing sessions rather than relying of expensive one-off external training programs. Karas et al. (2020) highlight that a conducive organizational culture enhances the effectiveness of CPD initiatives, leading to improved job satisfaction and employee retention. Institutional investment in professional development not only yields a more skilled workforce but also cultivates greater engagement and motivation among team members, contributing to institutional success and innovation.

However, professionals face various challenges in pursuing CPD, including time constraints, resource limitations, and insufficient institutional support (Adefuye et al., 2020). Online learning platforms have emerged as a viable solution, offering flexible and accessible options for skill enhancement (Byungura et al., 2022). These digital alternatives have shown promise in resource-limited settings where traditional training methods may be impractical,

democratizing access to professional development opportunities. The integration of emerging technologies into CPD practices can significantly save costs, enhance learning experiences, and outcomes.

As demand for skilled professionals continues to grow, the significance of CPD in STEM, TVET, and information science becomes increasingly apparent. Ahmad et al. (2020) emphasize that successful professional development requires collaboration between individuals and employers, creating a synergistic approach to learning and development. This partnership approach creates an environment where continuous learning is valued and supported, ultimately leading to improved job satisfaction and professional fulfillment. The rapid pace of technological advancement demands vigilance in updating skills and knowledge, making CPD an essential component of long-term career success in these fields, while ensuring that educators remain effective and relevant in their roles.

Conclusion and Recommendation

In conclusion, the integral relationship between technology, education, and society underscores the critical need for professionals in STEM, TVET, and information science to embrace a lifelong learning mindset. As digital technologies continue to reshape educational landscapes, the importance of innovative pedagogy becomes increasingly evident. This pedagogical approach not only enhances the learning experience but also prepares students for the complexities of the modern workforce. The major shifts in Library and Information Science further illustrate the necessity for adaptability and continuous professional development, as these fields evolve in response to technological advancements. The prognosis for the future indicates that digital technology will significantly impact education, entrepreneurship, and economic development, necessitating proactive engagement from individuals, institutions, and governments alike. Therefore, to thrive in the coming decades, professionals must prioritize their own professional development, recognizing that continuous learning is not merely an option but a fundamental requirement for career success and fulfillment.

To this end, it is recommended that STEM, TVET, and information science practitioners develop personalized CPD plans that align with their career goals and the evolving demands of their fields. This self-directed approach to learning will empower professionals to take charge of their growth, ensuring they remain competitive and capable of leveraging new technologies effectively. Furthermore, institutions should foster a culture of continuous learning by providing resources and support for CPD initiatives, while also encouraging collaboration and knowledge sharing among professionals. By embracing a growth mindset and committing to lifelong learning, educators and practitioners can not only enhance their own capabilities but also contribute to the advancement of their fields, ultimately benefiting society.

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LEAD PAPER II

TECH-DRIVEN PEDAGOGIES FOR ENTREPRENEURSHIP AND ECONOMIC DEVELOPMENT

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Protocol: To be measured.

Introduction

This lead paper titled 'Tech-Driven Pedagogies for Entrepreneurship and Economic Development' is focused on the strategic infusion of technology into instruction to ensure the production of graduates with entrepreneurial mindsets and the ability for economic development. The title comes from how tech-driven pedagogies should transform education and make learning interactive, accessible, and personalised. These approaches foster innovation and critical thinking, to equip students with the needed skills for economic development and global competitiveness to promote sustainable practices and inspire students through real-world success stories.

To establish the links and affinities in this presentation title as derived from the conference theme, the following terms: emerging technologies, tech-driven pedagogies, entrepreneurship, and economic development will be clarified to establish the framework for this presentation. These terms, when clarified, will provide a sound basis for understanding the ideas in this paper.

Emerging technologies have the potential to be widely adopted to improve teaching and learning but are not already in common use in education or can change the existing state of education. Some technologies have emerged and will continue to evolve at a rapid rate, creating a state of continuous emergence. Emerging technologies and practices may not be innovative, may be in constant change until a "way of doing things" arises, may not be fully understood or investigated, may experience hype, and may not yet realise their full potential. Emerging technologies are futuristic advances that will drive the next wave of educational innovation, and thus can be viewed as the essence of change. They are tools, innovations, and advances that can be applied in various educational contexts (in-class instruction, online, and blended). Emerging technologies could improve the individual and organisational outcomes of educational institutions (Veletsianos, 2016). The 2020 COVID-19 pandemic served as a stimulus for more technological use in education, thereby making emerging technologies a vital part of modern digital education (Yusuf, 2023).

Tech-driven pedagogies are approaches to education focusing on integrating technology in different instructional settings to enhance students' learning. It involves starting with pedagogical approaches that identify specific learning contexts or student needs that can be met through technology. Beyond concentrating on the technology itself, it involves educators reflecting and making decisions about how to appropriately integrate technology into their instruction by designing a technology-driven approach with clear goals. Tech-driven pedagogy also aims to improve engagement, interactivity, communication, visibility, and goal-setting in education through strategic use of technology tools and resources (Flynn, 2022). The education of the 21st century is technology-driven, as technology alters the skills required in the labour market, with an emphasis on creative, strategic, and analytical thinking. This entails a paradigm

shift and a new approach to preparation for life and work, with the 4 C's highlighting the importance of critical thinking, creativity, communication, and collaboration, essential for active citizenship, appreciation of arts, and social interactions. The emphasis turns to adaptable capacities and interaction with digital media, such as critical evaluation of online information, participation in various types of media, new communication models, and cooperation (Burbules et al., 2020).

Entrepreneurship is the process of creating, organising, and operating a business for profit, which is frequently associated with risk-taking and creativity. It is critical to a country's economic success because it drives innovation and allows it to adapt to a competitive global marketplace. It can be. Small Business Entrepreneurship involves enterprises such as local stores or services, which are frequently funded by small loans or personal savings. Scalable Startup Entrepreneurship is focused on innovative, scalable business concepts, attracts investors, and requires venture money. Large company entrepreneurship refers to existing organisations innovating to adapt to market changes, either through internal development or by acquiring innovative enterprises, whereas social entrepreneurship addresses societal needs and challenges without a major focus on profit-making. Entrepreneurs are people who start and succeed in new businesses, introducing new ideas and products to the market (Ellis, 2023).

Economic development refers to programmes, policies, or activities to enhance a community's economic well-being and quality of life. It is shaped by the unique opportunities, challenges, and priorities of each specific community. This process involves engaging and collaborating with individuals and businesses within the community to create strategies that promote job creation, business growth, improved quality of life, and overall economic prosperity. The main indices of economic development include creating more jobs and more job variety, keeping businesses and creation of new ones, improving life quality, and improved tax revenue from individuals and businesses. The indices also include the use of property more productively, the promotion of community assets, the production and sale of more local products, and the attraction of skilled workers to live in the community. Education is the key to economic development, as it provides more skilled workers. This is because education and skill development of the workforce play a crucial role in economic development (Ministry of Jobs, Economic Development, and Innovation Province of British Columbia, 2023).

To promote entrepreneurship and economic development, emerging technologies and tech-driven pedagogies will play a transformative role by ensuring up-skilling and reskilling opportunities, making the 21st century workforce adaptable to new economic demands. Individuals will be equipped with the skills necessary to innovate and create new business ventures. Personalised learning experiences become easier as learning experiences tailor education to individual needs to enhance the learning experience and foster essential entrepreneurial critical thinking and problem-solving skills. Digital platforms and online learning environments through global connectivity will provide access to global markets through the breakdown of geographical barriers. This allows entrepreneurs to expand their business and tap into international markets. Innovative pedagogies such as formative analytics, place-based learning, and learning with drones and robots encourage experiential learning and practical application of knowledge, which are crucial for developing entrepreneurial skills. Emerging technologies can be used to address systemic sustainability challenges not only to promote economic development in alignment with global Sustainable Development Goals (SDGs) for sustainability and inclusiveness. In addition, tech-driven pedagogies will provide a supportive ecosystem that fosters an innovative environment for startups through resources that offer mentoring, mentoring, and networking opportunities. This will help new businesses thrive

and contribute to economic growth (Amini Sedeh et al., 2022; Parmaxi et al., 2024; World Economic Forum, 2024).

Tech-Driven Pedagogies: An Overview and Examples

The modern educational landscape is rapidly evolving, requiring new knowledge and qualifications, and global higher education is undergoing reforms, prompting the search for innovative educational forms and technologies. The educational process should use holistic models that integrate methodology and methods for quality education. Quality education will impart knowledge and enable students to adapt and apply new scientific ideas and methods to promote academic and professional mobility in a rapidly changing world. The integration of new pedagogical and information technologies is essential for transforming education.

Tech-driven pedagogies are educational approaches that leverage technology to enhance teaching and learning through the integration of digital tools and resources into the classroom or other instructional settings, thereby transforming traditional learning methods. This implies that technology is used to create new learning experiences, facilitate collaboration, assess learning activities, and personalise learning for individual students, among others. Key characteristics of technology-driven learning include an emphasis on student-centred learning, where students are actively engaged in their learning and have more control over their learning process; personalised learning through customised learning paths, feedback, and support for students; and collaborative learning with tools for students to work together on projects, share ideas, and communicate with each other. It also covers interactive learning experiences, such as simulations, games, and virtual reality; assessment of student learning in real-time and provision of feedback that can be used to improve instruction (McNulty, 2024; OECD, 2010, 2016).

Tech-driven strategies are essential for cultivating 21st century learners who are capable of independent thinking and work, through the development of individual personal, cultural, and communicative skills, as well as the ability to acquire and develop knowledge independently. The personal and professional development of students is essential for navigating a complex and contradictory world. It involves reassessing educational values and integrating new methods to solve didactic problems. Tech-driven pedagogy must adhere to methodological requirements in the areas of conceptuality, consistency, manageability, efficiency, reproducibility, and unity of content and process, which are linked to the teacher's skill level and the methods employed in teaching. It pertains to specific methods of delivering educational content through careful organisation of methods and teaching materials. It combines traditional methods with advancements in social and technical progress. Sources of tech-driven pedagogies include social transformations, pedagogical sciences, and historical educational experiences (OECD, 2016, 2016; Pliushch & Sorokun, 2022).

There are various tech-driven pedagogies, each with unique procedural characteristics and methodological support. They are interactive technologies that promote student interaction and teamwork and address the lack of teamwork skills among students. Innovative pedagogical technology will ensure organised activities and thinking to implement new educational practices with effects on the goals, content, and methods of teaching. It will ensure differentiated, problem-based, and student-centred learning approaches, with learning technologies connecting education with students' life experiences and needs (Amini Sedeh et al., 2022; Pliushch & Sorokun, 2022; Suleymanova, 2022; Veletsianos, 2016).

It will also guarantee innovative approaches to teacher education by ensuring that professional training of future teachers fosters an environment for personal and professional development, allowing educators to understand their didactic capabilities. Modern information technologies will enhance pedagogical skills through diverse information forms and facilitate collective and individual research. Innovative technologies will allow student teachers to learn at their own pace, and develop positive emotions and motivation, and the professionally-oriented educational environment created through various digital resources will enhance pedagogical skill development. Tech-drive pedagogies in teacher education include structural and logical technologies for organised training systems, integration of technologies for interdisciplinary knowledge, professional and business gaming technologies for problem-solving skills, training tools for developing algorithms for practical problems, information and computer technologies for interactive learning, and dialogue and communication technologies for interactive teaching methods. The tech-driven pedagogy approach involves the use of digital technologies to create interactive and engaging learning experiences (Ally, 2019; Pliushch & Sorokun, 2022).

A few examples of tech-driven pedagogical approaches that use technology to enhance the learning experience include the following. The Khan Academy is an online platform that provides free educational videos and exercises covering a wide range of core subjects, learning management systems (LMS) platforms like Moodle, CANVAS, and Google Classroom, among others which allow teachers to create and manage assignments, communicate with students, track their progress, and assess learners. Accelerated Reader software is a class management and monitoring programme that fosters independent reading in primary and secondary school learners by helping students choose books at their reading level and track their reading progress. Educational Apps and Online Resources can provide students with access to a large amount of learning activities and information. Immersive Tech Tools such as virtual reality and augmented reality are used for creating immersive and engaging learning experiences. Tablets and computers are devices that can be used to access online resources, create presentations, and collaborate with classmates, while personalised systems can be used to adapt to each student's individual learning needs and provide personalised instruction. Others include adaptive learning algorithms that can be adjusted to the difficulty of learning materials based on a student's performance, cloud-based learning software that allows students to access learning materials and collaborate with classmates from anywhere with an internet connection, and Apps, Blogs, and Discussion Boards tools that can be used to facilitate communication and collaboration among students and teachers (Guido, 2022; Herold, 2022; News, 2024; Parmaxi et al., 2024; Pliushch & Sorokun, 2022; Sharma et al., 2024).

There are also Digital Interactive Whiteboards that can be used to display presentations, share documents, and engage students in interactive activities; Video Conferencing tools which allow students to participate in live lessons and collaborate with classmates from different locations; Smartboards that display presentations, share documents, and engage students in interactive activities; and multimedia lessons that incorporate a variety of media, such as videos, images, and audio, to create engaging and interactive learning experiences. Others include Augmented Reality which overlays digital information onto the real world, creating interactive and engaging learning experiences; Virtual Reality creating immersive and engaging learning experiences by transporting students to different environments. Digital Field Trips allow for virtual fields for students to explore different locations and learn about different cultures without leaving the classroom. Gamification approach which uses game mechanics, such as points, badges, and leaderboards, to motivate students and make learning more engaging; Mobile devices used to access online resources, create presentations, and collaborate with classmates; Podcasting for teachers to create and share audio lessons with students; 3D printing

which allows students to create physical models of objects, to help them understand concepts more deeply; and Tools that Track and Display Classroom Noise for teachers to manage classroom noise levels and create a more conducive learning environment (Guido, 2022; Herold, 2022; News, 2024; Parmaxi et al., 2024; Pliushch & Sorokun, 2022; Sharma et al., 2024).

The four main pedagogical technology options include technologies: focused on intellectual development and meaningful generalisation, prioritising emotional and creative development through play and training, aimed at practical thinking and vocational skills development, and for spiritual and moral formation, emphasising the innate mission and virtues of students (Pliushch & Sorokun, 2022).

Generally, tech-driven pedagogies in the education system can lead to several improvements. These include enhanced pedagogical skills and professional competence of future teachers, enabling them to participate effectively in innovative processes within education. There will be an improvement in the quality of educational achievements, leading to better learning outcomes and overall academic performance. Modernisation of the education system can help align educational practices with contemporary workplace needs and global standards. Tech-driven pedagogies can contribute to the formation of a modern style of thinking among specialists characterised by creativity, flexibility, dynamism, and objectivity, essential for adapting to the changing educational landscape. The gradual replacement of traditional methods with innovative technologies will allow higher education institutions to develop optimal approaches to organising the educational process. Tech-driven pedagogies will ensure increased contextual and problem-based learning, making education more relevant to students' lives, and thereby increasing their engagement and motivation (Pliushch & Sorokun, 2022).

Key Technologies Shaping Tech-Driven Pedagogies for Entrepreneurship and Economic Development

Challenges and Limitations of Tech-Driven Pedagogies

Tech-driven pedagogies integrate digital tools and technologies into educational practices to improve learning experiences and outcomes. These approaches leverage innovations such as artificial intelligence, virtual reality, and learning management systems to create more interactive, personalised, and engaging learning environments. In this section of this lead paper, seven key technologies and their relationship to tech-driven pedagogies are discussed as they influence entrepreneurship and economic development.

Artificial Intelligence and Machine Learning: Artificial intelligence (AI) refers to the simulation of human intelligence by machines programmed to think and learn like humans. AI systems perform tasks such as visual perception, speech recognition, decision-making, and language translation, and encompass technologies such as machine learning, natural language processing, robotics, and so on. Machine learning (ML) is an AI subset that focuses on the development of algorithms and statistical models that enable computers to learn and make predictions or decisions based on data with minimal human intervention. ML learning types include supervised learning, unsupervised learning, and reinforcement learning. It must be underscored that ML is a core component of AI. While AI is ML, it is a specific approach to achieving AI by providing the methods and tools that allow AI systems to learn from data and improve over time without being explicitly programmed for each specific task.

Artificial intelligence (AI) and Machine Learning (ML) are revolutionising education through efficient, adaptive, and efficient learning experiences. For Personalised Learning, AI systems can analyse student performance data to create individualised learning paths by adjusting content difficulty and pacing based on student responses. Carnegie Learning's MATHia uses AI to provide personalised maths instruction for middle school and high school students. In Intelligent Tutoring Systems, AI-powered tutors provide one-on-one guidance and feedback, and the systems can identify knowledge gaps and offer targeted assistance. An example is Third Space Learning which uses AI to support human tutors in delivering personalised mathematics lessons. For Content Generation and Curation, AI can generate practice questions, quizzes, and even explanations of complex topics, as ML algorithms can curate relevant educational resources from vast databases. An example is that Knewton's Alta platform uses AI to generate personalised content and assessments. Virtual assistants and chatbots can answer student questions 24/7 help with administrative tasks and provide basic tutoring. An example is that the NooAI chatbot assists students (Cheng et al., 2022; Kamalov et al., 2023; UNESCO, 2021; Walter, 2024).

Other AI and MI tech-driven pedagogical tools include automated grading and feedback with ML algorithms grading essays and providing instant feedback on writing, and AI systems can assess complex problem-solving in subjects like mathematics and computer science. An example is Essay-Grader.AI which uses AI to streamline grading for instructors. Predictive analytics using the ML models can predict student performance and identify at-risk students allowing educators to intervene early and provide necessary support; an example is Civitas Learning using predictive analytics to improve student retention in higher education. Immersive learning experiences using AI and ML enhance virtual and augmented reality educational experiences to create adaptive simulations for fields like sciences, engineering, medical and health sciences, an example is the zSpace which combines AR/VR with AI for interactive STEM learning experiences (Cheng et al., 2022; Kamalov et al., 2023; UNESCO, 2021; Walter, 2024).

The challenges of AI and ML tech-driven pedagogies include ensuring data privacy and security, addressing potential biases in AI algorithms, maintaining the human element in education, and ensuring equitable access to AI-enhanced learning tools, among others (Cheng et al., 2022; UNESCO, 2021).

Virtual and Augmented Reality: Virtual and augmented reality provide more engaging and interactive learning experiences. Students using AR and VR technologies have been found to have higher levels of motivation and engagement and better performance on academic tasks. They can be used to create virtual field trips, visit historical sites, and even experience different cultures. This technology has the potential to transform the way we learn and teach (Pang & Cai, 2023; Tene et al., 2024).

VR and AR can create immersive environments that are more engaging and motivating capture students' attention and make learning permanent. Students can explore historical sites, conduct virtual science experiments, or interact with 3D models of complex structures. AR and VR can participate in interactive simulation activities that would be impossible or impractical in real life. For example, medical students can perform surgeries in a virtual operating room, while engineering students can test their designs in a simulated environment. As an AT tool, VR and AR can adapt to individual learning styles and paces through adaptive learning platforms, allowing students to provide customised content and feedback, helping students better understand and retain information. Through collaboration and social learning using AR and

VR students can work together in virtual spaces, and interact with each other with virtual objects, thereby fostering teamwork and communication skills. Accessibility and inclusivity can be enhanced using virtual reality and AR to make learning more accessible to students with disabilities. VR can provide a safe and controlled environment for autistic students, while AR can offer visual and auditory aids for students with hearing or vision impairments. In addition, educators can also benefit from VR and AR through professional development programmes that offer immersive training and simulations, thus deepening teachers' ability to integrate these technologies into their classrooms (Hamilton et al., 2021; Pang & Cai, 2023).

Blockchain in Education: Blockchain technology securely records transactions across a network of computers using a decentralised and distributed digital ledger without the need for a central authority. Key characteristics include decentralisation where no single entity controls the network, transparency with all transactions visible to network participants, immutability because once recorded, data cannot be altered without consensus, and security using cryptographic techniques to ensure data integrity. Therefore, blockchain can transform education by offering more accountability, security, and efficiency (Alammary et al., 2019).

Blockchain technology as tech-driven pedagogies can improve transparency, security, and efficiency in education. It is useful for academic credentials and certification as the blockchain can securely store and verify academic credentials, such as diplomas, transcripts, and certificates, thus ensuring easily verifiable and tamper-proof records for employers and other institutions. Smart contracts for courses and assignments can automate administrative tasks (course registration, assignment submissions, and grading), and deadlines can be enforced with grades released when standards or conditions are met. Blockchain can be used to incentivise learning by creating token-based reward systems for students to complete courses and achieve high grades, serving as positive reinforcement. It can provide opportunities for personalised learning paths by securely storing and sharing student learning histories and preferences, thereby allowing educators to tailor educational content and experiences to individual needs (Alammary et al., 2019; X. Chen et al., 2023; Raj, 2023).

Blockchain provides a secure and decentralised way to manage sensitive educational data, such as student records and research data, from unauthorised access and ensure data integrity. Blockchain can facilitate collaborative learning and resource sharing through decentralized platforms where educators and students can share materials and collaborate on projects. Blockchain can support the issuance of micro-credentials by recognising smaller units of learning, like specific skills or competencies, thereby promoting lifelong learning by allowing individuals to continuously update their qualifications. Blockchain has the potential to reduce fraud and improve trust by providing a transparent and immutable record of academic achievements, thus reducing the risk of credential fraud and enhancing trust in the educational system (Alammary et al., 2019; X. Chen et al., 2023; Raj, 2023).

Internet of Things (IoT) and Smart Learning Environments: The Internet of Things refers to the network of physical objects, called "things," embedded with sensors, software, and other technologies to connect and exchange data with other devices and systems over the Internet. Smart Learning Environments are technology-enhanced learning spaces that use IoT devices and other technologies to create adaptive, interactive, and data-driven educational experiences. The key components of IoT in education include sensors and devices such as environmental sensors (temperature, humidity, light), wearable devices (smartwatches, fitness trackers) and interactive displays and smart boards. Connectivity using Wi-Fi, Bluetooth, RFID, NFC, and 5G networks for faster and more reliable connections. Data Analytics for big data processing,

machine learning algorithms, and predictive analytics. Cloud computing deals with the storage and processing of large datasets, and access to resources from anywhere (Ghashim & Arshad, 2023; Terzieva et al., 2022). The IoT promises to create more engaging, efficient, and effective learning experiences tailored to individual student needs and learning styles.

IoT-enabled devices significantly enhance the learning experience in smart learning environments by facilitating personalised, immersive, and data-driven educational practices. These technologies create dynamic ecosystems that adapt to individual learning needs and promote collaborative learning (Terzieva et al., 2022). It enables personalised and collaborative learning and improves user learning experiences.

IoT devices integrated with AI enable personalised learning experiences by analysing student data to tailor content and assessments to individual learning styles and paces. Real-time feedback mechanisms, such as smart cameras and microphones, monitor student engagement and adapt learning materials accordingly (Kamruzzaman et al., 2023). IoT ecosystems foster collaborative learning by integrating data-driven thinking into STEM education, enhancing problem-solving and analytical skills among students. Successful implementations in Singapore demonstrate the scalability and effectiveness of IoT-based frameworks in engaging large student populations (Benita et al., 2021). The integration of IoT in smart environments improves user experience by creating engaging educational applications that cater to diverse student and educator interests (Curry et al., 2020).

The applications of IoT in smart learning environments can assist in adaptive learning through personalised content delivery based on student performance and preferences and real-time adjustments to their difficulty levels. It is useful in attendance and access control through automated attendance tracking using RFID or facial recognition and for secure access to facilities and resources. For environmental optimisation, the IoT can be used for automatic adjustment of lighting, temperature, air quality, and energy efficiency through smart resource management. The creation of interactive learning spaces becomes possible through smart boards and displays that interact with student devices and augmented and virtual reality integration for immersive learning. Asset tracking and management become easier by monitoring and managing educational resources and equipment and predictive maintenance of learning tools and infrastructure. Safety and security are ensured through smart surveillance systems and emergency response optimisation. IoT in smart learning environments allows data-driven decision-making through comprehensive analytics on student performance, engagement, and behaviour and insights for curriculum development and resource allocation (Curry et al., 2020; Ghashim & Arshad, 2023; Kamruzzaman et al., 2023; Terzieva et al., 2022). Although the benefits of IoT in education are substantial, challenges such as data privacy and equitable access must be addressed to ensure that all students can fully benefit from these advancements.

Blended Learning Approaches: Blended learning is an educational approach that combines traditional face-to-face instruction with online learning experiences. Blended learning uses technology to create more flexible, personalised, engaging and effective learning experiences. The features of blended tech-driven pedagogies are traditional classroom Face-to-Face Instruction interactions with online learning self-paced digital content and activities for online learning, using digital tools and platforms, with the student having control over time, place, path or pace of learning. Common blended learning models include rotation, flexibility, A La Carte model, flipped classroom, and Enriched Virtual Model (Bizami et al., 2023; Radovan & Radovan, 2024).

Technologies used in blended learning include Learning Management Systems (LMS), video conferencing tools, interactive content creation platforms, adaptive learning software, virtual and augmented reality applications, mobile learning apps, and online assessment tools, among others. Blended learning employs technologies for real-time (synchronous) sessions via video conferencing tools like Zoom or Google Meet and self-paced (asynchronous) activities like discussion forums and recorded lectures. At times, gamification and interactive tools like Kahoot! Quizlet and Classcraft, among others, are used in incorporating game elements and interactive tools to make learning more engaging and motivate students to participate actively (Bizami et al., 2023; Buchan & Precey, 2023).

Gamification and Interactive Learning: Gamification refers to the application of game elements in non-gaming contexts to motivate and engage students, enhance their learning experience, and make learning more enjoyable and effective. By incorporating gamification elements such as points, badges, leaderboards, and quests into learning activities, educators can create a more engaging and motivating environment for students. Educators can motivate students to take charge of their learning, foster collaboration, and create a positive attitude toward academic pursuits. Gamification transforms learning from a tedious task into an exciting quest, encouraging students to immerse themselves in the curriculum. Gamification fosters increased motivation, increased engagement, collaboration, competition, and a positive attitude toward learning, transforming it into a fun and rewarding experience, leading to improved learning outcomes (Wang, 2021).

Gamification in education can be categorised into low-tech, medium-tech, and high-tech activities, each varying in duration and complexity. Low-tech activities, such as Twitter debates or collaborative writing projects using trivia games, and Google Docs, encourage students to engage creatively with familiar tools while developing collaborative skills. Medium-tech examples include web-based games, like Classcraft and Kahoot, which enhance learning experiences, while content-based teaching approaches utilise authentic materials to immerse students in language and culture, demonstrating that gamification can extend beyond language courses. High-tech gamification activities offer more complex and engaging learning experiences like Labster and Minecraft: Education Edition (Wang, 2021).

Key elements of gamification in education include points and rewards where students earn points or rewards for completing tasks or achieving goals; badges and achievements where students receive badges or achievements for specific accomplishments; leaderboards and rankings with students competing against each other on leaderboards or rankings; quests and challenges involving students on quests or challenges to solve problems or achieve objectives; and storytelling and narrative where learning can be framed within a narrative or story, making it more engaging and immersive (Wang, 2021).

Project-Based Learning Using Technology: Project-based learning (PBL) is an educational approach that emphasises real-world problem-solving and collaborative work among students. Tech-driven project-based learning (PBL) integrates digital tools and technologies into the PBL framework, enhancing the learning experience through improved collaboration, research capabilities, content creation, and presentation options. The integration of technology, particularly Artificial Intelligence (AI), into PBL has the potential to enhance effectiveness and adaptability, creating a more engaging learning environment. Tech-driven PBL can assist in the personalisation of learning experiences to meet the unique needs and interests of individual students. It can enable adaptive assessments that adjust the difficulty of tasks based on a

student's proficiency level so that each learner is appropriately challenged, allowing them to progress at their own pace while receiving customised feedback. One of the most significant advantages of incorporating technology into PBL is the provision of real-time feedback, as AI-powered tools can assess student work instantly, offering insight and suggestions for improvement. Technology tools can facilitate collaboration among students by providing platforms for communication and project management in PBL. Research is a critical component of PBL, and tech-driven PBL is relevant in streamlining the research processes, by organising data, summarising content, and managing references. It is also relevant for task management automation as technology like AI can automate scheduling, task assignments, and priority settings within student teams, enhancing productivity and organisational skills (Garbade, 2021; Stefanic, 2024; Tang et al., 2024).

The key components of PBL are the driving question or challenge, sustained inquiry, authenticity, student voice and choice, reflection, critique and revision, and public product. Technologies used to enhance PBL include collaboration tools (e.g. Google Workspace, Microsoft Teams, Slack), Project Management Tools (e.g. Trello, Asana, Microsoft Planner), Research and Data Collection (e.g. Zoho Form, Zotero, Google Forms), Content Creation Tools (like Canva, Adobe Creative Suite, iMovie), Virtual and Augmented Reality (for instance, Google Expeditions, CoSpaces Edu, Merge Cube), Coding and App Development (e.g. Scratch, App Inventor, Thunkable), 3D Printing and Design (like Tinkercad, SketchUp, Fusion 360), and Learning Management Systems (LMS) (e.g. Google Classroom, Canvas, Moodle), among others (Garbade, 2021; Stefanic, 2024; Tang et al., 2024).

Integration of AI into project-based learning represents a significant advance in educational practices. By enhancing personalization, providing adaptive assessments, facilitating real-time feedback, promoting collaboration, streamlining research processes, and automating task management, AI transforms PBL into a more dynamic and effective educational approach. As educators continue to adopt these technologies, they will likely see improved engagement and learning outcomes among students, preparing them for future challenges in an increasingly complex world (Garbade, 2021; Stefanic, 2024; Tang et al., 2024).

Integration of technology-driven pedagogies in education presents several challenges and limitations that can hinder their effectiveness (Ajadi, 2024; L. Chen et al., 2024; Zidán et al., 2019). Some of these challenges are discussed in this paper.

Digital Divide and Accessibility Issues: The digital divide remains a significant barrier that hinders the potential benefits of tech-driven pedagogies. Lack of access to necessary technology such as computers and reliable Internet connections may lead to unequal learning opportunities and exacerbate existing educational inequalities against students from low-income families or rural areas.

Data Privacy and Security Concerns: The increased reliance on technology has raised concerns regarding data privacy and security in educational settings, as schools collect sensitive information, including personal data about students and staff. The potential for data breaches poses risks such as identity theft and unauthorised access to personal information.

Teacher Training, Adaptation, and Readiness: The effective implementation of tech-driven pedagogies is dependent on adequately trained educators who are prepared to use new technologies. Many teachers are unprepared or lack confidence in integrating these tools into their teaching practices.

Ensuring Equity and Inclusivity: Tech-driven education may inadvertently reinforce existing inequalities if not implemented thoughtfully. For example, AI systems do reflect biases present in their training data, which might lead to unequal learning opportunities for marginalised groups. Therefore, educators must actively work to ensure that tech-driven approaches are inclusive and accessible.

Teacher Training, Adaptation, and Readiness: Many educators lack the necessary training to effectively use technology in their teaching, leading to reliance on traditional methods. Teachers may lack the necessary technological skills or pedagogical knowledge to effectively implement tech-driven pedagogies.

Resistance to Change: Some teachers may be resistant to adopting new technologies or changing their teaching practices. They may resist adopting new technologies because of comfort with traditional teaching methods, scepticism about the effectiveness of tech-driven approaches, or reservations about technology-driven pedagogies. Resistance can slow the integration of innovative pedagogies into classrooms, limiting the potential benefits for students.

Over-reliance on Technology: Technology can enhance learning experiences; however, there is a risk of over-reliance on digital tools at the expense of critical thinking and interpersonal skills development. Therefore, a balance must be found between using technology and fostering essential soft skills that are crucial for students' future success.
Cost and Resource Allocation: Implementing and maintaining tech-driven pedagogies can be expensive, particularly for schools and institutions with limited budgets. In addition, ensuring the long-term sustainability of tech-driven initiatives requires careful planning; therefore, ensuring the long-term sustainability of tech-driven education requires ongoing investment and maintenance.

Pedagogical Effectiveness: The effectiveness of tech-driven pedagogies depends on the quality of the digital content and tools used. Poorly designed resources can hinder learning rather than enhance it. While technology can enhance engagement, it can also be a source of distraction, thus the need to balance the use of technology to maintain student focus is essential.

Assessment and Evaluation: Assessing the impact of technology-driven pedagogies on student learning outcomes can be challenging. Additionally, providing timely and constructive feedback in a tech-driven environment requires robust systems and processes. Developing reliable evaluation methods is necessary to ensure that these approaches are effective.

Ethical Considerations: Tech-driven pedagogies, particularly AI-enabled, can introduce biases that affect student outcomes. Furthermore, promoting healthy digital habits and addressing issues such as screen time and online behaviour are important for student well-being. Ensuring fairness, transparency, and digital well-being in these systems is critical.

Addressing these challenges is vital to maximise the benefits of tech-driven pedagogies in education, which requires a collaborative effort from educators, policymakers, technology providers, and the community. By focusing on pedagogical effectiveness, equitable access, robust teacher training, investing in digital infrastructure, prioritising data privacy and ethical use of data, and costs, and fostering an inclusive environment, educational institutions can create a more effective learning landscape that harnesses the full potential of technology while mitigating its risks.

Strategies for Implementing Tech-Driven Pedagogies to Enhance Entrepreneurship and Economic Development

Integrating technology-driven pedagogies into entrepreneurial education can significantly improve student learning outcomes and foster a more vibrant entrepreneurial mindset for economic development. Technology is essential in modern education, but it requires a balance with human elements for effective pedagogy. Implementing tech-driven pedagogies requires careful planning and execution; therefore, educators should adopt a multifaceted approach that integrates innovative strategies, fosters engagement and emphasises continuous professional development. Such a balanced approach can create a beneficial tech-driven learning environment for all students (Hilkemeijer, 2024; Khurama, 2023; Parveen et al., 2024). Here are a few key strategies for implementing tech-driven pedagogies.

Needs Assessment and Planning: Educators should conduct a thorough analysis of current educational needs and technological capabilities, develop a clear vision, and set specific goals for tech integration. This should be done through the survey of stakeholders (teachers, students, administrators) to identify needs and challenges. Based on the survey, a technology integration plan should be created to align with curriculum objectives, accompanied by measurable outcomes and success criteria.

Infrastructure Development: The development of robust technological infrastructure to support new pedagogies is necessary. This should include the upgrade of network capabilities (Wi-Fi, broadband) to handle increased digital traffic, implementation of cloud-based solutions for scalability and accessibility, and establishment of a plan for device acquisition and management (BYOD or school-provided).

Professional Development: Provision of comprehensive training and support to educators to help them effectively integrate technology. Continuous development in the pedagogical use of technology will empower educators to stay up-to-date on emerging technologies and their integration into learning. This can be done through workshops on specific technologies and their pedagogical applications, the establishment of mentorship programmes pairing tech-savvy teachers with those less comfortable with technology, the creation of online resources and communities for ongoing learning and support and encouraging teacher participation in educational technology conferences and webinars.

Curriculum Integration: There must be a seamless integration of technology into the existing curriculum. This can be done through review and revision of the existing curriculum to incorporate technology-enhanced activities, development of tech-integrated lesson plans and unit designs, and creation of a repository of tech-enhanced learning resources accessible to all teachers.

Blended Learning Approaches: Combine traditional and online learning for personalised experiences to create an engaging and balanced pedagogical approach. The blended learning should align with the resources to encourage flexible, personalised, collaborative learning activities.

Student-Centred Approach: Tech-driven pedagogical approaches are student-centred, with a focus on student engagement and personalised learning experiences. This involves the implementation of adaptive learning technologies to cater to individual student needs, the encouragement of project-based learning using digital tools for research and presentation, and the use of gamification elements to increase motivation, engagement, and deeper learning.

Digital Citizenship Education and Safety: Teach students to navigate online spaces responsibly, critically evaluate digital content, and engage in respectful online discourse to promote ethical use of technology. To do this, prioritise digital literacy and online safety by developing a comprehensive digital citizenship curriculum, implementing internet safety protocols, educating students on responsible online behaviour, and teaching critical thinking skills for evaluating online information.

Regular Assessment, Feedback, and Reflection: Evaluate the impact of technology on learning to make the necessary adjustments and improve practices. Key performance indicators (KPIs) for tech integration success should be established, regular surveys and focus groups with stakeholders to be conducted, data on technology usage and its impact on learning outcomes analysed on time, and educators stay informed about emerging technologies and pedagogical approaches. Technology should be used for more effective assessment and feedback using digital assessment tools. Through regular assessment, feedback, and reflection, educators can make informed decisions about the use of technology for learning and improve their pedagogical use of technology.

Collaboration and Communication: Tech-driven pedagogies must promote and enhance collaboration between students, teachers, and parents. This is achievable through the adoption of collaborative learning platforms (e.g., Google Workspace for Education, Microsoft Teams), implementation of a Learning Management System (LMS e.g. CANVAS, Moodle) for streamlined communication and resource sharing, and facilitation of global classroom connections through video conferencing tools and other resources (e.g., virtual laboratory or field trip).

Accessibility and Inclusivity: Educators must ensure that tech-driven pedagogies are accessible to all students. Achievable by choosing technologies with built-in accessibility features, providing assistive technologies for students with special needs, and offering multiple means of engagement and expression in tech-enhanced learning activities.

Sustainable Funding and Resource Allocation: Sustainable funding is critical for tech-driven pedagogies. To achieve this, there is a need to develop a sustainable model for funding and maintaining tech-driven initiatives. Options for this include exploration of grants and partnerships with tech companies, implementation of a phased approach to technology adoption to spread costs over time, and consideration of total cost of ownership, including maintenance and upgrades, in budgeting.

Parent and Community Engagement: It is important to involve parents and the community in the tech integration process. To implement this, institutions can host information sessions and workshops for parents on new technologies and their educational benefits, provide resources for parents to support tech-enhanced learning at home, and partner with local businesses and organisations for real-world tech-driven projects. Communication tools like ClassDojo or Remind can be used to engage parents and the community.

By systematically adopting these strategies, educators and educational institutions can create an effective and efficient framework for implementing tech-driven pedagogies, to ensure that technology enhances rather than detracts from the learning experience.

Conclusion

Integration of tech-driven pedagogies into educational systems presents a transformative opportunity to promote entrepreneurship and drive economic development. As we have explored throughout this paper, emerging technologies such as artificial intelligence, virtual and augmented reality, and blockchain, among others, are reshaping the educational landscape, making learning more engaging, interactive, personalised, and accessible. When implemented effectively, emerging technologies can enhance intellectual development, emotional and creative growth, practical vocational skills, and spiritual and moral formation. They can reshape the educational landscape and offer unprecedented opportunities for improved learning. The diverse examples of tech-driven pedagogies, such as Khan Academy, Learning Management Systems, immersive tools, and a range of technological tools and platforms, provide educators with a rich toolkit to foster entrepreneurial mindsets and skills for economic development. These tools not only facilitate knowledge acquisition, but also promote critical thinking, creativity, and problem-solving skills essential for entrepreneurial success. They also create simulated environments where students can practice real-world problem-solving and decision-making, crucial competencies for aspiring entrepreneurs.

It must be underscored that the implementation of tech-driven pedagogies is not without its challenges. Issues such as the digital divide, data privacy, and the need for comprehensive teacher training must be addressed to ensure equitable access and effective implementation. Additionally, the over-reliance on technology and the associated costs require careful consideration to avoid worsening existing inequalities. Despite these challenges, the benefits of tech-driven pedagogies for entrepreneurship and economic development cannot be over-emphasised. Using technology, educators can create dynamic and engaging learning environments that prepare students for the demands of the modern economy. As we continue to innovate and refine these approaches, it is crucial to prioritise inclusivity, ethical considerations, and the holistic development of learners to truly harness the transformative power of technology in education.

The strategies outlined for implementing tech-driven pedagogies underscore the importance of a holistic approach. This approach must consider needs assessment and planning, infrastructure development, curriculum integration, professional development for educators, and curriculum integration. In addition, regular evaluation, feedback, and reflection, along with collaboration communication, and stakeholder engagement, are essential for continuous improvement to create a sustainable and effective pedagogical learning ecosystem. By adopting student-centred approaches and fostering digital citizenship, we can harness the full potential of these technologies to nurture entrepreneurial talent and drive economic growth. As emerging technologies continue to evolve, so must our pedagogical approaches. The key lies in striking a balance between leveraging technology to improve learning and maintaining the human element of education that is crucial for developing well-rounded entrepreneurs and economically savvy citizens. Futuristically, entrepreneurial education and economic development are inseparably linked to technological advancement. Tech-driven pedagogies offer a transformative path for entrepreneurship education and economic development. There is a need for continued research, collaboration, and adaptive strategies to refine and optimise tech-driven pedagogies to ensure that education remains a powerful catalyst for entrepreneurship and sustainable economic development in the 21st century and beyond.

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Entrepreneurial Skills Training Modules Development for Woodwork Technology Education Graduates of Colleges of Education in Northwest, Nigeria

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Abstract
This study was carried-out on entrepreneurial skills training modules development and validation for woodwork technology education graduates of colleges of education. Three research questions were answered while three null hypotheses formulated were tested out in North West Zone States of Nigeria. The population for the study was 273 experts. There was no sampling because of the manageable size of the population. The instrument for data collection was questionnaire titled: Woodwork Technology Education Entrepreneurial Skills Training Structured Questionnaire (WTEESTSQ). Five experts validated the instrument and modules of entrepreneurial skills training. The internal consistency of questionnaire items was determined using cronbach alpha reliability formula or a method and reliability coefficient of 0.86 was yielded for objectives of module of entrepreneurial skill training. 0.85 For the contents of module of entrepreneurial skills training. 0.84 For the facilities for implementing the module of entrepreneurial skill training. While, 0.85 was yielded as the overall reliability coefficient value for the entire questionnaire items. Out of 273 copies of WTEESTSQ administered, only 208 copies were completed representing 86.00% return rate. Mean was used for answering the research questions while Analysis of Variance (ANOVA) was employed for testing the null hypotheses. The findings of the study revealed that 12 objectives and 151 contents were adequate for modules of entrepreneurial skills training development. The findings of this study also revealed that 40 facilities for entrepreneurial training skills were considered for implementing module of entrepreneurial skills training. The hypotheses tested revealed that there was no significant difference in the mean responses of respondents on the development and validation of entrepreneurial skills training modules were developed based on the findings of the study. It was recommended that developed modules of entrepreneurial skills training should be employed to retrain the woodwork technology education graduates. These used for implementing the modules of entrepreneurial skills training.

Keywords: Woodwork Technology Education, Module, Entrepreneurship, Graduate.

Introduction
Woodwork technology education (WTE) in colleges of education (CoE) is one of the programme under School of Secondary Education (Technical) (SOSETECH) designed for equipping individuals with knowledge, skills and attitudes for employment. In woodwork technology individuals trained relevant materials such as curriculum, tools, machines and equipment to enhance their skills acquisition for employment (Okwori, 2017). It targets

producing teachers for secondary schools and skilled men for self-employment or construction industries. Woodwork technology is directly related to preparation of individuals for paid or self-employment in following areas: carpentry and joinery, general woodworking, cabinet making, machine woodworking, upholstery work and ornamental design skills (National Commission for Colleges of Education (NCCE, 2012).

The minimum standard for NCCE (2012) explained that the essence of woodwork technology education in the curriculum of colleges of education as the part of technology education is to equip students with cognitive and psychomotor skills that is, on both theory and practical aspects of skills. The individual who graduated in woodwork technology education programme after meeting all requirements for graduation in colleges of education are called Woodwork Technology Education Graduate. These graduates are expected to be skilled and knowledgeable in woodwork students of school of secondary education (technical) in colleges of education offer combined courses in their year one and year two and specialize in the year three in any one of these area of specialization as: automobile, building, electrical/electronics, metalwork and woodwork technology education having all-round knowledge of all the components of the programme. Colleges of education prepare the individual for a carrier in teaching, employment in industries, civil service and business establishment as well as self-employment (Ubong & Wokocha, 2020). Colleges of education therefore is a tertiary institution where the students are expected to acquire skills for teaching in secondary schools and to practice what they have learnt in form of paid or self-employment after graduation. Colleges of education offer different programmes among which woodwork is one of them.

Entrepreneurship refers to all the efforts committed by the entrepreneur in business formation and management. Entrepreneurship is a well-directed effort capable of satisfying the needs of the individual and of the economy (Hisrich, 2017). Entrepreneurs contribute to economic welfare as they increase the innovative capacity of the economy. Entrepreneurship refers to the way of thinking, reasoning and acting that is opportunity-based, holistic in approach and leadership balanced (Timmons & Spinnelli, 2024). Entrepreneurship results in the creation, realization, enhancement and renewal of value not just for the owners, but for participants and stakeholders. Entrepreneurship is the process of identifying, developing and bridging a vision of life (Nwoye, 2021). Entrepreneurship involves the ability to sets up a business as different from being employed. Entrepreneurship makes someone self-reliant having acquired ideas and skills.

Skill refers to a craftsman's dexterity in a trade which enables him to perform or carried-out various operations relating to the trade. Skill is the capability of accomplishing a job with precision of certainty, practical knowledge in combination with ability, cleverness and expertness (Abdullahi, 2020). Similarly, Horby, (2020) defined skill as the ability to perform in an activity in a competent manner.

Entrepreneurial skills are the various business tactics required by individuals to attain the status of self-reliance and thus become useful to self and the society in general. Entrepreneurial skills are the abilities woodwork technology education graduates must possess a part from technical skills or competence in woodwork construction to establish their own businesses and employ others (Okwori, 2021). It has been observed that woodwork technology education graduates of colleges of education lacks the necessary ingredients to establish business ventures that will contribute meaningful to the nation's economy. Majority of entrepreneurs in Nigerian societies nowadays make little achievement in their various businesses and the reason is that they lack or deficient in entrepreneurial skills required for success in ventures. Hisrich and Peters (2022)

also attributed lack of capacity to establish ones' business to failure of the education and training to adequately equip woodwork technology education graduates with the essential entrepreneurial skills required for success in business. Akpan, (2024) also noted that the inadequacy of entrepreneurial skills exhibited by the woodwork technology education graduates is particularly shown in the level of growth and survival of enterprises established by them. Agomuo (2021) asserted that every prospective entrepreneur should in addition to the specific technical skills require for certain operations in their chosen area be trained to acquire essential entrepreneurial skills that will enhance success of their businesses. It then becomes imperative for graduates of woodwork technology education to acquire relevant training tailored towards making assets to the nation.

Training is an activity delivery carried out to equip individual with skills or competence in an area. Training involves providing individuals with directed experience that enables them to be more effective in performing the various tacks that constitute their jobs (Osuala, & Okeke, 2023). Training is always conducted when a new technology is introduced in an area. If training is effective, the training experiences result in changes in someone's attitudes, works habits and performance. Training defined by Olaosebikan, (2021) is the process of acquiring such knowledge or skills that may be required in the performance of tasks or multiplicity of such tasks. According to, Bakare (2020) training involves presentation and learning of contents as a means for enhancing skills development and improving workplace behavior. Solomon, (2021) noted that training helps to reduce gap between performances of workers in terms of work output such that the attainment of organizational goals is ensured. Training can described as an activity concerned with making individuals more articulate and efficient in the performance of their current tasks or in preparation for a new of job to meet the dynamic needs of the organization (Olatunje, Kajibola & Cover, 2021). Okorji, (2021) said that training may be inform of short term courses, attendance to seminars, conferences, workshops and further educational programme. Abiodun, (2022) added that training can takeplace in a number of ways, on the job or off the job; in the organization or outside organization. Training is therefore planned activity to modify knowledge, skills and attitudes of woodwork technology education graduates of colleges of education to embark on their businesses. Training can be organized or done by equipping woodwork technology education graduates with entrepreneurial skills or competence for effective training of woodwork technology to take place, technology in order to become creators of employments in the society (Spinelli, 2020). They are expected to work as employees in relevant industries or owners of their ventures or enterprises and employ others. They are individuals who were trained to specialize in woodwork technology education. Sunday, (2022) observed that the curriculum of woodwork technology education in colleges of education lacks entrepreneurship skills or components. Uwaifo, (2021) posited that woodwork technology education is the training of technically oriented personnel who are to be initiators, facilitators and implementers of technological development of a county. This view of woodwork technology education relates its recipients to initiators which is one of the major characteristic of an entrepreneur.

Technology education programme is meant to equip individuals with necessary knowledge, skills and attitudes for self-reliance, hence the programmes are offered at different levels of education to produce different categories of manpower in the following areas: woodwork, metalwork, building, automobile and electrical/electronics technology education. The Federal Republic of Nigeria (FRN, 2014) identified Universities, Polytechnics, Monotechnics, Colleges of Education and Technical Colleges as institutions that offer technology education programmes. Each of these institutions prepares different categories of personnel. One

important institution for production of pre-service teachers and personnel for self and paid employment is the college of education.

College of education is tertiary institution where individuals are trained to acquire teaching and practical skills for appointment in secondary schools as teachers and to also work in the industries. A college of education is a tertiary institution that offers three years minimum and five years maximum training to students in many programme of interest for entry into the teaching profession (FGN, 2014). College of education (CoE) is an educational tertiary institution established to prepare individuals to be leaders and practitioners in education and related human service fields by expanding and deepening understanding of education as a fundamental human endeavor in helping society define and respond to its educational responsibilities and challenges. Bakare and Ogbuanya (2021) described colleges of education as special tertiary institutions established in order to provide teacher education programmes to interested individuals in Nigerian society. Colleges of education offers combined courses to students. For example: all the training contents such as entrepreneurial skills must be organized in a module.

Facilitating entrepreneurial skills acquisition through module development is a right direction in equipping woodwork technology education graduates. A module is an independent unit of a planned series of learning activities designed to help students accomplish certain-well defined objectives. According to Olaitan (2023) is a unit of curriculum based on the development of entry level competencies of students. Olaitan further stated that in a modular design, the students and their occupational goals form the basis for programme planning. A module is a unit in the total curriculum of a particular field. The modules are of equal length that will take approximately specific hours of instructional time to achieve by the average group of students. A module in this study is a unit of instruction with a cluster of entrepreneurial skills designed for the purpose of training woodwork technology education graduates.

Entrepreneurial skills training module therefore is a package containing information arranged and organized to include: training objectives, planning, organizing, technical, marketing, managerial, personal skill, communication skills and training facilities, teaching techniques suitable for assessing the activities of the woodwork technology education graduates of colleges of education. Oristian (2021) stated that a training module is an organized package of information that includes elements such as objectives, contents, assignments, or activities and assessment. Onuka (2020) explained that in a module, the training objectives, content and methodology are presented at a glance in a concise form for the use of trainers and trainees to ensure that they participated effectively in training programme.

Objectives are the statement of expectations or outcomes. Wilburn and Wilburn (2020) stated that objectives are specific and concise statements that state that will make what change, by how much, where and when. It is brief, clear statements that describe skills, values, and attitudes students should exhibit that reflect the broader goals. Objectives guide the teachers on what to teach and what to learn by the students. Objectives in technical education can be stated in behavioral or specific ways. Specific objectives are specified statements of behavioral expectations of the learners at the end of each learning sequence. William (2021) explained that behavioral objectives are educational objectives, which identify precisely the type of behavior a student should exhibit at the end of a module/course or programme. In other words, objectives are stated in terms of the behavior expected of the woodwork technology education graduates after going through some planned entrepreneurial skills or experiences. Training objective determines what is going to be the contents of the module.

Content is a list of relevant topics to be taught and learnt by the teacher and students. Content can be defined as what the teacher and the students pay attention to in the teaching and learning processes (Bakare, 2020). Content simply means the body of knowledge which the teacher exposes the students to. Content (Kapoma & Namusokwe, 2021) refers to a list of topics, skills, themes, concepts or works to be covered by teacher and his students. Well prepared contents in technology education for instance can enhance the competence of individual woodwork technology education graduates. The possible contents of the entrepreneurial skills training module therefore include planning, organizing, marketing, technical, managerial, personality, communication and financial skills. Woodwork technology education graduates can only acquire the entrepreneurial skills through effective use of the modules.

Training facilities are objects, structures, tools or equipment used equipping individuals with knowledge and skills in an area. Facilities are physical items and structures such as buildings, offices, equipment, machines, tools and other materials (Okorie, 2020). Agbo (2022) described Facilities as something designed or created to provide a service or fulfill a need. According to Training facilities are used to facilitate achievement of learning objective which can only be measured or determined through appropriate evaluation methods and also through using appropriate facilities. Bakare (2024) stated that adequate and relevant training facilities make the learning process more satisfying. Some of the facilities that can help making training in entrepreneurship satisfying include numerous machines, planes, saws, chisels, hammer, mallet, marking gauge and mortise gauge. The acquisition of skills required by trainees/learners depends on the facilities used during training. Woodwork technology education graduates will acquire entrepreneurial skills if relevant facilities are used for training. Robert (2022) explained that facilities help trainers to translate abstract ideas to concrete ideas. When learners are trained without facilities, they find it difficult to practice after graduation. To complement effective use of training facilities, there should be proper instructional strategies.

It is time to empirically develop entrepreneurial skills training module for woodwork technology education graduates of colleges of education should be able to secure paid employment and also setup their own businesses as entrepreneurs. Adetola (2020) stated that woodwork technology education graduates set various levels of education can only display little technical skills to setup their own businesses and employ others. This could be attributed to type of training they received while in schools. Abdulkarim (2021) stated that lack of entrepreneurial skills in the woodwork curriculum of woodwork technology education deprived graduates of setting-up their businesses. In making improving graduates of woodwork technology business skills, there is need to develop entrepreneurial skills training modules for woodwork technology education graduates in colleges of education in northwest geo-political zone of Nigeria.

Statement of the Research Problem

It has been observed that woodwork technology education graduates of colleges of education lack the necessary ingredients to establish business ventures or will contribute meaningfully to the nation's economy. Hence, Hisrich and Peters (2022), attributed lack of competency to establish ones' business to failure of the education and training to adequately equip woodwork technology education graduates with essential entrepreneurial skills required for success in self-employment. Akpan (2024) also noted that the inadequacy of entrepreneurial skills exhibited by the woodwork technology education graduates in particularly shown that in the level of growth and survival of ventures established by them. Naturally, such a situation will lead to high unemployment rate efficiently among woodwork technology education graduates. There has been a long argument whether an entrepreneur can be trained in the classroom and

by the extension, the school but the general opinion now is that entrepreneurs can be trained at least to some extent in the classroom via adequately prepared and planned training modules.

In view of the positive social and economic effects of entrepreneurship, it is utmost importance to advance entrepreneurial thinking and behavior to develop students' awareness of relevance of entrepreneurship training. Oviawe (2020) had reiterated the massive of unemployment has reached alarming. Proportions as a result of entrepreneurial skills deficient module, practical entrepreneurial training and consciousness while still in their training institutions. Although students' awareness for entrepreneurship education has grown in the last five years and attitudes towards acquiring entrepreneurial skills has become more positive, but woodwork technology education curriculum seems to lack the aims, contents and work method of entrepreneurial training which hindered the inculcation of the desired knowledge and entrepreneurial skills to the students.

These woodwork technology education graduates lack entrepreneurial skills required for self-employment in woodwork technology. Modern technical skills and knowledge in carpentry and joinery, are also absent in the present modules of woodwork technology education graduates. The inability of woodwork technology education graduates to acquire the relevant entrepreneurial skills due to deficient curriculum has also led to the problem of poor growth and high incidence of business failure and unemployment in the area of study. All the technical skills and knowledge in woodwork technology education and other entrepreneurial skills in planning, managerial, marketing, personal and communication skills could be developed into modules for woodwork technology education graduates of colleges of education. This is because no module has been empirically developed for training entrepreneurial skills in woodwork technology in Nigeria. Therefore, there is need to develop entrepreneurial skills training module for self-employment of woodwork technology education graduates of colleges of education in Nigeria.

Research Questions

The following research questions were answered to achieve the general purposes:

1. What are the objectives suitable for the development of entrepreneurship skills training module for woodwork technology education graduates of colleges of education?
2. What are the contents of entrepreneurship skills training modules for woodwork technology education graduates of colleges of education?
3. What are the facilities for implementing entrepreneurship skills training modules for woodwork technology education graduates of colleges of education?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

Ho_1: There is no significant difference in the mean responses of woodwork technology education lecturers, students and woodwork workshops employers on the objectives suitable for the development of entrepreneurship skills training module for woodwork technology education graduates of colleges of education.

Ho_2: There is no significant difference in the mean responses of woodwork technology education lecturers, students and woodwork workshops employers on the contents of entrepreneurship skills training modules for woodwork technology education graduates of colleges of education.

Ho_3: There is no significant difference in the mean responses of woodwork technology education lecturers, students and woodwork workshops employers on the facilities for

implementing entrepreneurship skills training modules for woodwork technology education graduates of colleges of education.

Methodology

Research and Development (R & D) research design was adopted for the study. Gall and Borg (2020) described research and development as an industry-based development approach involving the use of research findings to design and develop new programmes and materials which assist in improving knowledge and skills. Therefore, Research and Development (R & D) research design was suitable for this study because it developed a new product which entrepreneurial skills training modules for woodwork technology education graduates of colleges of education.

The area of study was northwest states geo-political zone of Nigeria. The northwest states Nigeria consists of seven states are: Jigawa, Kaduna, Kano. Katsina, Kebbi, Sokoto and Zamfara. Northwest geo-political zone of Nigeria having fifteen colleges of education out of which six offering woodwork technology education programme. Northwest was chosen for study because, it was observed that graduates of woodwork technology education programme of colleges of education lack enough entrepreneurial skills which are useful for self-reliance in woodwork technology enterprises.

The population of the study was 273 subjects which consist of 45 woodwork technology education lecturers, 200 woodwork technology education students and 28 woodwork workshops employees. The six colleges of education conducted the study with their woodwork technology education lecturers and students' were: Federal College of Education (Technical) Bichi, Kano State, Federal College of Education (Technical) Gusau, Zamfara State, Federal College of Education, Gidan-Madi, Sokoto State, Kaduna State College of Education, Gidan-Waya Kafancan, Kaduna State, Isah Kaita College of Education, Dutsin-Ma, Katsina State and Sa'adatu Rimi College of Education, Kumbotso, Kano State all in northwest geopolitical zone of Nigeria. While, woodwork workshops employers used purposive sampling in the seven states of northwest Nigeria. There was no sampling for woodwork technology education lecturers and their students' because of the manageable size of population.

The instrument for data collection was Woodwork Technology Education Entrepreneurial Skills Training Modules Questionnaire (WTEESTMQ). WTEESTMQ was developed based on the specific purposes of the study. The items in the questionnaire were designed to provide data to answer the research questions and to test the null hypotheses. WTEESTMQ was divided into part 1 and 2. Part 1 solicited information on personal data of the respondents, while Part 2 with three sections A, B, and C solicited information on the objectives of entrepreneurial skills training modules for woodwork technology education graduates, contents of entrepreneurial skills training modules for woodwork technology education graduates and facilities for implementing entrepreneurial skills training modules for woodwork education graduates to develop the WTEESTMQ, the researcher formulated the objectives of entrepreneurial skills training modules and visited woodwork workshops employers, to identify various entrepreneurial skills and added information from literature to it in order to make the contents of the modules. The researcher also listed types of facilities and reviewed literature on possible instructional strategies and evaluation techniques for assessing the training modules.

The instrument was structured on a five point likert scale with response options, as follows:
Strongly Needed (SN) 5
Needed (N) 4

Undecided (U) 3
Not Needed (NN) 2

Strongly Not Needed (SNN) 1
The respondents were asked to respond to options on each item based on the development of entrepreneurial skills training modules for woodwork technology education graduates.

Entrepreneurial skills training modules questionnaire was subjected to face validation by three experts. The experts includes: one from Department of Industrial and Technology Education, School of Science and Technology Education, Federal University of Technology, Minna, Niger State, one from Department of Science and Technology Education, Faculty of Education, Bayero University, Kano, and remaining one from Sabi'u Isah Woodwork and Interior Decorations Company Limited, Gandun Albasa, Kano. The questionnaire was subjected to content validation through try-out to determine the appropriateness and structure of the skills items identified through the respondents. The title, the aim and objectives (purpose) of the study, the statement of research problem, the research questions and hypotheses were attached to the instrument to guide the experts. They were requested to reword the items as they consider appropriate, correct any mistakes such as ambiguous or unclear statements, wrong conceived ideas, missing information, irrelevant items and ascertain the adequacy of the items in the questionnaire for equipping woodwork technology education graduates with entrepreneurial skills training modules. Items in the WTEESTMQ were sequentially organized by the experts. They were also requested to review the items in terms of their clarity, relevance, appropriateness of language and instructions to the respondents. The experts were asked to include relevant items to the questionnaire. Their corrections and comments were used to modify the questionnaire. The final version of the instrument was structured based on their corrections.

Cronbach alpha reliability method was employed to determine the internal consistency of the questionnaire items. To determine this, 23 respondents; 8 woodwork technology education lecturers and 12 their students from Niger State College of Education, Minna and also, 3 woodwork workshops employers in the Minna metropolitan were involved. The researcher had chosen the Niger State which is outside the study area in order to get reliable coefficient for the instrument for data collection. Reliability coefficient value of 0.85 was yielded for objectives of entrepreneurial skills training modules, 0.83 for contents of entrepreneurial skills training modules, 0.82 for the facilities for implementing the entrepreneurial skills training modules, while 0.88 was yielded as the overall reliability coefficient value for the entire questionnaire items. Statistical Package for Social Sciences (SPSS) 25 version was employed to analyze the data collected from the respondents.

Two hundred and seventy three copies of the questionnaire were administered on the lecturers and students of woodwork technology education programme as well as woodwork workshops employers in northwest states of Nigeria with help of six Research Assistants (RAs). The research assistants (RAs) were instructed by the researcher on the procedures of administering copies of the questionnaire so as to ensure safe handling and running of the instrument. The research assistants were also briefed on how to approach the respondents and administer the questionnaire on them. Each of the research assistants was deployed to administer copies of the questionnaire on the respondents in their various locations while the researcher administer copies of the questionnaire on respondents in Kano State and also, supervised the research assistants while administering the questionnaire. After one week the researcher and research assistants went round to collect the administered copies of instrument for analysis. Out of 273

copies of questionnaire administered, 175 copies were retrieved back which represented 68.06% return rate.

The data collected for the study were analyzed using mean to answer the research questions while the Analysis of Variance (ANOVA) was employed for testing the null hypotheses at 0.05 level of significance. In taking decision on research questions, any item with a mean value of 3.50 or above was regarded as Needed (N) while any item with a value of less than 3.50 was regarded as Not Needed (NN). In taking decision on the hypotheses tested, the hypothesis of no significant difference was accepted for any item where the p-value is greater than 0.05 and rejected where the p-value is less than 0.05. All computations were done using Statistical Package for Social Sciences (SPSS) version 25.

Results

Table 1

Mean Responses of Respondents on the Objectives Suitable for the Entrepreneurial Skills Training Module Development for Woodwork Technology Education Graduates of Colleges of Education

S/NO.	Item Statements By the end of entrepreneurial skills training module, the graduates should be able to:	$\bar{X}$	SD	REMARK
1.	Acquire basic knowledge about entrepreneurial education to run their woodwork technology enterprises.	3.91	0.88	NEEDED
2.	List various types of entrepreneurial skills for running woodwork technology enterprises.	3.62	0.89	NEEDED
3.	Apply planning skills in woodwork technology enterprises.	4.11	0.89	NEEDED
4.	Employ various forms of technical skills to establish woodwork technology enterprises.	3.74	0.88	NEEDED
5.	Acquire various financial skills to set-up woodwork technology enterprises.	4.13	0.99	NEEDED
6.	Manage woodwork technology enterprises.	3.71	0.90	NEEDED
7.	Develop sound communication skills to promote woodwork technology enterprises.	3.85	0.94	NEEDED
8.	Develop adequate personal skills to promote woodwork technology enterprises.	4.05	0.91	NEEDED
9.	Recognize various types of tools and machines for effective running of woodwork technology enterprises.	4.04	0.86	NEEDED
10.	Select right tools and machines for various woodwork technology enterprises.	3.60	0.96	NEEDED
11.	List steps in establishing woodwork technology enterprises.	3.81	0.99	NEEDED
12.	List steps for marketing woodwork technology products and services.	3.74	1.00	NEEDED
	CLUSTER MEAN	3.99	0.97	NEEDED

Data in Table 1, research question 1 revealed that all the 12 items have their mean value ranged from 3.62 to 4.13. This shows that all the 12 objectives are suitable for the development of entrepreneurial skills training module for woodwork technology education graduates of colleges of education. The Table 1 also shows that the standard deviations of the items are

within the range of 1.00 this indicated that the mean values of the respondents were not far from one another in their responses.

Table 2

Mean Responses of Respondents on the Contents Suitable for the Entrepreneurial Skills Training Module Development for Woodwork Technology Education Graduates of Colleges of Education

S/NO.	Contents	$\bar{X}$	SD	REMARKS
A.	Planning Contents in Woodwork Technology			
1.	Objectives of the woodwork technology enterprises.	4.08	0.95	NEEDED
2.	Establishing plans for woodwork technology enterprises.	3.71	0.92	NEEDED
3.	Locations for the woodwork technology enterprises.	3.90	0.98	NEEDED
4.	Budgets for woodwork technology enterprises.	3.98	0.97	NEEDED
5.	Sources of finance for setting-up woodwork technology enterprises.	4.03	0.96	NEEDED
6.	Tools and machines/equipment to take off the woodwork construction enterprises.	3.73	0.99	NEEDED
7.	Consumables for the woodwork construction enterprises.	4.02	0.97	NEEDED
8.	Rules and regulations for the operation of the woodwork construction enterprises.	3.90	0.99	NEEDED
9.	Levels of manpower needed for woodwork technology enterprises.	3.94	1.00	NEEDED
10.	Woodwork technology enterprises opportunities in the society.	3.99	0.96	NEEDED
11.	Feasibility studies prior to woodwork technology enterprises.	3.99	0.96	NEEDED
12.	Reports before actual commencement of the enterprise in order to assess viability of intended enterprises.	3.82	0.96	NEEDED
13.	Needed skills, abilities and attitudes required to intended enterprise through training.	4.01	0.99	NEEDED
14.	Procurement of appropriate facilities for woodwork technology enterprises.	4.03	1.00	NEEDED
15.	Various basic steps involved in starting a business.	3.81	0.99	NEEDED
16.	Procedures for achieving the specific objectives of the woodwork construction enterprises.	3.99	0.96	NEEDED
17.	Develop business plan for the woodwork technology enterprises.	3.73	0.99	NEEDED
18.	Negotiations with customers/clients, labour, suppliers of materials, financiers and banks.	3.70	0.96	NEEDED
B.	Technical Contents in Woodwork Technology			
19.	Setting-up plans for customers.	4.11	1.00	NEEDED
20.	Classifying the wood into hardwood and softwood.	3.81	0.95	NEEDED

21.	State the process of manufacturing board.	3.91	0.96	NEEDED
22.	State the technical names for marketing wood.	3.79	1.00	NEEDED
23.	Identification of both properties of timber and its characteristics.	4.09	0.88	NEEDED
24.	Identification of types of wood preservatives.	3.71	1.42	NEEDED
25.	Identification wood defects for both natural and artificial defects.	3.84	0.92	NEEDED
26.	Treat wood with relevant preservatives.	4.07	0.88	NEEDED
27.	Sharpen saws and other cutting tools.	3.75	0.93	NEEDED
28.	Produce detailed drawing and transfer to a full size setup.	3.27	0.99	NOT NEEDED
29.	Read and interpret drawings to determine materials required for wood construction.	3.71	0.94	NEEDED
30.	Design based on elements and principles of design.	3.72	0.90	NEEDED
31.	Mix pigments, oil and other ingredients to obtain the required colour.	3.92	1.15	NEEDED
32.	Select appropriate tools, materials, process and products.	3.80	1.01	NEEDED
33.	Design and construct simple living room furniture with emphasis on skills dispositions on good finishing and maintenance.	3.74	0.93	NEEDED
34.	Finish or refinish damaged, worn, used or renew furniture for high degree using specified colour.	3.60	1.06	NEEDED
35.	Utilize knowledge and wood properties, finishes and furniture styles.	3.80	1.02	NEEDED
36.	Connect electrical portable sander and control operation.	3.64	1.25	NEEDED
37.	Select types of gauge and different sizes of screws and the correct drill to use.	3.71	1.27	NEEDED
38.	Carry out veneer work for decorative values.	3.60	0.95	NEEDED
C.	Marketing Contents Woodwork Technology			
39.	Marketing opportunities in woodwork technology.	3.90	1.22	NEEDED
40.	Client's/customers needs and devising best the needs would be met.	3.82	0.85	NEEDED
41.	Analysis of marketing opportunities in woodwork technology.	3.74	0.96	NEEDED
42.	Various aspects of sales and sales techniques.	3.79	1.12	NEEDED
43.	Good marketing strategies to customers about products or services.	3.85	1.05	NEEDED
44.	E-marketing of woodwork construction products and services.	3.68	1.07	NEEDED
45.	Marketing of woodwork construction products or services through social media.	3.98	0.96	NEEDED
46.	Linkages with other business personals and stakeholders.	3.96	0.88	NEEDED
47.	Attention of the customers about the woodwork construction products.	3.78	0.93	NEEDED

48.	Retention of attention of the woodwork construction customers through marketing strategies.	4.00	0.94	NEEDED
49.	Market opportunities in the woodwork construction business location.	3.77	0.84	NEEDED
50.	Market opportunities in business location.	4.00	1.02	NEEDED
51.	Effective sales habits for woodwork construction products.	3.88	0.89	NEEDED
52.	Specific market to be served with woodwork construction products.	4.07	1.07	NEEDED
53.	Rebranding of woodwork construction products to attract customer attention.	3.90	0.83	NEEDED
54.	Advertise woodwork construction products using various strategies.	3.85	0.91	NEEDED
55.	Appropriate use of records and inventories after sale.	3.78	1.34	NEEDED
56.	Right decision on marketing mix.	3.66	1.22	NEEDED
57.	Promotion of woodwork construction products.	3.36	1.01	,NOT NEEDED
58.	Right marketing strategies for selling woodwork construction products.	3.92	1.05	NEEDED
59.	Marketing research development in products woodwork construction enterprises.	3.75	0.97	NEEDED
60.	Market survey to determine the customers' needs and satisfaction.	3.85	0.88	NEEDED
61.	The concept of marketing for woodwork construction products.	3.85	0.88	NEEDED
62.	Forecasting and analysis of sales of woodwork construction products.	3.74	0.89	NEEDED
63.	Customers' woodwork needs.	3.60	0.85	NEEDED
64.	Service to meet customers woodwork needs.	3.92	0.94	NEEDED
65.	The target market for sale of woodwork construction products and services.	3.65	0.88	NEEDED
66.	Sale promotion to motivate customers on woodwork construction products.	4.06	0.85	NEEDED
67.	Products and services of woodwork construction enterprises to customers in remote areas.	3.73	0.83	NEEDED
68.	Factors and strength of competition.	4.04	0.89	NEEDED
69.	Interpretation of factors and strength of competition.	3.96	0.85	NEEDED
70.	Market information about current market prices.			NEEDED
71.	Products for sale through appropriate media.	3.84	0.87	NEEDED
D.	Managerial Contents in Woodwork Technology			
72.	Business goals setting.	4.00	0.99	NEEDED
73.	Resource for goal attainment.	3.86	0.93	NEEDED
74.	Implementation of plan for goal attainment.	3.63	0.88	NEEDED

75.	Environment that support organization change.	3.72	0.91	NEEDED
76.	Business plan with strategies planning tools.	3.85	0.91	NEEDED
77.	Creation of conducive environment for both employees and customers.	3.88	1.14	NEEDED
78.	Explanation of budget to accomplish organization programme.	3.95	1.08	NEEDED
79.	Interpretation of budget to accomplish organization programme.	3.84	1.11	NEEDED
80.	Implementation of organizational budgets to accomplish organization programme.	3.93	1.10	NEEDED
81.	Organizational budgets to accomplish organization programme.	4.06	1.11	NEEDED
82.	Fostering relationship among members of the woodwork technology enterprises.	3.00	1.06	NOT NEEDED
83.	Creation of a favorable environment in which team members are willing to share ideas.	3.83	1.15	NEEDED
84.	Think creativity and critically in decision making.	3.99	1.06	NEEDED
85.	Tasks/responsibities to subordinates in woodwork construction enterprises.	3.83	1.15	NEEDED
86.	Coordination of activities or events in the woodwork construction enterprises.	3.83	1.15	NEEDED
87.	Appraisal of woodwork technology employees' performance.	3.90	1.17	NEEDED
88.	Set a channel for effective feedback from customers.	3.84	1.13	NEEDED
89.	Timely completion of woodwork projects.	3.74	1.07	NEEDED
90.	Managing time and meet schedules.	3.99	1.02	NEEDED
91.	Woodwork construction job schedule always.	3.98	0.99	NEEDED
92.	Handling of difficult customers with patience and care.	3.98	0.99	NEEDED
93.	Developing of organization policies.	3.71	0.90	NEEDED
94.	Long term vision and mission for woodwork construction enterprises.	3.80	0.90	NEEDED
95.	Open door policy for enterprise.	3.90	0.90	NEEDED
96.	Control, direct and delegate authority to others.	3.70	0.91	NEEDED
97.	Organizing human resources for goals attainment.	3.73	0.94	NEEDED
98.	Organizing material resources for goal attainment.	4.03	1.03	NEEDED
99.	Maintaining authority in dispensation of leadership.	3.82	1.12	NEEDED
100.	Need for employees growth and development.	3.77	0.97	NEEDED
101.	Evaluation of all activities/operations in the process of goal attainment.	3.77	0.97	NEEDED
E.	Personal Contents in Woodwork Technology			
102.	Difficulties in the process of nurturing the enterprises.	3.79	0.94	NEEDED

103.	Risk in the enterprise.	3.15	0.98	NEEDED
104.	Performance of employees.	3.75	0.98	NEEDED
105.	Leading others properly towards goal attainment.	3.90	1.04	NEEDED
106.	Adapting to new changes as technology and society is dynamic.	4.03	0.99	NEEDED
107.	Facilities available for woodwork construction enterprises.	3.93	1.11	NEEDED
108.	Sympathy for customers in terms of damages or losses.	3.97	1.10	NEEDED
109.	Perceive or identifying enterprise or new business opportunities and being innovative and creative.	3.94	1.09	NEEDED
110.	Foster good human relationship both outside and within the firm.	3.85	1.88	NEEDED
111.	Being interest in work and workers of the enterprise.	3.19	1.17	NEEDED
112.	Being focus driven externally.	3.94	1.00	NEEDED
113.	Sense of responsibility.	4.07	1.01	NEEDED
114.	Causes of failure of similar businesses.	3.74	1.03	NEEDED
115.	Self-control and disciplined in the discharge of duty.	3.95	1.02	NEEDED
F.	Communication Contents in Woodwork Technology			
116.	Communicating to customers in a polite manner.	4.03	0.99	NEEDED
117.	Explaining to customers what their jobs or products entail.	3.83	1.03	NEEDED
118.	Listen to people and identify barriers to listening.	3.65	1.13	NEEDED
119.	Conducting quality oral presentation.	3.83	1.03	NEEDED
120.	Reading wide range of publications.	3.29	1.15	NOT NEEDED
121.	Comprehending wide range of publications.	3.83	1.13	NEEDED
122.	Differences of opinions of customers about products.	3.73	1.00	NEEDED
123.	Audiences/customers point of view.	4.03	1.04	NEEDED
124.	Provides specific details supported by carpentry constructions as example.	3.96	1.13	NEEDED
125.	Fit and fix in doors; windows and architraves.	3.98	1.00	NEEDED
126.	Set-out the construct straight flight stairs.	4.07	1.02	NEEDED
127.	Erect a free standing flight stairs.	4.03	1.04	NEEDED
128.	Ability to frame, nogging for ceiling, wall and the spacing required suiting various materials.	3.99	1.04	NEEDED
129.	Locate and construct building geometry (roof, center of arch, beams and others).	4.07	1.02	NEEDED
130.	Ability to set-out a small building using timber.	4.03	1.04	NEEDED
131.	Timbering for trenches and construct formwork.	3.99	1.04	NEEDED

132.	Ability to set-out varanda using timber.	3.91	1.15	NEEDED
133.	Ability to locate and construct timber floor.	4.03	0.98	NEEDED
G.	Financial Content in Woodwork Technology			
134.	Developing strong financial knowledge requiring keen understanding of finance and the economy.	4.07	1.18	NEEDED
135.	Anticipate financial needs of the enterprise and where the most is cost effective and beneficial source to obtain it from.	3.83	0.97	NEEDED
136.	Budgets for the woodwork construction enterprise.	3.72	1.00	NEEDED
137.	Business plan, a cash flow forecast and projected profit and loss account for the woodwork construction enterprise.	3.83	0.93	NEEDED
138.	Familiarity with "Periods for Finance Business" (Short-Medium Borrowing), features and processes involved.	3.83	0.93	NEEDED
139.	Banking operations in a particular community efficiently for the benefit of the woodwork construction enterprises to flourish.	3.78	0.96	NEEDED
140.	Operational timetable, starting-up/running cost aid required for obtaining take-off/conventional loan for the woodwork construction business.	3.61	0.94	NEEDED
141.	Demonstration of prudence in money management for success of woodwork construction enterprises.	3.81	0.94	NEEDED
142.	Financial integrity of the woodwork technology enterprise.	3.68	0.99	NEEDED
143.	Numerical expressions or numbers and explain financial position.	4.05	0.92	NEEDED
144.	Interpretation of financial statements for the woodwork technology accuracy.	3.72	0.90	NEEDED
145	Preparation of financial statements for woodwork enterprises.	3.72	0.90	NEEDED
146.	Preparation and interpretation of payroll and various deductions.	3.81	0.87	NEEDED
147.	Keep record of property owned, debts owned and money invested by the woodwork technology enterprise.	3.85	0.95	NEEDED
148.	Provision of financial information to the administrators for use in preparing financial statement of the enterprise.	3.73	0.89	NEEDED
149.	Profit and loss accounts of the technology enterprise.	4.06	0.88	NEEDED
150.	Good filing system so that financial documents are kept safely and methodically.	3.92	0.93	NEEDED
151.	Information and Communication Technology (ICT) for online business transactions and general communication through the internet.	3.73	0.89	NEEDED

152.	Auditing of finances and resources.	4.06	0.88	NEEDED
153.	Balance sheet for business financial transaction.	3.92	0.93	NEEDED
154.	Financial decision.	3.96	0.91	NEEDED
155.	Cost analysis and allocation of cost to item and projects.	4.06	0.90	NEEDED
156.	Business strategies for profit making in woodwork construction enterprises.	3.99	0.90	NEEDED
157.	Prepare records of all transactions about woodwork construction enterprises.	3.76	0.90	NEEDED
	Cluster Mean	3.99	0.98	NEEDED

Data in Table 2, research question two revealed that all the 151 items out of 157 have mean ranged from 3.62 to 4.11. This shows that the mean value of each item was above the cut-off point of 3.50, indicating that 151 items could be used as contents for the development of entrepreneurial skills training modules. The Table 2 also shows that the standard deviations of the items are within the range of 0.82 to 1.10; this indicated that mean values of the respondents were not far from one another in their responses.

Table 3

Mean Responses of the Respondents on the Facilities for Implementing Entrepreneurial Skills Training Module for Woodwork Technology Education Graduates of Colleges of Education

S/NO.	Item Statements	$\overline{X}$	SD	REMARK
1.	Tape Measure	3.75	0.97	NEEDED
2.	Ruler	3.85	0.88	NEEDED
3.	Sliding T Bevel	3.71	0.89	NEEDED
4.	Calipers	3.69	0.96	NEEDED
5.	Try Square	3.75	0.97	NEEDED
6.	Combination Square	3.68	0.87	NEEDED
7.	Marking Gauge/Mortise Gauge	3.90	0.91	NEEDED
8.	Steel Square	3.75	0.89	NEEDED
9.	Protractor	3.73	0.94	NEEDED
10.	Spirit Level	3.84	0.84	NEEDED
11.	Mortise Meter	3.90	0.81	NEEDED
12.	Saws	3.63	0.75	NEEDED
13.	Chisels	3.90	0.88	NEEDED
14.	Planes	3.82	0.82	NEEDED
15.	Handsaw	4.10	0.94	NEEDED
16.	Jigsaw Machine	3.81	0.74	NEEDED
17.	Circular Saw Machine	3.75	0.79	NEEDED
18.	Router	4.09	0.82	NEEDED
19.	Bandsaw Machine	3.62	0.86	NEEDED
20.	Surface Planing Machine	3.72	0.80	NEEDED
21.	Radial Arm Machine	3.82	0.90	NEEDED
22.	Sanding Machine	3.74	0.85	NEEDED
23.	Jointing Machine	4.09	0.83	NEEDED
24.	Hammer	3.84	0.98	NEEDED
25.	Mallet	4.03	0.93	NEEDED
26.	Pincers	3.96	0.98	NEEDED

27.	Braces	4.11	1.02	NEEDED
28.	G-Cramp	4.07	0.99	NEEDED
29.	Sash Cramp	4.06	0.95	NEEDED
30.	Lathe Machine	4.10	0.98	NEEDED
31.	Mortising Machine	4.19	0.94	NEEDED
32.	Sewing Machine	4.18	0.95	NEEDED
33.	Stuffing Regulator	3.97	1.07	NEEDED
34.	Mattress Needle	4.08	1.08	NEEDED
35.	Skewers	3.74	0.98	NEEDED
36.	Sharp Knife	3.62	0.99	NEEDED
37.	Upholstery Hammer	3.91	1.01	NEEDED
38.	Tack Lifter	3.87	0.85	NEEDED
39.	Webbing Stretcher	3.75	0.87	NEEDED
40.	Small Pointed Scissors	3.86	0.98	NEEDED
41.	Upholsterer's Shears	3.96	0.84	NEEDED
	Cluster Mean	3.97	0.87	NEEDED

Data in Table 3 revealed that all the 41 items have their mean value ranged from 3.62 to 4.10. This shows that the mean value of each item was above the cut-off point of 3.50, indicating that all items are required for implementing the entrepreneurial skills training module. The Table 3 also shows the standard deviations of the items are within the range of 0.75 to 1.02, this indicated that the mean values of the respondents were not far from one another in their responses.

Testing Hypotheses

Table 4

Analysis of Variance (ANOVA) of the Mean Responses of Respondents on the Objectives Suitable for the Development of Entrepreneurial Skills Training Module

Sources of Variance	Sum of Squares	Df	Mean Square	F-Cal	Pattern Value	Level of Sig.	Remark
Between Groups	1.496	2	0.748	1.011	0.366	0.05	No Sig.
Within Groups	1.64969	223	0.740				
Total	1.66465	225					

Data presented in Table 4 showed that objectives of entrepreneurial skills training modules had p-value of 0.366 and was greater than 0.05 at degree of freedom 2 and 223. This indicated that there was no significant difference between the mean responses of woodwork technology education lecturers, woodwork technology education students and woodwork workshops employers on the objectives suitable for the development of entrepreneurial skills training module for woodwork technology education graduates of colleges of education.

The objectives of the entrepreneurial skills training module had their p-values ranged from 0.152 to 0.965 and were greater than 0.05. This indicated that there was no significant difference between the mean responses of woodwork technology education lecturers, woodwork technology education students and woodwork workshops employers on the objectives suitable for the development of entrepreneurial skills training module for woodwork technology education graduates of colleges of education.

Table 5

Analysis of Variance (ANOVA) of the Mean Responses of Respondents on the Contents of Entrepreneurial Skills Training Module

Sources of Variance	Sum of Squares	Df	Mean Square	F-Cal	F-Tap Pattern Value	Level of Sig.	Remark
Between Groups	1.570	2	0.785	0.561	3.00 0.572	0.05	No Sig.
Within Groups	312.151	223	31.400				
Total	313.721	225					

Data presented in Table 5 showed that contents of entrepreneurial skills training modules had p-value of 0.572 and was greater than 0.05 at degree of freedom 2 and 223. This indicated that there was no significant difference between the mean responses of woodwork technology industries on contents of entrepreneurial skills training modules for woodwork technology education graduates of colleges of education.

The contents of entrepreneurial skills training modules had 157 items out of which 151 had their p-values ranged from 0.007 to 0.044. This indicated that there was significant difference between the mean responses of woodwork technology education lecturers, woodwork technology education students and woodwork workshops employers on 152 contents of entrepreneurial skills training modules and that there was a significant difference in the mean responses of the respondents on five contents required for the development of entrepreneurial skills training modules for woodwork technology education graduates. Therefore, the null hypothesis of no significant difference was upheld for the five items. In order to know the direction of significant, post hoc was conducted for three items 16, 21, 22, 132, and 138 and found the direction of significant was in direction of significant was in between the woodwork technology education students and their lecturers for items 16, 22 and 138 woodwork workshops employers and woodwork technology education lecturers for item 21.

Table 6
Analysis of Variance (ANOVA) of the Mean Responses of Respondents on the Facilities for Implementing the Entrepreneurial Skills Training Module

Sources of Variance	Sum of Squares	Df	Mean Square	F	F-Tab	P-value	Level of Sig.	Remarks
Between Groups	1.275	2	0.638	0.710	3.00	0.493	0.05	No Sig.
Within Groups	200.176	223	0.898					
Total	201.451	225						

Data presented in Table 6 showed that facilities for implementing entrepreneurial skills training modules had p-value of 0.493 and was greater than 0.05 at degree of freedom 2 and 223. This indicated that there was no significant difference between the mean responses of woodwork technology education lecturers, their students and woodwork workshops employers on the facilities for implementing the entrepreneurial skills training modules.
The facilities had their p-values ranged from 0.493 and were no significant difference between the mean responses of woodwork technology education lecturers and their students as well as woodwork workshops employers on the facilities for implementing the entrepreneurial skills training modules. Therefore, the null hypothesis of no significant difference was upheld for all the 41 facilities.

Discussion of Findings

The findings of the study revealed a total of 12 objectives for the development of entrepreneurial skills training modules and prominent among the objectives; acquire basic knowledge about entrepreneurial education to run their woodwork technology enterprises, list different types of entrepreneurial skills for running woodwork technology enterprises, apply planning skills in woodwork technology enterprises, employ various financial skills to setup woodwork technology enterprises, develop sound communication skills to promote woodwork technology enterprises, develop adequate personal skills for enhancing woodwork technology enterprises and recognize various types of tools and machines for smooth running the woodwork technology enterprises. The findings were in agreement with opinion of Sheen (2022) that behavioral/performance objectives are the best for the study carried out to individuals with skills, knowledge and attitudes. Objectives of a programme serve as guide for the implementation of a training programme. It directs teachers and students on what to study, the types of skills, knowledge to acquire most especially when it is stated in action words. Orlich (2021) explained that action words such as do, solve, repair, service, develop, dismantle among others are used in setting behavioral/performance objectives for capacity building programme. In addition, Mager (2022) reported that performance objectives are very precise statement of what a teacher expect the students to do; and should consists of three elements namely, statement of observable behavior or performance on the part of student descriptions of the condition under which student behavior is to occur and prescription of a minimally acceptable level of performance or criteria on the part of student.

It was found that 151 contents are suitable for development of professional skills retraining programme and some of the contents identified are facilitate auditing of finances and resources, utilize balance sheet for business financial transaction, develop strong financial knowledge requiring keen understanding of finance and the economy, anticipate financial needs of the enterprise and where the most is cost effective and beneficial source to obtain it from, prepare simple budgets for the woodwork construction enterprise, accept feedback and response as appropriate, write legible proposals, communicate the organization vision and mission to others, judge performance of employees, lead others properly towards goal attainment, adapt to new changes as technology and society is dynamic, organize human resources for goals attainment, organize material resources for goals attainment, maintain authority in dispensation of leadership, implement plan for goal attainment, create an environment that support organization change, develop business plan with strategies planning tools, conduct market survey to determine customers' needs and satisfaction, understand the concept of marketing for woodwork construction products, retain attention of the woodwork construction customers through marketing strategies, identify market opportunities in the woodwork construction business location. Content is the list of skills or knowledge required by teachers or trainers for effective teaching or training to take place. The findings of the study are in agreement with the findings of Onah (2023) who developed a digital empowerment programme for students on e-learning in the universities in southeast, Nigeria and found knowledge on e-learning, forum skills, lesson skills, resources skills, glossary skills, choice skills, quizze skills, survey skills, chat skills, wiki skills and assignment skills as suitable contents for digital empowerment programme. Also the findings of the study agreed with the findings of Ogunmilade (2021) who developed and validated a professional development programme for retraining auto mechanics teachers in technical colleges in Lagos State and found teachers of technical colleges need constant retraining for effective implementation of various trades. The finding was in agreement with opinion of Kapoma and Namusokwe (2021) that content is the main must be covered in a programme. Balitu (2022) viewed content as the knowledge, skills, concept,

principles, attitudes and values to be learned. Nwoyi, (2021) stated that content are various issues, topics or questions dealt with in class, teaching, speech, discussion or a piece of writing. The findings of the study reveal 41 facilities for implementing entrepreneurial skills training modules: saws, hammers, planes, gauges (marking and mortise), circular saw machine, surface planning machine and bandsaw machine. The findings agreed with the opinion of Robert (2022) who stated that facilities help trainers to translate abstract ideas to concentrate ideas. Ubong and Wokocha (2020) stated that fire extinguishers, oil spill collectors, rags and pliers for holding small objects are quite useful during maintenance work. According to National Board for Technical Education (NBTE, 2022) Annual Reports for 2022/2023, to achieve the solution to shortage technical personnel in Nigeria, there must massive investment in facilities in the technical institutions, thereby keeping pace with national demands to school environment. The findings agreed with the findings of Bakare (2021) that carried out a study on development of entrepreneurial skills. The findings also were in agreement with the findings of Bakare (2020) who developed and validated cell phone maintenance training modules for national diploma students and found set of screwdrivers, writing pads, and pens, table and chairs, projector with white screen, laptops with relevant features, technical technical textbooks among others as part of the facilities for implementing training programme. The findings also is consonance with the opinion of Ogbodo (2023) that training facilities are the things that facilitate teaching and learning process in schools and include all types of building, teaching aids and devices such as modern educational hardware and their software in the form of magnetic tapes, films and transparencies.

Conclusions

Woodwork technology is the one of training programmes in curriculum of colleges of education where students are expected to acquire relevant knowledge, skills and attitudes for paid or self employment after graduation. The graduates of this programme are saddled with major responsibilities of teaching related subjects or trades in secondary schools and also practice what they have learnt. Most of the graduates of woodwork technology education are found in secondary schools implementing relevant school subjects but few of them involved themselves in any enterprise within woodwork technology due to the little or entrepreneurial skills acquired while in schools. This study was than conducted to develop and validate entrepreneurial skills training module for woodwork technology education graduates for colleges of education; suitable objectives and contents were determined for the development of the module. Relevant instructional training facilities were also considered for assessing the entrepreneurial skills training module.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Government should make use of the developed entrepreneurial skills training module in woodwork technology to retrain the graduates especially on the objectives of the module.
2. All the training contents identified should be used by trainers/trainees for implementing entrepreneurial skills training module.
3. Trainers/trainees should make use of the identified facilities for implementing entrepreneurial skills training module.

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EMERGING TECHNOLOGIES FOR ENHANCING THE TEACHING OF TVET GRADUATE OF TECHNICAL EDUCATION AT NIGERIA CERTIFICATE IN EDUCATION IN NORTH CENTRAL, NIGERIA

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Abstract
This study identified Emerging Technologies for enhancing the teaching of TVET Graduates of technical education at the Nigerian Certificate in Education (Technical) level. Two research questions and two research hypotheses were formulated to guide the study at 0.05 level of significance. The study used post- test only type of quasi experimental research design. Two hundred and eighty students of 200 level NCE (Technical) programme were used as respondents in the study from six institutions in the North-central geo-political zone of Nigeria. One hundred and forty students each were assigned to the control and experimenta1 groups respectively. Control and the experimental groups were taught using the lecture method and Emerging Technology package methods respectively and administered with Technical Education Achievement Test (TEAT) in a post-test. The data from the post-test were analyzed using the mean and standard deviation to answer the two research questions and t-test statistics was used to test the two hypotheses in the study. The study found that the subjects in the experimental group performed better than their counterparts in the control group in the post- test with mean score of 23.76. The subjects in Federal Colleges of Education performed better than those in the State Colleges of Education. The study also found significant differences in the performances of the control and the experimental group and between those in the Federal-owned and State- owned institutions. Some recommendations made in the study include Colleges of Educations offering NCE (Technical) programme should have well equipped computer centers and emerging technology tools for teaching and learning technical education.

Keywords: Emerging Technologies, Education, Enhancing, Teaching, TVET Graduates, Technical Education.

Introduction

The evolution of technology has profoundly influenced nearly every sector of society, with education being one of the most affected. In technical education, where the practical application of skills is critical, emerging technologies have created new avenues for improving teaching and learning. The rise of digital tools, artificial intelligence (AI), virtual and augmented reality (VR/AR), and other cutting-edge innovations has revolutionized the traditional classroom environment, making it more interactive, personalized, and accessible. These technological advancements offer promising solutions to the longstanding challenges faced by technical education, such as the need for hands-on learning, the demand for real-world application, and the ability to keep pace with rapidly evolving industries. One of the most transformative emerging technologies in technical education is the integration of AI-powered systems. These systems can provide personalized learning experiences, ensuring that students receive targeted feedback based on their individual learning needs. According to Liu et al. (2020), AI has the potential to analyze student performance data and generate insights that allow educators to

tailor instruction to the specific needs of each learner. In technical fields, where the mastery of complex skills is often required, this level of customization can enhance student understanding and retention of information. Furthermore, AI-powered simulations can recreate real-world technical scenarios, enabling students to practice and refine their skills in a controlled and risk-free environment.

Similarly, virtual and augmented reality technologies are proving to be valuable tools for technical education. VR/AR creates immersive learning environments where students can interact with three-dimensional models of machines, tools, or even entire workshops, without being physically present. This technology can be especially useful in technical and vocational education and training (TVET), where access to costly machinery or specialized environments may be limited. A study by Prensky (2018) highlights the growing use of VR/AR in technical education as a way to replicate real-world conditions, providing students with practical experience that is as close to reality as possible. By immersing students in these virtual environments, educators can bridge the gap between theory and practice, preparing students for the challenges they will face in the workplace. Another major trend in the enhancement of technical education is the use of digital collaboration tools and learning management systems (LMS). These platforms have expanded the scope of learning beyond the classroom, offering students the flexibility to access educational content, participate in group projects, and interact with instructors from any location. As industries become more globalized, the ability to work collaboratively across geographical boundaries has become an essential skill. Technical education institutions are increasingly leveraging these tools to develop collaborative learning environments that mirror the interconnected nature of the modern workplace. According to Johnson et al. (2019), the use of LMS platforms has increased student engagement and improved communication between instructors and students, fostering a more inclusive and dynamic learning experience.

The impact of these emerging technologies is not limited to the student experience; they also benefit educators by providing new methods for delivering instruction. Digital tools such as interactive whiteboards, cloud-based applications, and video conferencing software enable teachers to create more engaging and flexible lesson plans. Additionally, these tools allow for real-time assessments, enabling educators to adjust their teaching methods based on immediate feedback from students. This adaptability is crucial in technical education, where students must quickly apply theoretical knowledge to practical situations. According to Kundu and Bej (2021), teachers who integrate digital tools into their teaching strategies report increased student motivation and improved learning outcomes, particularly in technical disciplines where active engagement is essential.

The rapid advancements in technology, computerization, and digitalization have led to the development and implementation of various instructional methods to address teaching and learning challenges in developed countries. However, in Nigeria, these innovative approaches are not yet fully integrated into most educational institutions. Computers offer solutions to instructional challenges and can significantly improve the quality of education across all schools. This is an area where promising technological and educational developments are currently emerging (Kundu and Bej, 2021). Research indicates that Information and Communication Technology (ICT) has the potential to transform teaching and is particularly valuable in supporting student-centered approaches to instruction, fostering higher-order skills, and facilitating collaborative activities (Prensky, 2018). Recognizing the significance of emerging technology in education, many countries worldwide have implemented ICT teacher training programs in various forms. Numerous efforts have been made to equip teachers with

the necessary skills to effectively utilize emerging technology as a tool for enhancing teaching and learning (Uko & Ebute, 2013). The focus of this study is on the continued challenges faced in the teaching and learning of technical subjects due to an overreliance on traditional lecture methods. It is imperative for technical education teachers to explore alternative means of imparting knowledge and skills to learners by leveraging modern technologies.

Statement of the Problem

The teaching of technical education faces significant challenges in ensuring that students acquire the necessary practical skills and competencies needed to thrive in today's rapidly evolving industries. Traditional teaching methods, which rely heavily on theoretical instruction and limited hands-on experience, often fall short of preparing students for real-world technical demands. Additionally, many technical education institutions lack the resources to provide students with access to modern, expensive equipment and tools, which further hinders the development of critical practical skills. In light of these challenges, emerging technologies such as artificial intelligence (AI), virtual and augmented reality (VR/AR), and digital learning tools have the potential to revolutionize the teaching of technical education by offering new ways to deliver interactive, personalized, and practice-oriented learning experiences Prensky (2018). However, despite the promising potential of these technologies, their integration into technical education remains inconsistent and underexplored, especially in developing regions. There is a need to critically assess how emerging technologies can be effectively utilized to enhance the teaching of technical education and address the gaps in traditional approaches.

The problem, therefore, lies in the underutilization and inadequate integration of emerging technologies in technical education, which limits the ability of educators to provide students with the skills and competencies needed to excel in the modern workforce (Johnson et al, 2019). This research seeks to explore the role of these technologies in enhancing technical education and to identify the challenges and opportunities associated with their adoption. Miller and Joshua, (2017) opined that the Nigerian government, as well as individuals and organizations, place significant emphasis on the teaching and learning of technical education courses, particularly at the NCE (Technical) level. However, despite this emphasis, the objectives of scientific and technological education have not been fully realized due to issues with teaching methodologies at colleges of education and other tertiary institutions in Nigeria. The current methods of instruction have led to ineffective teaching, poor academic performance by students, low learning rates, retention issues, and subpar job performance. This has made it challenging to achieve the scientific and technological objectives of the country. As a result, there is a pressing need to explore modern and appropriate alternatives to traditional teaching methods.

Purpose of the Study

The main purpose of this study is to identify the Emerging Technologies for enhancing the teaching of TVET Graduates of technical education at the Nigerian Certificate in Education (Technical) level. Specifically, the study sought to:

1. Compare the academic performance of the students taught with the two methods of instruction (Emerging Technologies and lecture method).
2. Compare the academic performance of the students taught with the Emerging Technologies Tool in either Federal/State Government institution.

Research Questions

The study attempts to answer the following questions:

What is the academic performance of students taught with the two methods of instruction (Emerging Technologies and lecture method)?

2. What is the academic performance of students in Federal and State Colleges of Education that are taught with emerging technologies tools?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

Ho1: There is no significant difference in the mean performances of students taught with emerging technologies tools and those taught with the traditional lecture method.

HO2: There is no significant difference in the mean performances of students in Federal and State Colleges of Education that are taught with emerging technologies tools.

Research Design

Post-Test only quasi experimental research design was used for the study. Yusuf, (2013) described Post-Test quasi experimental design as the Ex- Post Facto research design which requires two assigned groups of subjects, each assigned to different conditions and utilizes post-test only without any pre-test to generate data for the study. The researchers compare the data of the subjects that experience the treatment and those that did not experience the treatment and establish the cause of the difference between the groups in the study.

Area of Study

This study was carried out in the Colleges of Education that offer Technical Education at NCE (Technical) level in the North-Central geo-political zone of the country. These institutions include College of Education, Minna, Niger state; College of Education, Ankpa , Kogi State; College of Education, Katsina Ala, Benue State; College of Education, Akwanga, Nasarawa State, Federal College of Education, Pankshin, Plateau State and College of Education (Technical) Lafiagi, Kwara State.

Population and sample of the Study

The population for the study consisted of all the 200 level students of NCE (Technical) programme in all the institutions in the North-Central Geo-political zone of the country. T Stratified random sampling technique was used to generate 280 subjects from the classes of the participating institutions for both the experimental and control groups to represent the entire population of the study.

Validation of the Research Instrument

The developed Research Instrument (TEAT) was subjected to face and content validation by three (3) Technology lecturers each from the six (6) participating institutions using a 46-item researcher developed test instrument. All observations and suggestions were noted and corrected to prepare the final draft of the package used for the study.

The Reliability of the Research Instrument

The scores of the students' performance in both the control and experimental groups in the pilot study were used to establish the reliability of the test instrument (TEAT) using Pearson's product moment correlation coefficient to determine the reliability coefficient. The reliability (r) values obtained were 0.97 and 0.98 for the control and experimental groups respectively.

Methods of Data Collection

The research instrument (TEAT) was researcher-made achievement test consisting of 46-items objective test was administered to both the experimental and control groups for the study.

Methods of Data Analysis

Data collected from both the experimental and control groups in the post test were analyzed using Mean, Standard deviation and t-test Statistical tool. The data were analyzed to answer the research questions and test the hypotheses at 0.05 level of significance. Data used in the study were analyzed using Statistical Package for Social Sciences (SPSS) software.

Results

Research Question One

What is the academic performance of students taught with the two methods of instruction Emerging Technologies and lecture method? The analysis required to answer this research question are presented in table 1.

Table 1: Mean Score and Standard Deviation of Control and Experimental group In Post-Test

	TEAT		
Groups	No. of Subjects	Mean	Standard Deviation
Control	140	18.06	3.80
Experimental	140	23.76	5.36
Total	280	41.82	9.16

The result presented on table I shows that, the mean scores of students performance in TEAT by the control group had a mean score of 18.06 with standard deviation of 3.80 while that of the experimental group had a mean score of 23.76 with standard deviation of 5.36. The experimental group thereby performed better than the control group.

Research Question Two

What is the academic performance of students in Federal and State Colleges of Education that are taught with Emerging Technologies tools at NCE (Technical) level? The analysis required to answer this research question are presented in table 2.

Table 2: Mean Score and Standard deviation of Students in State and Federal Colleges of Education in Post-Test.

Groups	No. of Subjects	Mean	Standard Deviation
State COE.	100	22.34	4.55
Federal COE.	40	27.33	5.65
Total	140	49.67	10.20

The result presented in table 2 shows that, the scores of students in TEAT in state owned and federal-owned Colleges of Education obtained a mean score of 22.34 and standard

deviation of 4.55; a mean score of 27.33 and a standard deviation of 5.65 respectively. The students in Federa1 Colleges of Education performed better than the students in State Colleges of Education.

Hypothesis One

There is no significant difference in the mean performances of students taught with Emerging Technologies- tools and those taught with lecture method at NCE (Technical) level. The analysis required to test this hypothesis in the study are Presented in table 3.

Table 3: Post-Test Mean, Standard Deviation and t-values of Control and Experimental Groups.

Groups	No. of subjects	Mean	SD	df	Prob. level	t-value calculated	t-critical Value	Decision
Control	140	18.06	3.80	278	0.05	3.44	1.96	Significant
Experimental	140	23.76	5.36					

The result in table 3 shows that, the mean performances of students taught with lecture method (control group) was 18.06 and standard deviation of 3.80. The students taught with the Emerging technologies tools (experimental group) obtained a mean score of 23.76 and a standard deviation of 5.36. The table also revealed that, the calculated t-value obtained was 3.44 while the t-critical value at 0.05 level of significance was 1.96. Since the calculated t-value of 3.44 is greater than the t-critical value of 1.96, there is a significant difference between the performances of the control and the experimental groups. This hypothesis is hereby rejected in favour of the experimental group students since they obtained a higher mean score in TEAT.

Hypothesis Two

There is no significant difference in the mean performances of students in Federal and State Colleges of Education taught with the Emerging Technologies tools at NCE Technical level.

Table 4: Mean, Standard Deviation and t- value of Students in State and Federal Colleges of Education in Post–Test5

Groups	No. of subjects	mean	SD	df	Prob. level	t-value calculated	t-critical value	decision
State Institutions	100	22.34	4.55		0.05	2.17	1.98	Significant
Federal Institutions	40	27.33	5.65	138				

The analysis required to test this hypothesis in the study are presented in table 4. The result in table 4 revealed that, the mean performances of students in the State Colleges of Education had mean score of 22.34 and a standard deviation of 4.55. The mean performance of students in Federal Colleges of Education was 27.33 and standard deviation of 5.65. The table also revealed that, the calculated t-value obtained was 2.17 while the t-critical value at 0.05 level of significance was 1 .98. Since the calculated t-valu was 2.17 higher than the t-critical value

of 1.98, the hypothesis was rejected. Therefore, there is a significant difference between the mean performances of the students in State institutions and those in the Federal institutions. The difference is in favour of the students in Federal Colleges of Education who obtained mean score of 27.33 compared to mean score of 22.34 obtained by the students in the State Colleges of Education.

Findings

In research question one, the results of the students' academic performances in Technical Education using the TEAT revealed that, the students in the experimental group performed better than those in the control group. This was owed to higher mean score obtained by the students in the experimental group as compared to that of the students in the control- group.

The findings in research question two revealed that, the students in Federal Colleges of Education performed better than their counterparts in State Colleges of Education in the TEAT. This was because the students of Federal Colleges of Education obtained higher mean score of 27.33 as compared to the mean score of students in State Colleges of Education that had mean score of 22.34.

The findings in research hypothesis one revealed that, there was a significant difference in the academic performances of students taught with Emerging Technologies tools and those taught with the lecture method at NCE (Technical) Level. This hypothesis was rejected since the calculated t- value (3.44) was greater than the table 1-value (1.96) obtained at 0.05 level of significance. The findings in research hypothesis two revealed that, there was a statistically significant difference in the mean performances of the students in State Colleges of Education and those in the Federal Colleges of Education taught with Emerging Technologies tools. This hypothesis was rejected because the calculated t-value (2. 1 7) was greater than the t-critical value (1 .98) at 0.05 level of significance. The significant difference was in favor of the students of Federal Colleges of Education since they obtained higher mean score compared to their counterparts in the State Colleges of Education.

Discussion of Findings

In research question one; the findings revealed that, the students in the experimental group taught with Emerging Technologies Tools performed better than those students in the control group. This finding was in line with that of Achor (2013) which revealed that, the students in the experimental group taught Basic Technology with Emerging Technologies tools performed better than those students in the control group that were not exposed to the Technological tools lesson. The finding of Achor (2013) was in conformity with the experimental group students' mean scores that were greater than that of their counterparts in the Control group.

Similarly, this finding was also in agreement with the study of Prensky (2018) in which the Experimental group also had higher mean score than the control group. The findings revealed that, the students in the experimental group taught with Emerging Technologies performed better than the students in the control group that were not exposed to Technological tools lessons.

However, the finding was the same with the view of Enoch, (2013) who was of the opinion that, state-owned institutions were worst affected in terms of operational facilities, instructional materials, quality and quantity of teaching staff, staff remuneration etc. Students' performance in such institutions cannot be the same or better than institutions were these facilities and staff were available and adequate in number and quality.

In hypothesis one, the findings revealed that, there was a significant difference in the academic performances of students taught with Emerging Technological tools and those taught with lecture method. This finding was in agreement with the study of Akour (2019) who conducted research to investigate the effects of traditional instruction (TI) plus Emerging Technological Tool (ETT) versus TI alone on college students' Achievement in Introductory Basic Science course. An analysis of covariance on the post-test scores with pre-test scores as covariates showed that, the TI plus ETT group performed significantly better than the TI alone group. The findings indicated that, there was a statistically significant difference in the performances the subjects in the experimental and the control groups. The finding of the study on this hypothesis was also in agreement with the findings of Ibrahim (2012) which revealed that, there was significant difference between the post-test scores of students in the experimental group exposed to Emerging Technologies Tools (ETT) and control ETT. The significant difference was confirmed when the students in the experimental group obtained higher mean score than the students in the control group.

In hypothesis two, the findings revealed that, there was a significant difference between the performances of the students in state-owned institutions and those in the federal-owned institutions taught with ETT package. The finding was also in agreement with the study of Achor, Otor and Umoru (2013 who determined the effects of computer-Based instruction (CBI) on students' retention in biology in secondary schools in North-central, Nigeria. The study revealed that, the state and private schools lacked adequate human and materials resources for teaching and learning Science, Mathematics and Technology. They observed that, the situation is similar to other states and negatively affects the performance of students in such schools.

Conclusion

Based on the findings of this study, it has been observed that developed emerging technologies (ETT) are playing a pivotal role in transforming the teaching of technical education. By providing innovative solutions to the challenges of hands-on learning, personalized instruction, and real-world application, these technologies have the potential to significantly enhance the quality of technical education. As AI, VR/AR, and digital collaboration tools continue to evolve, they will likely play an even greater role in shaping the future of technical education, ensuring that students are well-equipped to meet the demands of the modern workforce. The developed ETT package used in the study for teaching has significant influence on students' academic performance at NCE (Technical) level and also has significant influence on the academic performance of students taught with ETT package at NCE (Technical) level. This could be in terms of facility provision and quality of staff employed.

Recommendations

The following recommendations are made based on the findings of the study.

1. Integrate Virtual Reality (VR) and Augmented Reality (AR) into Classrooms VR and AR technologies can simulate real-world technical environments and enhance hands-on learning experiences. In technical education, they can help students visualize complex machinery, processes, or engineering designs. Teachers can use these technologies to provide immersive demonstrations, where students can engage with tools and environments they might not have immediate access to in traditional settings.

2. Adopt Interactive Simulations and Gamification Interactive simulations allow students to practice technical skills in a risk-free environment. Gamification, using game-like

elements such as challenges, rewards, and levels, can make learning more engaging. For instance, digital tools can simulate mechanical engineering tasks, programming environments, or industrial processes, enhancing students' technical competencies through practice and feedback.

3. Utilize 3D Printing and Additive Manufacturing 3D printing allows students to design, prototype, and create physical models of their ideas. In technical education, this can be an invaluable tool for teaching design, manufacturing, and engineering principles. Introducing students to 3D printing technologies can help them understand product development cycles and give them hands-on experience in creating real-world solutions.

4. Incorporate Learning Management Systems (LMS) with Technical Modules LMS platforms, such as Moodle or Blackboard, can be tailored with specific technical education modules. These systems allow for the creation and delivery of structured courses that include technical tutorials, practical tasks, assessments, and feedback. They also enable asynchronous learning, which is ideal for flexible skill development.

5. Use Artificial Intelligence (AI)-Driven Tutoring Systems AI can offer personalized learning experiences based on a student's learning pace and style. AI-driven tutoring systems can help technical education students by providing real-time feedback, monitoring their progress, and suggesting areas for improvement. These systems can also help automate repetitive tasks, such as grading and tracking student performance in practical tasks.

6. Integrate Internet of Things (IoT) for Smart Learning Labs IoT can transform technical education labs into smart learning environments by connecting tools, machines, and devices through sensors. Instructors can teach students to operate IoT-enabled devices and understand how connected systems function in real-world applications, such as automation, manufacturing, and smart home technologies.

7. Leverage Cloud-Based Tools for Collaborative Projects Cloud computing allows students to collaborate in real-time on technical projects, such as software development, engineering designs, or data analysis. Teachers can encourage the use of cloud-based platforms (e.g., Google Cloud, Microsoft Azure) for team-based technical tasks, where students can work on the same project remotely, access resources, and share feedback.

8. Implement Data Analytics for Performance Tracking Data analytics tools can be used to track student performance, evaluate their skills, and adjust teaching methodologies. Teachers can analyze data related to student assignments, lab performances, or attendance to identify learning patterns and offer more tailored support to those who need it. Analytics can also help in forecasting which areas of technical education need more emphasis based on student feedback and outcomes.

9. Promote E-Learning and Remote Workshops E-learning platforms that offer video tutorials, webinars, and virtual workshops can complement technical education programs. Remote learning tools enable students to access technical content from anywhere, breaking barriers such as distance or limited resources. Teachers can also host virtual workshops where students can engage in technical tasks using simulation software.

10. Adopt Robotics and Automation in Technical Education Robotics and automation technologies can revolutionize technical education, especially in fields such as manufacturing, electronics, and engineering. Teachers can introduce students to robotics kits, teach programming, and expose them to industrial automation processes. This prepares students for the demands of a tech-driven job market, especially in industries where automation is prevalent.

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HARDWARE AND SOFTWARE REQUIREMENTS FOR LIBRARY AUTOMATION

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Abstract
This paper provides a comprehensive overview of the hardware and software components required for a successful library automation, it examines the key functionalities required for efficient library operations, including cataloging, circulation, acquisition and patron management. The paper analysis various hardware options, such as servers, network infrastructures, workstations e.g. computer, printers, barcode scanners, internet of things devices (IoT) e.g. RFID readers, hardware security systems for access control and surveillance. It also delved into different types of software that are used for library automation, discussing different library management system (LMS), opensource software, cloud-based software, learning management software, discovery software, circulation software, digital access software, cataloguing software, Acquisition software, integrated library software (ILS), databased management (DBMS). The paper concludes by providing recommendations for selecting appropriate hardware and software solutions based on the specific needs and budgets of the library.

Keyword: Library automation, hardware requirements, software requirements.

Introduction
Prior to application of information and communication technology, the task in the libraries were performed manually and independently far from one another. Task to do with collection development, cataloguing and classification, circulation and reference services, current awareness, selective dissemination of information (SDI) and other bibliographic services were being carried out manually. With the advent of computers and telecommunication technology, library activities are carried out through the use of integrated library system. An integrated library system (ILS) also known as library management system (LMS) is an enterprise resource planning system for library used basically to track items owned, orders made, bills paid and record of patrons who have borrowed library resources. This is supported by the work of Omeluzor, et al (2012) who opined that "integrated library management software is designed to enhance all library routine activities as expected by the library users". Therefore, the applications of library management system and other information and communication technologies in library operations and services is known as library automation. By extension, the word "automation" has been derived from Greek word "automose" meaning something which has power of spontaneous motion or self-movement. The term "automation" was first introduced by D.S. Harder in 1936, who was then with General Motor Company in the U.S. He used the term automation to mean automatic handling of parts between progressive production processes. Similarly, satyanarayana (2014) opined that "the word automation generally refers to the process of self-activating, self-controlling by automatic means". This implies that, automation is simply the application of modern technologies and other related machineries to accomplish task or developments that decrease the necessity of human intervention.

In line with the above assertions, encyclopedia of Library and Information Science define library automation as "the technology concerned with the design and development of process

and system that minimize the necessity of human intervention in operations". In the same vein, jaiswal and Ubale (2020) defines library automation as "the application of automatic and semi-automatic data processing machines to performs traditional library housekeeping activities such as acquisition, circulation, cataloguing, reference and serials control". Satyanrayana (2014) opined that "library automation is the process to mechanize or computerized all the activities of the library such as acquisition, circulation, serial control, cataloguing etc.". This means that, library automation encompasses the application of various technologies such as robotics, computer hardware, software to streamline and mechanize repetitive or complex library activities in order to increase efficiency, accuracy, productivity while reducing human efforts and errors in service delivery.

Literature Review

Library automation refers to the use of hardware and software technologies to streamline the various library processes such as cataloguing, circulation, collection development, resource management. This is supported by the idea of Saharan (2014) who observed that "the comprehensive studies of library computer systems world over include discussions of machine-managed acquisitions, cataloguing, serials control, circulation and bibliographic service modules". To implement effective and efficient library automation system, it is therefore necessary to understand hardware and software requirements necessary for its successful operations. The prerequisites facilities for library automation program includes hardware and software packages, program application, networking devices, database server, adequate collection, financial assistance, Maintenance of department, Knowledgeable manpower, open source software, computer system (Jaiswal & Ubale,2020) in the same vein, Pawar (2020) reveal that "to make effective and productive use of automation services, system analysis with the most up-to-date and appropriate hardware and software is required". This shows that, for a library to be fully automated relevant hardware and software are required.

Hardware Requirements for Library Automation

For a library to be fully automated, there is the need to have necessary hardware and software in place. Das and Chatterjee (2015) opined that hardware is the next important elements of library automation, number of products and manufacturers are available for this purpose. The hardware configuration mainly depends upon the software. Hardware refers to part of computer that can be seen and touch while software refers to programs or set of instructions which enable computer system to carry out the necessary processing (Beena & Malviya, 2011). The physical part of computer system required for library automation includes storage devices, input and output devices, printer, scanner among others.

Hardware specification depends on available budget, size of the data to store, usage load, required speed, features to upgrade when it requires availability of servicing (maintenance), compatible with operating system, what we are going to use and warranty period. This is in line with the idea of Pawar, (2020) who indicated that "hardware specifications are determined by the available funds, the amount of data to be stored, usage volume, necessary speed, upgradeable features when need, the accessibility of services". Therefore, for it is important to consider the size of collection and financial budget of the library before choosing the relevant hardware automation. This is supported by Prajapati (2020) who postulated that "hardware's required for any middle-class library are pentium IV 64 megabytes of ram, 150-megabyte pen drive, floppy disk drive**,** VGA color monitor, 8 port intelligence I / b paper**,** X.25 card drive software, internal modem**,** laser printer and TCP / IP internet".

Types of Hardware Components

Different type of hardware is vital for automating library systems, facilitating various software and technologies for smooth operations, functioning and streamline library processes. Hardware components such as computers and servers, networking infrastructure, printing and copying equipment, barcode scanner, audiovisual equipment, digital signage, self-check stands, RFID readers are required for a successful library automation (Pawar, 2020). Satyanarayana (2014) in his book a manual for library automation and networking discussed about functions, features and types of computer and storage devices such as magnetic tape, punched paper tape, tapes, cassettes, cartridges, magnetic disk, floppy disk, Winchester drum, magnetic drum, optical storage devices like photo CD system, DVD, CD-ROM, CDR and CDRW as hardware required for automation library.

Computers and Servers

Computer: is a device that operates upon information or data. Desktop or laptop computers are essential hardware components for library automation. Library staff uses these computers to access and manage the library management software, cataloging tools, circulation systems, and other administrative functions. Public access computers may also be available for library patrons to search the catalog, browse digital resources, and perform self-service tasks. Thus, computer advancement, telecommunication, and audio-visual technologies gave way to new possibilities in information handling (satyanarayana, 2014). However, different types of computers can be used for library automation such as desktop and laptops computers.

Server: Servers serve as the central processing units of library automation systems. They host and manage the library management software, databases, and other applications required for library operations. Servers provide the necessary computing power and storage capacity to handle the vast amount of data and user requests within the library system.

Storage Devices

Magnetic tape: are hardware storage device used in libraries to store data/information in order to protect data loss. Satyanarayana (2014) defined magnetic tape as a plastic ribbon usually half inch wide that is coated one side with an iron-oxide material which can be magnetized. the tape ribbon stored in reel of 50 to 2400 feet or small cartridge or cassette, similarly to the tape used on tape recorder expect that it is of high quality and more durable.

Magnetic disk: is a thin, circular metal, plate coated on both sides with a magnetic material consist of a number of a number of disks, three or more mounted about half an inch apart from each other on a central shaft which rotates at a speed of 2400 or more revolutions per minutes (satyanarayana, 2014)

Floppy disk also refers to as diskettes or floppies made up a plastic which is coated with magnetic oxide enclosed with a square plastic called jacket (satyanarayana, 2014).

CD-ROM is familiar audio compact disk used as medium of storing music, in the computer world, the medium is called compact disk used only memory is a typical disk that can store large amount of data, including text, audio and video (satyanarayana, 2014).

Disk Read Only Memory: DVD (or versatile) is a high density medium capable of storing a full-length movie on a single disk in the size of a CD and uses both sides of the disk and a special data compression to achieved a high storage capacity (satyanarayana, 2014). They are capable of storing large amount of data just like the CD-ROM consequently, they are employed

in the library for the purpose of storing high definition audio and videos, (multimedia contents), educational videos, software applications and archival materials.

Self-Check Machines

Self-check machines are standalone hardware units installed at the library entrances and exits to prevent unauthorized removal of library materials, they consist of touchscreens or display panels. This includes basic self-check kiosk, integrated self-check Kiosk, self-check service with RFID, barcode scanners and payment systems for handling fines or fees. They are used to streamline circulation processes, reduce wait times, and enhance user autonomy. These machines are automated devices that allow library users to borrow and return books independently. Therefore, streamline the borrowing processes by making it faster and easier without contacting the library staff. The following are some examples of self- check machines in library.

Radio Frequency Identification (RFID): is a smart card based inventory control, it is the technology that is slated to replace barcodes in library application and used for library automation such as issue return, Stock verification, Library security etc. (jaiswal and Ubale, 2020) The RFID system provides a key too effectively for collecting, managing and distributing the books. with this computerized system there will be no loss of book record or member record which generally happens when a non-computerized system is used (kore & patil, 2022).

Barcode Scanners: Barcode scanners read and capture barcode information printed on library materials. They enable quick and accurate identification of items during circulation transactions, inventory management, and cataloging processes, they are of various forms, including handheld scanners and integrated scanners built into self-check machines or circulation desks. It saves time, manpower and get the exact figures in stock verification.

Printing and Copying equipment

Printers are used to generate various types of documents in the library, such as patron receipts, overdue notices, or catalog records. They are used for providing physical copies of information and facilitating communication between the library and its users. This can be any electrostatic printer to print circulation slips for library users (Gavid, 2019). Satyanarayana (2014) postulated that printers are the most commonly used output devices that can grouped as serial or character impact printer such as dot matrix, daisy wheel, golf ball and cylinder printer. Additionally, Laser printers offers high quality printing and fast speeds for documents and reports, inkjet printers are situatable foe occasional printing and photo printing while multifunction devices combine printing, copying, scanning, and faxing capabilities.

Networking Infrastructure

Networking infrastructures, including routers, switches, and access points, is crucial for establishing and maintaining the library's local Area Network (LAN) or wireless network (Wi-Fi). These components enable connectivity between different devices, allowing seamless communication and access to library automation systems and online resources. Networking is required to interconnect the computers, computer peripherals, switches to share the information with the intension of distributing information among the interconnected users. (Devi & Raghuveer, 2012).

Mobile Devices:
Mobile devices, such as smartphones and tablets, are increasingly used by library staff and patrons to access library services through mobile applications. These devices provide flexibility and mobility in performing various library functions, such as catalog searches, self-checkout, and account management.

Security Cameras and Surveillance Systems
Surveillance cameras are essential for monitoring and safeguarding library facilities particularly during non-operational hours. Academic libraries such as Bayero University, Kano and Federal University of Education, Kano library used CCTV camera for monitoring and safeguarding their information resources.

Audiovisual Equipment
Digital Signage
LCD display provides information about the library services that ate offered, events and resources of the library while interactive display library users to search catalog, browse online resources and access digital contacts.

Software Requirements for Library Automation
Software are the programs, instructions or a collection of programs to enhance the working capabilities of the hardware. This is supported by the idea of Satyanarayana (2014) who posit "that software refers to a set of computer programs, procedures and associated documents (flow, charts, manuals, etc.) that describe the programs and how they are to be used." This implies that software is used in the computer through which the computer is capable of performing certain types of tasks. There are quite of a number of software required for library automation in libraries, this includes open source software, cloud-based software, learning management software, discoveries, Acquisition software, Data management software, integrated library system among others, some of them are commercial while some are open source available free of cost. Das and Chatterjee (2015) pointed out the different types of available library software includes in house development software or custom designed, software packages developed by commercial agencies, organizations and institutions and cooperative ventures. For instance, Bayero University Kano library developed an in-house software for better provision of services to users. The program controls the computer to process data and to do what to be done, Different types of library automation software packages include Soul, Koha, E-Granthalaya Granthalaya Slim, Libsys Alice for Window, NG-Tlms, Virtuails, Lamp, Techlib Plus Winsanjay Libsuite, Autolib, Newgenlib Nexlib (Jaiswal and Ubale, 2020). Furthermore, Tabusum, Saleem &Batcha (2023) in their article titled "Impact of Library Automation in the Development Era" pointed out few Software for library automation such as Alice for Windows, Autolib, Caliban. libasoft, librarian, Libsys, Nirma, Soul and Tlms. Satyanarayana (2024) postulated that "a right software is needed to be chosen as per the requirement of the individual libraries. Some of the prominent library automation packages are explained below:

1. **Autolib:** is a user friendly, fully integrate/multi-use software developed by librarians and computer professionals to automate library activities regardless of collection or size. It uses visual basic and Microsoft access, available on various platforms like Windows 95, Windows NT and LAN version. Versions module includes circulation Search, database administration, Serials and acquisition control are additional modules. (Tabusum, Saleem & Batcha, 2023).

2. **Libsy:** is a widely used software in south Africa for library automation, developed and marketed by libsys corp., New Delhi. It consists of acquisition, cataloguing, circulation, serial control, OPAC and article indexing.
3. **Alice for windows:** a product of soft link in 1983, integrated library software package consists of four distinct versions including public, special, academic and school library versions also comprised of three different modules such as standard, advance, and special set. The software module includes acquisition, management, circulation, periodical, journal indexing, multimedia, subject authority, web enquiry, book hire, multimedia and patron self-checking.
4. **Soul:** software for university library is one of the most state of art integrated management library software developed by INFLIBNET under UGC patron suitable for MS-SQL and My-SQL and international bibliographic format among others. The software modules are acquisition, circulation, serial control, OPAC, administration and cataloguing.
5. **Virtua:** virtue is developed by VTLS (Virginia Tech Library System) Inc., it is UNIX, Linux based server windows-based client application software consist of acquisition and fund accounting, circulation, chameleon gateway, serial control, OPAC, statistics and reporting.
6. **Koha:** is an open source software for integrated library management system, which was developed in 1999 by Katipo Communication Limited of Wellington, New Zealand for Horowhenua Library Trust. It is a free downloaded software customized facility of web-based interfaces containing all essential working modules such as acquisition, circulation, serials, OPAC, cataloguing, patron management, branch management and reservation. Pathak, (2021) opined that "Koha's web-based interface allows users to access the system from anywhere with an internet connection, making it easier for libraries to manage their resources remotely and also have qualities of barcode scanning, automated circulation, and advanced search capabilities, help improve the user experience".
7. **SLIM21:** System of library information and management, a product of algo rhythms Consultants Pvt. Ltd, it is a multi-user, multi- tasking integrated software working on a single machine or in a client-server multi- platform environment consist of acquisition, circulation, serials, technical, administration, OPAC, daily schedules and MIS report.
8. **E-granthalaya:** is a library automation software that provide LAN/Web based data entry solutions for a cluster of libraries where a centralized/common catalog can be created with union catalog output. It provides Web OPAC interface to publish the library catalog over internet or intranet and runs only on window flat forms (Satyanarayana, 2014).
9. **Cloud-based software** consists of applications and services hosted on remote servers and accessed through the internet, rather than being installed locally on a device. This model enables users to utilize software and store data without requiring physical infrastructure, offering flexibility
10. **Database management software (DBMS):** plays a crucial role in the automation of library operations by facilitating the organization, storage, and retrieval of library data. It enhancing cataloging, circulation management, user services, search and retrieval, data security back up, integration with other systems and inventory control. By streamlining these processes, libraries can improve operational efficiency and provide better services to their users.
11. **Learning management software (LMS):** is a web-based application used for library automation to facilitate the administration, documentation, tracking, reporting, and delivery of educational courses and training programs. It is suitable for course

management, user tracking and reporting, accessibility, collaboration tools and customization and integration capabilities in libraries. The types of learning management software include corporate, educational and open-source, they are all are all efficiency, scalability and cost-effectiveness.

13. **Acquisition Software:** Acquisition software refers to specialized applications designed to facilitate the process of acquiring, managing, and analyzing data from various sources to improve library management.

Conclusion

The hardware and software requirements for library automation play an essential role in promoting service delivery in modern libraries. The combination of both hardware and software requirements are necessary for the library to automated successfully. Robust server infrastructure, networking equipment and other requirements ensures efficient data management and seamless connectivity. With a comprehensive software ecosystem, including integrated library systems, digital asset management tools, and user-friendly discovery interfaces, libraries can efficiently catalog, preserve and provide access to their diverse collections, both physical and digital. By carefully considering these requirements, libraries can create dynamic, user-centric environments that cater to the evolving needs of patrons while preserving the rich heritage of traditional libraries in a digital age. Therefore, it important for libraries to select appropriate hardware and software solutions based on the specific needs and budgets of the library for a successful automation.

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APPLICATION OF ASSISTIVE TECHNOLOGIES FOR PROVISION OF LIBRARY AND INFORMATION SERVICES TO STUDENTS WITH SPECIAL NEEDS

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Abstract
The integration of assistive technologies in library and information services has significantly enhanced accessibility and learning opportunities for students with special needs. This paper examines the various applications of assistive technologies that facilitate inclusivity, discussing tools, technologies, and practices that libraries have adopted to cater to diverse needs. It explores the benefits of these technologies, including improved access to information, personalised learning experiences, and enhanced independence for students with special needs. The paper also addresses the challenges and considerations in implementing assistive technologies solutions in library services, emphasising the importance of ongoing training and support for both library staff and users. Through a comprehensive review of current practices and literature, this paper highlights the critical role of assistive technologies in creating inclusive educational environments.

Keywords: Assistive Technologies in libraries, special needs students, library services, information services, inclusive education, digital inclusion

Introduction

Information and Communication Technology (ICT) has revolutionised the way information is accessed and disseminated in libraries, particularly the invention of assistive technologies which ease access to information by students with special needs. The integration of these technologies into provision of library and information services has enabled libraries to provide more inclusive and accessible resources, ensuring that all students have equal opportunities to learn and prosper. Assistive technologies are necessary for ensuring independent living and equal participation in an information-based society for students with special needs (Alabi & Okiki, 2023).

Corroborating the above submission, Mutula and Majinge (2016) suggest that libraries must initiate policies that promote practical interventions, such as providing suitable buildings equipped with assistive technologies. With this, assistive technology is any device or product that assists or supports an individual with a kind of disability [student with special needs] to function like others with little or no support from human being (Obim & Akpokureries, 2022). According to Dominic, Joshua and Eyitayo (2020) assistive technology refers to devices or applications made precisely to aid the purpose or adapted and used to aid as technical assistance for students with special needs and professionals. It helps librarians to effectively and efficiently facilitate provision of library and information service to students with special needs. Library and information services provided by libraries are mainly determined by library users. Gakibayo, Odongo and Okello-Obura (2013) recognises this fact when they stated that the user is very critical in the practice of librarianship. Accordingly, library and information service are the assistance a librarian or information manager renders to the clientele by enabling him/her to get the information he/she wants from the library (Edom & Edom, 2019). This implies that one of the prime objectives of contemporary library is to provide information services in an inclusive setting by acquiring relevant information resources, equipment and facilities to

facilitate access to information by all users. Because some library users have one form of deformity or the other usually refers to students with special needs.

Students with special needs are regarded as the physically challenged or students with disabilities or impairment. Hence, Atabor (2015) opined that the terms, impairment, physically challenged, handicapped, disabled, and special needs persons are used interchangeably They are people that are in a state that restricts their ability to function physically, mentally or socially. Ananya (2013) identified those with physical challenges to include those who have long term physical, mental, intellectual or sensory impairments which may hinder their full and effective participation in society on an equal basis with others, hence, their need for special attention.

In light of this, application of assistive technologies for provision of library and information service for the students with special needs enable them have access to the resources and facilities that best suit their needs. Based on the foregoing background, the researcher tends to explore application of assistive technologies for provision of library and information services to students with special needs.

Applications of Assistive Technologies for Library Services

Provision of assistive technologies into operations and services of library can enhance both social and digital inclusion of students with special needs' academic activities as it's facilitated access to needed information. Assistive technologies are specialised tools designed to support students/ individuals with disabilities in accessing information. These include screen readers, magnification software, and text-to-speech programs, which are particularly beneficial for students with visual impairments (Hersh & Johnson, 2010).

According to Assistive Technology Industry Association (ATiA) as cited by Ayiah (2017) defines Assistive technology (AT) is any item, piece of equipment, software program, or product system that is used to increase, maintain, or improve the functional capabilities of persons with disabilities. For instance, screen readers convert digital text into synthesized speech, allowing visually impaired students to listen to written content (Smith & Anderson, 2019). This depicts that assistive technologies are the sole means of independent learning by students with special needs.

From the foregoing, assistive technologies (AT) according to Doiron, (2020) encompass a wide range of devices, software, and hardware designed to support individuals with disabilities in performing tasks that may otherwise be challenging or impossible for them. In library settings, it can include magnification tools, adaptive keyboards, and alternative input devices. This portrays that assistive technologies enable students with special needs to intermingle with library resources effectively.

In an empirical study conducted by Alabi and Okiki (2023) who investigated the assistive technologies (AT) preferences of people living with visual disability as information access tools in academic libraries. The study found that access to electronic resources, scanning/conversion of print resources to electronic formats and access to information on the Web were among the technology-based services provided to visually disabled students. COBRA, Zoom Text, Supernova and Dragon Naturally Speaking are the most preferred assistive technologies (software). At the same time, handheld scanners (x□=4.40) and braille keyboards (x□=4.60) are the most preferred assistive technologies in the hardware category by visually challenged students.

Similarly, Odigie and Okube (2021) investigated the place of assistive technologies in the service delivery of special need users in academic libraries of Kogi State. The study found emphasis was placed on certain assistive technologies like Computers and LCD projectors, while the majority of the assistive technologies were not present at the institutions. The study further found the provision of equal opportunity and rendering of library service to users with the use of these technologies were some of the roles of Assistive technology.

In another study, Obim and Akpokurerie (2022) investigated the utilisation of assistive technology for effective school library service delivery to students with disabilities in Nigeria; it was revealed that, there is inadequate availability of assistive technologies for effective school library service delivery to students with disabilities in Nigeria. Also, the extent of utilization of assistive technologies for effective school library service delivery was very low except for braille technology and hearing aids. This indicates that application of assistive technologies enhances the academic activities of students with special needs. Dominic, Joshua and Eyitayo (2020) in North West, Nigeria, the findings revealed that, majority of the assistive technologies required to support students with disabilities are not available in most of the special education schools. This unavailability affected the extent of utilisation of these technologies. Also, Rowlands (2015) found out that, there is inadequate availability of assistive technologies in the schools studied, which translated to low utilisation due to factors such as inadequate funding, inadequate technical skills of utilising assistive technologies, lack of support services among others. This specifies that application of assistive technologies requires huge investments, awareness and technical know-how to satisfy the information needs of students with special needs.

Benefits of assistive technologies in Library Services for Students with Special Needs

The application of assistive technologies in library services offers numerous benefits for students with special needs, including:

Enhanced Accessibility

One of the most significant benefits of assistive technologies in library services is the enhanced accessibility it provides. Traditional print materials can be inaccessible to students with special needs. Assistive technologies such as screen readers, magnification software, and braille displays enable students with visual impairments to access digital texts independently (Hersh & Johnson, 2010). Screen readers convert text into synthesized speech, allowing visually impaired students to listen to written content, while magnification software enlarges text and images for those with low vision (Smith & Anderson, 2019).

Digital and Audiobooks

Digital and audiobooks are crucial ICT resources that cater to the needs of students with special needs. These formats are especially beneficial for students with dyslexia or other reading difficulties, as they offer alternative ways to engage with text. Audiobooks provide auditory learning opportunities, which can be easier to process for some students compared to traditional reading (Burgstahler, 2012). Furthermore, digital books often come with adjustable text sizes and background colors, which can help students with visual impairments or contrast sensitivity (Mates, 2011).

Personalized Learning

ICT enables personalized learning experiences tailored to the individual needs of students. Adaptive learning technologies can adjust the pace and difficulty of content based on the student's performance and preferences. For example, speech recognition software allows

students with physical disabilities to dictate text, reducing the need for manual input (Raskind & Higgins, 1998). Similarly, word prediction software helps students with learning disabilities by suggesting words as they type, facilitating faster and more accurate writing (Shinohara & Wobbrock, 2011).

Independence and Self-Reliance

The use of assistive technologies in libraries empowers students with special needs by promoting independence and self-reliance. Accessible online catalogs and digital resources enable students to conduct research and access information without needing constant assistance from library staff (Seale, 2014). This autonomy not only boosts their confidence but also encourages self-directed learning, which is critical for academic success and lifelong learning (Jaeger & Bertot, 2010).

Interactive and Engaging Learning Materials

Assistive technologies provide access to a wide range of interactive and multimedia learning materials that can make the learning process more engaging and enjoyable for students with special needs. For instance, educational apps and software programs often include interactive elements such as quizzes, games, and simulations, which can help to maintain students' interest and motivation (Hehir et al., 2016). Multimedia resources, such as videos and animations, cater to different learning styles and can make complex information more understandable (Burgstahler, 2012).

Inclusive Learning Environment

Assistive technologies help create a more inclusive learning environment by ensuring that all students, regardless of their abilities, can access the same educational resources. This inclusivity fosters a sense of belonging and equality among students, which is essential for their social and emotional development (Hehir et al., 2016). Libraries that offer assistive technologies resources and services demonstrate a commitment to inclusivity and accessibility, setting a positive example for the broader educational community (Cox & Emmott, 2020).

Challenges and Considerations

While the benefits of assistive technologies in library services for students with special needs are substantial, there are challenges to consider. The cost of acquiring and maintaining assistive technologies can be a significant barrier for many libraries (Lynch, 2010). Additionally, library staff requires ongoing training to stay updated on the latest assistive technology tools and best practices for supporting students with special needs (Cox & Emmott, 2020). There is also a need for increased awareness and promotion of these resources to ensure that students and educators are aware of and can effectively utilise the available technologies (Mates, 2011).

Conclusion

The integration of assistive technologies into library services offers numerous benefits for students with special needs, including enhanced accessibility, personalized learning experiences, increased independence, AR/VR applications, mobile solutions and the creation of an inclusive learning environment. While challenges such as cost and the need for training exist, the positive impact of assistive technologies on the educational experiences of students with special needs is undeniable; assistive technologies play a vital role in promoting inclusivity, accessibility, and engagement in library environments. By embracing these technologies, libraries can play a pivotal role in supporting the academic success and overall development of all students, regardless of their abilities or disabilities.

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BLOCKCHAIN TECHNOLOGY AS A TOOL FOR MITIGATING CYBER CRIME: A REVIEW

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Abstract
The rise of cybercrime has become a significant concern in today's digital age. Blockchain technology has emerged as a potential solution to mitigate cybercrime. This paper provides a comprehensive review of the current state of blockchain technology and its applications in preventing and investigating cybercrime. We explore the inherent features of blockchain technology, such as decentralization, immutability, and transparency, and how these features can be leveraged to combat cybercrime.

Keywords: Blockchain Technology, Cybercrime, Mitigating tool

Introduction
What is Blockchain
With the ability to completely change a number of industries, blockchain technology has come to light as a revolutionary invention. It is a distributed ledger technology that is resistant to heat. Similar to internet technology, it can be used because of its distributed and secure nature. One of the main features of blockchain is that technology enables a collective of people to carry out and document transactions on a shared ledger, making it impossible for one person to alter or tamper with the records once they are written down and made public (Sapra and Dhaliwal 2022).

Cryptocurrencies like Bitcoin are often associated with blockchain technology (Simanta, 2018). It is a transnational computer network that maintains and verifies the accuracy of a distributed database of transaction records. The records are maintained and managed by a large community of users on the network, as opposed to being under the authority of a single body (like banks). Furthermore, the transaction histories cannot be changed or removed, and no one person has access to the records. Peer-confirmed assurances and the distributed nature of blockchain ensure that data cannot be changed without the approval of other network members. It prevents a single central organization from taking control of the network by enabling everyone on it to view each other's entries. Every time someone.

Blockchain as an Emerging Technology
Stuart Haber and W. Scott Stornetta worked on a cryptographically-secured chain of blocks in 1991 that prevented anyone from tampering with the time stamps on documents, which marked the beginning of blockchain technology. In order to handle more documents in a single block, they modified their system in 1992 and added Merkle trees (Mohuiddin, 2020). But Satoshi Nakamoto unveiled the blockchain as we know it today in 2008. He is regarded as the blockchain technology's brainstem. Since 2009, when Satoshi published a white paper outlining every aspect of the technology, blockchain development has advanced significantly and seen numerous applications.

What is Cybercrime

Cybercrime is defined by the Merriam Webster Dictionary (2024) as criminal behavior (such as theft, fraud, or the dissemination of child pornography) carried out through the use of a computer, particularly with the intent to access, send, or manipulate data illegally. The word "cybercrime" refers to a wide range of illegal activities when computers or computer networks are utilized as a weapon, a target, or a location for criminal conduct. These activities include denial-of-service assaults and electronic cracking. It can also be applied to more conventional crimes where the illegal action is facilitated by the use of computers or networks (Das and Nayak, 2013).

According to Viano (2017), the introduction of the internet and information and communication technology has caused a significant shift in how individuals do business, share information, and go about their daily lives at work. As a result, criminality and cybercrimes are evolving to keep up with these online activities. Users of internet platforms might suffer severe emotional and financial trauma at the hands of cybercriminals. These illegal activities rise into a big worry that affects the states, the general public, and small and large corporate systems (Baltezarević & Baltezarević, 2021). Cyber dangers have become more prevalent due to the rapid speed of innovation, increasing interconnectedness, and heavy reliance on online platforms (Pantami, 2022).

Economic Challenges of Cybercrime:

A research conducted by Cukier (2007), as cited by Pantami (2022), found that every 39 seconds, a cyberattack takes place somewhere in the world. The consequences of these attacks are not only growing, but Accenture (2019) projected that it will cause losses totaling over $5.2 trillion worldwide by 2023. Pantami went on to say that while the GDP of Africa hit $3.3 trillion in 2017, cybercrimes also lost a lot of money in that same year, with South Africa, Kenya, and Nigeria suffering the biggest losses.

Relationship between Blockchain and Cybercrime

Globally, cybercrime has grown to be a serious threat to people, businesses, and governments. It is more challenging to halt and investigate cybercrimes due to the sophistication of cyberattacks. Even though the Blockchain was originally intended for use in bitcoin transactions, the technology has demonstrated potentials in combating cybercrime. Blockchain technology is a decentralized, distributed ledger that records transactions across a network of nodes. Its key features include:

- **Decentralization**: No single point of control or failure
- **Immutability**: Tamper-proof and irreversible transactions
- **Transparency**: All transactions are publicly visible

These features are applicable in cybercrime mitigation such as

- **Secure Data Storage**: Blockchain-based storage solutions protect sensitive data from unauthorized access.
- **Identity Verification**: Blockchain-based identity management systems prevent identity theft and fraud.
- **Supply Chain Security**: Blockchain technology ensures the integrity of supply chains, preventing counterfeiting and tampering.
- **Smart Contracts**: Self-executing contracts with built-in security and compliance measures.
- **Incident Response**: Blockchain-based systems facilitate swift and secure incident response.

Literature Review

The way people do business, share information, and go about their everyday lives at work has significantly changed since the advent of the internet and information and communication technologies, claims Viano (2017). Because of this, criminality and cybercrimes are developing to match these online pursuits. Cybercriminals have the potential to cause significant psychological and financial harm to users of online platforms. The states, the public, and both small and large corporate systems are impacted by these illicit operations, which are becoming a major concern (Baltezarević & Baltezarević, 2021). Because of the growing interconnection, fast pace of innovation, and strong reliance on online platforms, cyber risks have increased in frequency (Pantami,2022)

Chikelue, C.N. et al. (2020) examined the application of blockchain technology for cyber security of developing markets multinational organizations through an examination of Nigerian internationalized banks. The Internet Crime Complaint Center, Proshare, and the Africa Cybersecurity Report provided secondary data, which was acquired and examined by the researchers. Based on this analysis, they concluded that blockchain technology will make cybercrimes more expensive for the perpetrators and deter them from carrying out further schemes. According to this study, when blockchain technology is implemented in Nigerian banks, there will be safer financial transactions and more growth since cybercrime will be reduced. Once more, Nigerian banks will be in a strategic position to effectively compete with developed banks worldwide.

Olomukoro (2023) asserts that cyber-security is essential to the effective application of blockchain technology since there is a high likelihood that a cyberattack may compromise and expose the transaction flow. His study led to the Central Bank of Nigeria introducing Central Bank Digital Currency, which enabled safe payment transaction mechanisms inside a regulated financial environment.

In 2023, Patmanathan, P. and colleagues conducted research on the efficacy of blockchain technology in mitigating financial criminality. They noticed that the consensus method, distributed ledger technology, immutability, and smart contracts found in the blockchain had an impact on financial criminality. They came to the conclusion that financial cybercrime may be prevented, reduced, and managed with the use of blockchain technology. They went on to say that knowledge of both blockchain technology and financial cybercrime is crucial since blockchain technology seeks to prevent, lessen, and safeguard against the occurrence of financial cybercrime.

Samuel, A., et al. conducted a comparative study of the application and outcomes of blockchain technology in the banking sectors of the US and Nigeria (2024). Although technology adoption in Nigeria was still in its infancy, they pointed out that it had advanced significantly in the US banking sector and improved financial transaction, security, and cost efficiency. In Nigeria, efforts were focused on financial inclusion and increasing the effectiveness of cross-border payments. They also discovered that Nigeria's poor infrastructure and murky regulations acted as roadblocks to the adoption of the technology.

Methodology

This paper conducted a secondary data review of some existing literature on the application of blockchain technology in combating cybercrime with interest on developing countries particularly Nigeria. This secondary data review highlighted the potentials of blockchain

technology in mitigating cybercrime, while also identifying challenges, limitations, and areas for future research.

Results

The advent of blockchain technology represents a paradigm shift in the digital world and presents hitherto unimaginable opportunities for economic growth. Blockchain technology is significant for financial transactions because it provides a transparent, unchangeable, and secure platform for trustworthy, safe transactions. When appropriately adapted and applied, cybercrime problems will be minimized

Conclusion

Blockchain technology has shown great potential in mitigating cybercrime. Its decentralized, immutable, and transparent nature makes it an attractive solution for secure data storage, identity verification, supply chain security, smart contracts, and incident response. However, challenges and limitations need to be addressed to fully realize its potential.

Challenges

There are numerous challenges in the way of integrating blockchain technology into financial transactions. To fully realize the promise of blockchain technology, a number of significant obstacles must be addressed, including technological complexity, regulatory uncertainty, and security concerns.

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ASSESSMENT OF THE REBUILDING OF RAIL INFRASTRUCTURE IN NIGERIA: A CASE STUDY OF NIGERIA RAILWAY CORPORATION

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Abstract
Rail transport is seen worldwide as an environmentally friendly public transport system. As a result, many countries continued to take measures to improve the efficiency of their rail transport industry. Assessment of the Rebuilding of Rail Infrastructure in Nigeria, a case study of Nigeria Railway Corporation. This research assessed the government investment and total revenue realise by the government from 1983 to 2015. The study is based on documentary analysis, mainly sourced from Nigeria Railway Corporation records. The data were analysed using simple line graph. The results revealed that public sector investments are very inconsistent and unsustainable. The results implies that government investment in railway has substantially led to an increase in economic growth of Nigeria. The study concluded that there is need to address adequate funding in rail transportation and put measures in place to minimise mismanagement in this important sector of the transport industry.

Introduction
All over the world, the transportation of people, goods and services is a key development objective for governments. The problems of environmental pollution, and transportation accidents, especially on the roads/highways also makes it imperative for policy makers to seek out better alternatives. For instance, in the United Kingdom, the Essex and Southend-on-Sea Joint Replacement Structure Plan, sets out a transport objective to encourage alternative means of travel which have less environmental impact; and reduce reliance on the private car and road haulage (Essex County Council (2011).

In Nigeria, the irony in the rail transport sector arose mainly after the oil boom in the 1970s when the railway system rather than improving with increased national earnings, started declining. Prior to that time, during the colonial era, the nation's diversified economy as put forward by Oyewale (2005) had the railway to depend on for the movement of agricultural produce and mineral products from the Northern part of Nigeria to the South for onward movement to Great Britain. Added to this, the railway system provided an utilisation channel for one of the nation's leading mineral products – coal. During this period, rail infrastructure development in Nigeria had enjoyed tremendous support from the Colonial Government because of its interest. However, since the discovery of petroleum in commercial quantities, successive national and regional administrations have systematically neglected the railway transport sector, shifting attention to the importation of alternatives that would ride on oil, and the development of a national road network.

Nevertheless, rising fuel costs, swelling population as well as rural-urban migration figures and deplorable road conditions have recently revealed a major flaw in the development rationale that Nigeria adopted for her transport system. More so, the absence of explicit distributive and regulatory policies also contributes to the plagues of the entire landscape thereby making the mass movement of goods and heavy cargoes a persistent headache.

This poses the challenge of creating an environment where car owners could decide not to use their car based on the availability of a cost effective alternative. Beyond that, developing countries like Nigeria also have the challenge of ensuring that their populace can move freely and efficiently from place to place. This is of particular importance since a country like Nigeria has an appreciable proportion of her population below the poverty line, and therefore cannot afford personal vehicles. Along these lines, several efforts – albeit with very little success - have been made to sustain the nation's railway system which was initiated towards the end of the 17th century (Nigeria Railway Corporation, 2006).

It is within this context that this study intends to look some of the key issues that affect Nigeria's railway transport system. The study establishes the potentials for profitable investments in the infrastructure development projects in railway transportation sector

Nigerian Railway compared to other transportation system

Generally Nigerian Railway has been continuously developed through innovations, technical and commercial changes, though the implementation of these changes have been slow over the years. International Labour Organization (1994) stated that for intercity travel, medium and speed rail travels constitute the first valid alternative to car and air travel in the increasingly congested road and air route networks. Some key factors promoting speed rail is that airports and highways have no room to expand, and are often overloaded while speed rail has the potential for high capacity on its fixed corridors, and has the potential to relieve congestion on the other transportation systems. However, the railway system in Nigeria when compared with those in advanced countries of the world, still plays an insignificant role in general infrastructural of the railway transportation as a whole. It is necessary that the railway sector improves for a working infrastructural system for the efficient transportation of commuters (Adesanya, 2010).

Efforts Aimed at Rebuilding the Nigerian Railway System

Efforts to upgrade Nigeria's railway system to improve its efficiency included technical collaboration between the NRC and Rail India Technical and Economic Services (1979-1982) and the Construction Corporation of China (1995-1999). These contracts focused on improving railway and telecommunications services; renovation of existing locomotives, coaches and wagons and provision of benches; and reopening of lines that have been closed until now.

Furthermore, the Federal Executive Council on 13 November 2002 published the 25-year strategic development plan for the Nigerian Railways. The development plan, with a budget of 60 billion dollars, is expected to be financed mainly by multilateral grants and private sector investment. The action plan will be implemented in three stages. Phase one will involve system transition and will be executed from 2002 to 2007. Phase two has system modernization and is expected to terminate by 2015 after commencing 2007. Phase three, termed system stabilization, will last till 2027, the expected terminal date of the strategic plan. Moreover, on the 30th of October 2006, the Federal Government and the China Civil Engineering Construction Corporation (CCECC) signed an $8.3billion contract for the construction of a standard gauge railway line covering 1,315km from Lagos to Kano.

In 2012, the administration of President Goodluck Ebele Jonathan attempted to reform Nigeria's railway system by renovating existing railways, rehabilitating old buses and acquiring new ones to improve the operation of rail transport in Nigeria. Despite these efforts, rail traffic continued to be unstable and weak. The main objective of this paper is to find out how economically viable rail transport service is in Nigeria. Is it commercially viable with its

current operations to the extent that it can attract private entrepreneurs to invest in its operations? The need to determine the commercial viability of rail transport service in Nigeria is very important for the implementation of public private partnership policy in the rail transport sub-sector. Therefore, this paper seeks to assess the commercial viability of rail transport in Nigeria to provide useful information for the implementation of rail transport policies in Nigeria (Ojekunle, 2016).

Part of the government's current priorities is to restore and improve the railway by removing sharp curves, smoothing steep grades and installing modern signalling equipment to improve train speeds and track safety. It also includes supply of locomotives, buses, wagons and railcars to increase operational capacity, efficiency, effectiveness, customer satisfaction and overall productivity. In order to improve the safety of passengers and equipment and faster train traffic, a contract for the supply and installation of a complete microwave digital backbone network has been signed and is under construction.

The NRC currently has a single-track narrow gauge line that covers most of the rail network with very limited standard gauge that has been operated by various consortia over the years. A profile of the Nigerian Railway system is currently shown Table 2.1.

Table 1: Nigerian Railway Corporation Profile – 2016

Track	Single track, steel/timber, sleepers.
Gauge	1067mm or 3'6", 3505 route km, 4332 track km.
Traction	Conversion of locomotive engines to diesel fuel occurred mid 1950's and led to a complete withdrawal of steam locomotives in the early 1970s.
Maintenance	Nigerian Railway Corporation
Management	Management Nigerian Railway Corporation
Technical Support	China Civil Engineering and Construction Corporation (CCECC).

Source: BPE (2005) and Authors' Survey (2021)

Despite the desire of the government to pay enough attention to rail transport and invest in the system, it is not sufficient, coherent or sustainable. However, the results show that the level of operational activity has increased significantly, and revenues have also increased significantly. Also, it's getting harder and harder to find the money to finance it, and that's why it collapsed. The NRC has gone bankrupt twice in its history. If a new government takes office and decides the headache is too great and believes it can rely more on road infrastructure than rail, then services will drop because the government has many needs to meet (Adaji, 2024)

The rehabilitation and development of existing standard gauge railway lines will undoubtedly promote an intermodal transport system with connections to the country's sea and river ports, as well as connectivity to the airport and major bus terminals across the country. The introduction of an intermodal transport system greatly contributes to the movement of passengers as well as raw materials, semi-finished products and finished products to industrial factories and markets, thus creating new business and employment opportunities. The high cost of transport in Nigeria is largely due to the absence of a rail system or poor connectivity with other modes of transport when they are used in other jurisdictions. The establishment of public-private partnership arrangements in the transport sector of the entire country will significantly affect the growth of Nigeria's Gross Domestic Product (GDP) in the near future (Infrastructure Concession Regulatory Commission (2020).

Research Methodology

Based on this study, a quantitative approach was used to collect and analyze data. The method used in this study was a one-to-one approach where secondary data was suitable for the study. Secondary data for this study was obtained from the Nigeria Railway Corporation on the government investment and total revenue realise by the government from 1983 to 2015. Line graph analysis was employed to show the rebuilding of rail infrastructure in Nigeria.

Results and Discussion

Line graph analysis was employed to show the rebuilding of rail infrastructure in Nigeria. In rebuilding rail infrastructure in Nigeria, the government investment and total revenue realise by the government from 1983 to 2015 is presented in Table 4.1.

Table 2: Government Investment and NRC Total Revenue

Year	Investment $'000	Total Revenue '000
1983	32,000	69,969
1988	88.000	8,726
1995	528,000	3,466
2003	52,220	2,238
2004	840,000	2,072
2006	8,300,000	1,487
2009	81,300	1,769
2012	1,490,200	5,912
2013	41,019,200	8,869
2014	25,100,000	10,461
2015	N/A	6,710

Source: NRC (2015), Authors' Survey (2021)

To show the clear picture of the Table 4.1, the data were further presented in Figure 4.1.

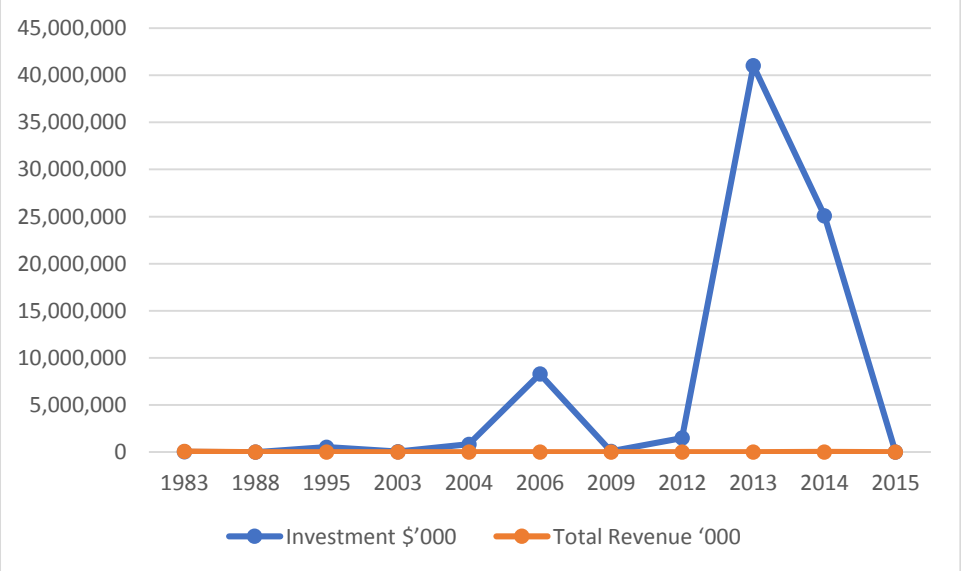

Figure 4.1: Government Investment and NRC Total Revenue

The Figure 4.1 shows the expenses of the government sector in the respective years, which despite the huge sums of money spent, the provision of NRC services is still insufficient compared to other developing countries or countries with a developed railway system. It is also clear that public sector investments are very inconsistent and unsustainable.

Because mutual funds are only available for popular approval at the beginning of the government of each administration. For example, the Shagari administration invested $32 million at the start of its civilian administration in 1983 and then no further investment was made for 5 years until Babangida came to power in 1986 when his military administration invested $88 million in 1988; Also eight years later, Abacha came to power in 1994 and invested $528 million in 1995; It also took another 4 years until Obasanjo came in 1999 and he invested in 2003, 2004 and 2006 while Yar'Adua started in 2007 and he invested in 2009; and Jonathan's government started in 2011 and his investment in the system started in 2012 and will continue until May 2015. Despite all these huge sums of money spent on the railway system, the revenue of the NRC continues to decrease, except in 2012 when it seems to be increased, together with revenue and passengers carried and in subsequent years based on continuous funding and investment.

Accordingly, based on the rebuilding of rail infrastructure in Nigeria, the study shows that notwithstanding the enormous sums of money spent, the service provision of NRC is still insufficient compared to other developing countries or countries with developed railway systems. It is also clear that public sector investments are very inconsistent and unsustainable. It was also discovered that the revenue of the NRC continues to decrease, except in 2012 when it seems to be increased, together with revenue and passengers carried and in subsequent years based on continuous funding and investment. This is in consonant with Adaji (2024) who asserts that it's getting harder and harder to find the money to finance NRC, and that's why it collapsed.

Conclusion

The study is to examine the rebuilding of rail infrastructure in Nigeria. Accordingly, the empirical study reveal that despite the huge sums of money spent, the provision of NRC services remains inadequate compared to other developing countries or countries with advanced railway systems. It is also clear that public sector investments are very inconsistent and unsustainable. It also found that NRC revenue continues to decline, except in 2012, when it appears to be growing with revenue and passenger numbers, and based on continued funding and investment in subsequent years.

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LIBRARIANS' ATTITUDE TO MOBILE TECHNOLOGY DEVICES AND PROVISION OF INFORMATION SERVICES FOR RESEARCH ACTIVITIES POSTGRADUATE STUDENTS IN UNIVERSITIES IN NORTH-CENTRAL NIGERIA

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Abstract

This study investigates the attitudes of librarians towards mobile technology devices and their impact on the provision of information services for postgraduate students' research activities in Nigerian universities. With the primary goal of enhancing learning, teaching, and research, Nigerian universities have increasingly integrated mobile technologies to support postgraduate research. The integration of mobile technology in Nigerian universities has the potential to significantly enhance research activities among postgraduate students. This study explores the attitudes of librarians towards mobile technology and its impact on the provision of information services for research activities of postgraduate students in Nigerian universities. Despite the widespread availability of mobile devices such as smartphones, and tablets, and mobile applications like WhatsApp, Gmail, and Zotero, the use of these technologies for academic research remains minimal. This can be attributed to challenges such as poor network connectivity and inconsistent power supply, which hinder the effective use of mobile technologies in research activities. The research employs a descriptive survey design, with a sample size of 1,024 postgraduate students selected from a total population of 15,041 across ten universities in North-Central Nigeria. The study utilizes questionnaires and observation checklists to gather data, with a focus on the types and levels of research activities conducted, as well as the availability and utilization of mobile technology in university libraries. Reliability testing using the Cronbach Alpha Formula confirmed the research instrument's validity, yielding an overall reliability score of 0.979. Findings indicate that postgraduate students in Nigerian universities engage in various research activities, including dissertation writing, attending workshops and seminars, and publishing research findings. However, while there is a moderate availability of mobile technology devices in libraries, their potential is underutilized for academic purposes. Instead, a significant portion of device usage

is for personal communication and social networking, with only 24% of students using their smartphones for academic activities. The study concludes that librarians' attitudes towards mobile technology are pivotal in facilitating research productivity and innovation. Positive engagement with these technologies can improve the accessibility and efficiency of information services, which are crucial for research endeavours. The study recommends the optimization of mobile-friendly resources, increased funding for updated technology in libraries, and continuous professional development for librarians to enhance their capability in utilizing mobile technologies effectively. Additionally, addressing infrastructural challenges such as network connectivity and power supply is essential to promote equitable access to mobile technology resources in Nigerian universities.

Keywords: Librarians' Attitude, Mobile Technology Devices, Provision of Information Services, Postgraduate Students.

Introduction

Universities in Nigeria were established with the primary aim of promoting learning, teaching, research and community service. This research component of the university is to create an enabling environment for the promotion of ideas that could lead to the production of goods and services for the development of society. Research activities create avenues for innovative and productive ideas and originality in research following the various processes involved in conducting ideal research. Research activities are defined as human actions carried out in the research of the issue depending on intellectual application. Discovering, interpreting, and developing approaches and systems for improving human understanding of many scientific and social issues of the world and the cosmos depends mostly on postgraduate study (May & Perry, 2022). Research projects might follow the scientific process to further knowledge. It is seen as a methodical attempt to learn fresh facts. Research has dictionary definition as "a careful investigation or inquiry, especially through search for new facts in any branch of knowledge". Anyim (2020) claims that research activities—including research creation, testing, and evaluation—designed to either produce or contribute to generalisable knowledge—are methodical investigations. These activities comprise designing research, guiding research, conducting experiments, recruiting research subjects, deciding whether or not to be eligible to participate in research, engaging in observational registry programs, analysing or reporting research data, or turning in manuscripts on research for publication. According to Anyim's (2020) definition, research activities are systematic as they follow order and protocols in reaching the research-set aims and objectives.

Similarly, Manuwa (2019) reported that there are other types of research activities that postgraduate students can engage in to find out new ideas or trends in their profession or field of specialisation, which may include; master theses or dissertation writing, attending workshops, seminars as well as conferences both nationally and internationally. Especially for postgraduate students at colleges, the value and need of research activities cannot be underlined as they improve academic production and creativity. The study considered how postgraduate students' research activities may be facilitated by mobile technology devices as well as how librarians' attitudes can be used to support information services delivery. From sourcing information resources for writing seminar and conference papers, writing theses and dissertations, downloading articles, searching databases for updated information as well and interacting with their supervisors, postgraduate students use mobile technology devices for diverse research activities.

The use of mobile technology devices effectively could lead to excellent research activities among postgraduate students. Postgraduate students are therefore encouraged to leverage the existence of mobile technology devices for quality research output. The advent of mobile technology devices, such as smartphones and tablets, have changed the landscape of research and information access. These devices offer students, including postgraduate students, unprecedented opportunities to access and manage information with ease. Mobile technology has also provided libraries with new avenues to deliver information services effectively, adapting to the changing needs and preferences of users. However, librarians play a pivotal role in facilitating access to information and guiding social science postgraduate students in their research endeavours. Their attitude towards embracing and leveraging mobile technology devices can significantly impact the quality of information services provided to postgraduate students. It is essential to understand librarians' attitudes to mobile technology devices to ensure that they are equipped to meet the evolving needs of their users. Additionally, librarians in Nigerian universities, like their counterparts worldwide, face several challenges when it comes to integrating mobile technology into their services. These challenges include inadequate infrastructure, limited budgets, and the need for continuous training to stay updated with the latest technologies. Moreover, concerns regarding information security, data privacy, and digital literacy also affect librarians' approach to mobile technology. According to Pew Research Centre (2016), mobile technologies are those that fit hand-held, carried, or transported simplicity. These are tools fit for "on-the-go" use. Among mobile technologies are tablets and iPads as well as smartphones. Web browsers, email, cameras, Wi-Fi, Bluetooth and audio/video players allow mobile technology.

Another variable key to this study is the librarians' attitude. The librarian's professional development is a key factor in the effective integration of mobile technologies in their operations in the library. Hence, whether beginner or experienced, mobile technology-related training programs can develop librarians" competencies in mobile technology use, influencing librarians" attitudes towards mobile technologies and assisting librarians in recognising how mobile technologies are significant in meeting the information needs of users, especially concerning the provision of information services to social science postgraduate students.

Statement of the Research Problem

The introduction of mobile technology devices in universities in Nigeria has motivated the research activities of both students and faculty through effective and efficient information service provision. In an ideal situation, mobile technology devices are supposed to facilitate the research activities of postgraduate students. Librarians are expected to show a positive attitude towards the provision of information services that will bring about research innovation and productivity using mobile technology devices such as smartphones, iPads, iPods, tablets, etc.. as well as mobile applications such as WhatsApp, Gmail, Messengers, Twitter, Chat Generating Pre-print Transformer (GPT), Dropbox, Udemy, Zotero and Coursera etc (Open Al, 2022). for research purposes rather than the non-academic use of this platform most times for personal chatting and social engagement. Previous studies have shown that postgraduate students' usage of mobile technology devices during their research activities is at its lowest point. Furthermore, exposed were problems with network connectivity and erratic power supply, which have slowed down the use of mobile technology devices in enabling the research activities of Social Science postgraduate students concerning the provision of information services using the mobile technology platform. According to Charles and Kevin (2017), out of 555 respondents; 38.2% of students used their phones for one to five hours per day, 98% of them utilised their cell phones to stay in touch with friends and relatives, 75% of users of their

cell phones engaged in social networking and 24% percent of students used their cell phones for academic purposes, thus related to research activities

This is clear from the write-up by Gaffar *et al.*, (2019) who noted that even if mobile technology devices if properly used could bring about efficient research productivity and innovation among postgraduate students, their use in enabling the research activities of postgraduate students in Nigerian institutions has been at its lowest ebb. It is important to underline that in terms of offering information services via mobile technology, academic libraries in this region of the globe are still in their embryonic stage, hence, the need for this study to investigate Librarians' Attitudes to Mobile Technology Devices and the Provision of Information Services for Research Activities of Social Science Postgraduate Students in Nigeria Universities.

Aim and Objectives of the Study

The study aims to investigate Librarians' Attitudes to mobile Technology devices and the provision of information services for research activities of postgraduate students in universities in Nigeria. To achieve this, the following specific objectives are set to:

1. find out the type of research activities carried out by postgraduate students in universities in North Central;
2. find out the level of research activities carried out by postgraduate students in universities in North Central; and
3. determine the availability of mobile technology devices (smartphone, iPod, iPad, GPS, personal digital Assistant, etc.) used for postgraduate students' research activities in universities in North Central.

Research Questions

The following research questions were asked and answered in the study.

1. What are the types of research activities carried out by postgraduate students in universities in North Central, Nigeria?
2. What are the level of research activities carried out by postgraduate students in universities in North Central, Nigeria?
3. What is the availability of mobile technology devices (smartphone, iPod, iPad, GPS, personal digital Assistant, etc.) used for postgraduate students' research activities in universities in North Central, Nigeria?

Scope and Significance

The general scope of the study is to look at librarians' opinions on mobile technology devices and the provision of information services for Social Science postgraduate students' research activities in Nigerian institutions. The study geographically covers North-central, Nigerian institutions. The research covers only a few chosen federal, state, and private universities in North-central Nigeria. The study's content scope covers research activities, mobile technological devices, librarian attitudes, information services offerings, and postgraduate students.

Likewise, the study will be very helpful to university libraries, librarians, information managers, postgraduate students, researchers, and IT specialist/database administrators. Technologists, educationists, telecommunication companies, information service providers and policymakers.

Research Methodology

A descriptive research survey was adopted for this study. The total population of the study was 15,041 from 10 Universities in North-Central, Nigeria. The multistage sampling procedure was adopted for the study. The determined sample size for the study is 376 social science postgraduate students using the Krejcie and Morgan (1970) table for determining the sample size of a large population, while the proportionate sampling technique using the Bowler's allocation formula (Abedoh, 2018) was used to determine the sampling fraction for each of the university. The sampling fraction used in selecting a sample of 376 social science postgraduate students out of 15,041 is 2.5%, this gave the researcher 1024 postgraduate students selected from ten (10) universities. The sample size of 1024 was considered adequate and represented the total population. This became possible taking cognizance of the fact that the population is a standardized population of postgraduate students.

The data collection instrument was the questionnaire supported by an observation checklist. The research instrument was validated by two experts in test and measurement in the department of science education Federal University of Technology, Minna and an independent staff in the department for clarity of instruction, proper wording, and appropriateness and adequacy of the items for the study. A reliability test was also conducted using the questionnaire and the result of the reliability test done variable by variable using the Cronbach Alpha Formula of SPSS gave the following reliability coefficients of 0.905, 0.891, 0.816, 0.877, 0.969, 0.958 and the overall reliability score is **0.979**., based on these results the instrument was confirmed to be reliable and can be used for the study.

Results and Discussions of Findings

Out of 1,024 copies of the questionnaire distributed, 796 copies were completed, retrieved and found usable, representing 78% success. The response rate from the 10 universities in North Central Nigeria is revealed in **Table 4.1.**

Table 4.1: Response Rate

		Copies distributed	Copies retrieved.
1.	Federal University of Technology, Minna, Niger State.	155	121
2.	University of Abuja, Abuja	111	86
3.	University of Jos, Jos.	168	130
4.	University of Ilorin, Ilorin.	123	96
5.	Nile University of Nigeria (NUN), Abuja.	7	5
6.	Prince Abubakar Audu University, Anyigba	45	35
7.	Benue State University, Makurdi	45	35
8.	Kwara State University Malete	25	19
9.	Ibrahim Badamasi University, Lapai	12	9
10.	Nassarawa State University, Keffi	333	260
Total		**1024**	**796(78%)**

Source: Author's Field Work (2022)

Table 4.1 shows the copies of questionnaires distributed and copies returned. The total copies of questionnaires distributed was 1024 copies and a total of 796 copies of the questionnaire were returned and found usable with a (78%) return rate.

4. Objective 1: **Find out the type of research activities carried out by postgraduate students in universities in Nigeria.**

Table 4.2: Type of Research Activities Carried Out by Postgraduate Students In Universities In Nigeria

S/N	ITEMS	MEAN	ST.D	Decision
1.	Workshops	2.84	1.15	Agreed
2.	Seminars	2.86	1.19	Agreed
3.	Thesis Writing	2.75	1.24	Agreed
4.	Basic Research	2.86	1.07	Agreed
5.	Publishing Research Findings	2.84	1.11	Agreed
6.	Applied Research	2.90	1.01	Agreed
7.	Symposiums.	2.82	1.11	Agreed
8.	Interdisciplinary Research.	2.82	1.08	Agreed
9.	Translational Research:	2.74	1.15	Agreed
10.	Conferences	2.72	1.12	Agreed
	Average Weighted Mean	**2.82**	**1.12**	

Source*:* Author's Fieldwork (2023)

Table 4.2 revealed the results of 796 respondents from the 10 universities selected for the study. The result showed that respondents agreed to the 10 types of research activities listed with an average mean score of 2.82 and an average standard deviation of 1.12. The research activities include Item 1: Workshops (mean = 2.84; StD = 1.15), Item 2 Seminars (mean = 2.86; StD = 1.19), Item 3: Research Publications. (mean = 2.75; StD = 1.24), Item 4: Basic Research (mean = 2.86; StD = 1,07), Item 5: Publishing Research Findings (mean = 2.84; StD = 1.11), Item 6: Applied Research (Mean = 2.90; StD = 1.01), Item 7: Symposiums. (Mean = 2.82; StD = 1.11), Item 8: Interdisciplinary Research. (Mean = 2.82; StD = 1.08), Item 9: Translational Research (Mean = 2.74; StD = 1.15), and Item 10 Conferences (Mean = 2.72; StD = 1.12). This implies that postgraduate students in universities in North Central Nigeria agreed to the various types of research activities such as Workshops, seminars, symposiums, Research Publications, Basic Research publishing Research findings, Applied Research, Interdisciplinary Research, Translational Research and Conferences.

Objective 2: **Find out the level of research activities carried out by postgraduate students in universities in Nigeria.**

Table 4.3: Level of Research Activities Carried Out by Postgraduate Students In Universities in Nigeria

S/N	ITEMS	MEAN	ST.D	Decision
1.	Workshops	2.86	1.19	High Level
2.	Seminars	3.08	0.91	High Level
3.	Thesis Writing	2.92	1.14	High Level
4.	Master's Level Research	2.98	1.04	High Level
5.	Ph.D. Level Research	2.98	1.10	High Level
6.	Collaborative Research	2.98	1.02	High Level
7.	Symposiums.	2.90	1.07	High Level

8.	Community-Based Research:	3.04	1.05	High Level
9.	Translational Research:	2.80	1.12	High Level
10.	Conferences	3.08	0.90	High Level
	Average Weighted Mean	**2.96**	**1.05**	

Source*:* Author's Fieldwork (2023).

Table 4.3: revealed the results of 796 respondents from the 10 universities selected for the study. The result showed that respondents agreed to the 10 items on the level of research activities of postgraduate students with an average mean score of 2.92 and an average standard deviation of 1.05. The level of research activities includes: Item 1: workshop (mean = 2.86; StD = 1.19), Item 2: Seminars (mean = 3.08; StD = 0.91), Item 3 Research Paper Publication Writing (mean = 2.92; StD = 1.14), Item 4: Master's Level Research (mean = 2.98; StD = 1.04), Item 5: Ph.D. Level Research (mean = 2.98; StD = 1.10), Item 6: Collaborative Research (Mean = 2.98; StD = 1.02), Item 7: Symposiums. (Mean = 2.90; StD = 1.07), Item 8: Symposiums. (Mean = 3.04; StD = 1.05), Item 9: Translational Research (Mean = 2.80; StD = 1.12), and Item 10: Conferences (Mean = 3.08; StD = 0.90). This implies that postgraduate students' level of research activities is high.

4.2 Objective 3: Determine the availability of mobile technology devices (smartphone, iPod, iPad, GPS, personal digital Assistant e.t.c.) used for postgraduate students' research activities in universities in Nigeria.

		Federal University of Technology Minna		**University of Abuja, Abuja.**		**University of Jos, Jos.**		**University of Ilorin, Ilorin.**		**Nile University of Nigeria (NUN), Abuja.**		Prince Abubakar Audu University, Anyigba		**Benue State University, Makurdi**		**Kwara State University, Malete**		**Ibrahim Badamasi University, Lapai**		**Nasarawa State University, Keffi**	
S/N	**Items**	**A**	**NA**	**A**	**NA**	**A**	**NA**	**A**	**NA**	**A**	**NA**	**A**	**NA**	**A**	**NA**	**A**	**NA**	**A**	**NA**	**A**	**NA**
1.	mobile phone	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-
2.	IPad	-	√	√	-	√	-	√	-	√	-	√	-	√	-	√	-	-	√	√	-
3.	IPods	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√
4.	Global positioning systems	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√
5.	Personal Digital Assistant (PDA)	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√
6.	Bluetooth	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-

7.	Wireless Fidelity (Wi-Fi)	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-
8.	Multi-touch screen	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√
9.	Mobile websites	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-
10.	Media creation and capture tools	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-
11.	Pocket personal computer	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√
12.	Blackberry	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√	-	√
	Total	5	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	5	7	6	6		
	Percentage	42%	58%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	42%	58%	50%	50%		

Source*:* Author's Fieldwork (2023).

Table 4.4 shows the checklist for observation checklist on the availability of mobile technologies devices. The result showed that the Federal University of Technology Minna and Ibrahim Badamasi Babangida University availability of mobile technologies devices used by Social Science postgraduate students is 5(42%) and 7(58%) for non-availability of mobile technologies respectively. However, the University of Abuja, University of Jos, University of Ilorin, Nile University of Nigeria (NUN), Abuja, Prince Abubakar Audu, University, Anyigba. Benue State University, Makurdi, Kwara State University, and Nasarawa State University's availability and non-availability of mobile technologies are 6(50%) and 6(50%) respectively. This implies that there is more need for the provision and adoption of mobile technology devices for research activities by postgraduate students in universities in North Central Nigeria.

4.1. Discussion of the findings are as follows:

1. The types of research activities carried out by social science postgraduate students in universities in Nigeria are dissertation writing, attendance of workshops, seminars, symposiums for research purposes, and publications of research findings in reputable journals. The findings were supported by the findings of "(Abu-helalah *et al.*, 2015; Beanland *et al.*, 2020; Borakati *et al.*, 2017; Kozlov *et al.*, 2017; Noguez & Neri, 2019; Razeghi, 2019; Roach, 2017; Swan *et al.*, 2018; Weiner & Watkinson, 2014)". The authors asserted that research activities such as attending conferences, seminars, and workshops, and interacting with intellectuals in various fields of human endeavour are key to innovation and academic publishing, especially among social science postgraduate students.
2. In a similar line, social science postgraduate students at Nigerian institutions engage in very high levels of research activity by attending workshops, conferences, and seminars, writing theses and dissertations, and interacting with

more experienced colleagues in the field. In support of this, Razeghi (2019) conducted research at the University of Mazandaran, Iran, on the variables impacting postgraduate students' research activities. According to Razeghi's (2019) research, there was no discernible difference in gender, marital status, or place of residence between the scientific pursuits of master's and doctorate students. According to beta coefficients, student academic activities were most impacted by university facilities ($\beta = 0.36$), student satisfaction with instructors ($\beta = 0.34$), and student engagement with professors ($\beta = 0.17$).

3. However, there is a moderate number of mobile technology devices available in university libraries in North Central Nigeria. These include mobile phones, iPads, iPods, Global Positioning systems, personal digital assistants, Bluetooth, wireless fidelity, multi-touch screens, mobile websites, media creation and capture tools, and pocket personal computers. This was against Gaffar, *et al.* (2019) assertion that there has been an explosion of specialised software applications to support communication for those who require the use of mobile technology for their research activities. In the same vein, Mohammadi, Sarvestani, and Nouroozi (2020) affirmed that the wide availability of mobile technology devices such as smartphones, iPads, iPods, and personal digital assistants (PDAs) has made research activities seamless.

4.2 Summary of the Findings

The following findings emanated from the study:

1. Types of research activities carried out by social science postgraduate students in universities in Nigeria are dissertation writing, attendance of workshops, seminars, symposiums for research purposes, and publications of research findings in reputable journals.
2. The level of research activities carried out by social science postgraduate students in universities in Nigeria through attendance of workshops, conferences, seminars, thesis and dissertation writing, and interaction with senior colleagues in the profession is very high.
3. There is a moderate number of mobile technology devices available in university libraries in North Central Nigeria. These include mobile phones, iPads, iPods, Global Positioning systems, personal digital assistants, Bluetooth, wireless fidelity, multi-touch screens, mobile websites, media creation, and capture tools, and pocket personal computers.

Conclusion and Recommendations

In conclusion, the study underscores that librarians' attitudes towards mobile technology devices play a crucial role in shaping the provision of information services for social science postgraduate students' research activities. The findings indicate that embracing mobile technology positively impacts the accessibility, convenience, and efficiency of information retrieval and research activities. , the study underscores the need for training and professional development to enhance librarians' familiarity with mobile technology tools and their effective incorporation into the academic environment. In the broader context of Nigerian universities and the evolving landscape of information services, the study advocates for proactive measures to address the digital divide and promote equitable access to mobile technology resources. It also emphasises the importance of continuous assessment and adaptation of the provision of information services to meet the evolving needs of social science postgraduate students, who are increasingly reliant on mobile technology devices for their research endeavours.

Given the preceding, the following recommendations were made in the context of the three (3) objectives of the study presented in this seminar 1 as follows:

1. Universities in Nigeria under study should ensure that there are mobile-friendly resources and research tools that are optimised for devices that can facilitate seamless access to information on the go since social science postgraduate students' research activities in universities in Nigeria are dissertation writing, attendance of workshops, seminars, symposiums for research purposes, and publications of research findings in a reputable journal.
2. It is important to commend the level of research activities carried out by postgraduate students in universities in Nigeria as the students actively engage in research activities through attendance of workshops, conferences, seminars, thesis and dissertation writing, and interaction with senior colleagues in the profession.
3. There is a need for universities in Nigeria under study to allocate sufficient resources to ensure the availability of up-to-date mobile technology devices, software, and applications in libraries as adequate funding can enable librarians to offer the latest technology tools to students for their research activities.

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PARAMETERS FOR HISTORY TEACHER'S PREFERENCE FOR INTERACTIVE RADIO AND TELEVISION INSTRUCTIONAL PROGRAMMES FOR DISTANCE LEARNERS IN NORTH CENTRAL, NIGERIA

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Abstract
This study investigated the influence/effect of history teachers qualification and experience on the performance for interactive radio and television instructional programme for distance learning. With two research questions, the study adopted a survey research design while the population comprised all history teachers in Lapai local government senior secondary schools with 200 randomly sampled. Two hypotheses are formulated to guide the study. A60-item adopted structured questionnaire validated by experts and with high reliability coefficient of 0.77 was used for data collection. The structuring data was analyzed with t-test statistics. The result shows that both teachers' qualification and teachers experience had significant influence on their preference of radio and television instructional programme for distance learning. Based on the findings, it was partly recommended that NOUN should frequently organize training courses for teachers on the use of the new interactive radio and television instructionaL programme, internet and other web-based interactive instructional programmes.

Keywords: history teachers, preference. Radio and television programmes, and distance learning

Introduction
Telecommunication currently marks the peak of development in human communication. It describes the transmission of messages across short or great distance, with the aid of electrical or electronic gadgets. The telegram, the radio, the telephone, the telex, the television, the faximile and the internet are all telegraphic means of communication. The advent of these

modern means of communication affords people the opportunity to exchange views over long distance with greater conveniences and interactivity

The continues development in communication technology has brought about the evolution of information and communication technology (ICT) which is fast growing and continuously affecting every aspect of human endeavor, be it educational, economic, political, social and even the religious aspect of man. Infact information and communication technology (ICT) has turned the whole world into a global village in the recent time (Abifarin, 2015).

The development of telecommunication technology especially radio and television and in the recent time, internet, has influenced and is still influencing the development of education in all the countries of the world most especially distance learning.

The success of any distance learning programme in any country rests heavily on the development of telecommunication system of such country. That is, for distance learning to thrive, the place of telecommunication is inevitable.

Abifarin (2017) stated that since the year 1996 to 2000, information technology has been playing very crucial role in the distance learning programmes in different parts of the world. For instance, in the United States of America, about 250,000 students were enrolled in independent study courses in over seventy (70) American Universities. Colleges have television Courses known as telecourses, teleconferencing and so on, provided either by two-way video or one-way video with two-way audio, audio conferencing, audio-graphics, cable and computer networking which have contributed to an explosion of internet in distance learning.

Similarly, Evuti (2017) opined that new technologies are having a considerable input on course production and delivery in open and distance learning. Baikie (2023) pointed out the role of the telecommunication in the distance learning system with its focus on the African Virtual University (AVU), a project financed, initiated and managed by the World Bank through the Kenyata University in Nairobi, Kenya. He stated that AVU is an ambitious means by which a broader access to higher education for Africa is achieved through internet and satellite technologies.

According to Olagunju (2022) Instructional Radio or Television programme refers to those broadcasts through the radio or television which relayed directly to an organized Programme of formal education and are directed at specific learners He stated that there are four major points to note in Instructional radio or television programme:

i. Teacher Guided: A teacher leads the viewer through learning experiences.
ii. It is Systematic: Broadcast are related to course of study or syllabus with well stated behavioral objectives and planned learning experiences.
iii. It is orderly and Sequential: Broadcasts are presented at regular intervals in sequence; one builds upon another.
iv. It is integrated: Broadcasts are related to other learning experiences such as laboratory practical, reading, discussion, writing, and assignment and so on.

Evuti (2018) asserts that interactive radio instruction involves teaching through the use of radio whereby the learners are able to interact with the teacher directly through their responses to his instruction. He states that interactive television has similar features with interactive radio in terms of its characteristics.

Presently, television is also very common especially in the later part of20th century and it is almost as available in the home as radio itself. In the recent past, there have been a lot of interactive programmes designed by radio and television stations through phone-in-programmes. If all these phone-in-programmes which are highly interactive in nature are recording greater successes in promoting social. political and religious awareness, it 1s therefore possible for the government to expand a reasonable percentage of the country's "oil money on academic interactive radio and television stations for academic purposes especially if the present open distance learning of the government is to succeed (Evuti, 2005).

Purpose of the Study

A good number of radio and television programmes in Nigeria are becoming highly interactive in nature, that is, (in-built phoning system). This study will therefore investigate history teachers' preference for interactive radio and television programmes as formats for distance learning programmes. The research will equally identify the variables that may influence teachers' preference for interactive radio and television programmes as formats for distance learning programmes.

The study seeks to find out history teachers' preference for interactive radio and television programmes. The study equally seeks to examine the influence of selected teachers examines characteristics variables such as teaching qualifications and teaching experience on preference for interactive instructional radio and television programmes.

Research Questions

1. Is there any difference between professionally qualified and unqualified secondary school history teachers' preference for interactive radio and television instructional programmes in history distance learning programme.
2. Is there any relationship in the experienced and less experienced secondary school history teachers' preference for interactive radio and television instructional programme in history distance learning programmes.

Hypotheses

Ho1: There is no significant difference in the professionally qualifiedand less qualified secondary school history preference for radio and television instructional programmes inhistory distance learning programme.

Ho2: There is no significant difference between the experienced andless experienced secondary school history teacher'spreference for interactive radio and television instructionalprogramme in history distance learning programme

Significance of Study

It is hoped that the findings of this study may further reveal the importance of interactive instructional radio and television programmes in the teaching and learning process and also as good formats for distance learning programmes. It will also serve as a guide to effective and efficient operation of open distance learning as a better option for the conventional educational system.

The study will also create awareness of the media of instruction that will enhance high level of interactivity between the teacher and learners and may also be of immense benefit to the government and school administrators in the planning of educational policies.

Authors and publishers may also be exposed to the interest of the teachers and learners in terms of level of interactivity of instructional media and this will guide them in the types of illustrations they will need to use in their books and even the type of instructional media they will need to produce or write on.

Scope of the Study

This study examined the history teachers' preference for interactive instructional radio and television programmes as formats for distance learning programmes in North Central geo-political zone of Nigeria consisting Niger, Kogi, Kwara, Nasarawa, Plateau and FCT Abuja. The study covered one thousand and two hundred (1200) secondary school history teachers randomly selected from two hundred and forty (240) secondary schools drawn from the six states.

Research Design

The study is carried out through the use of descriptive survey design. The researcher employed the technique of survey using questionnaire in gathering relevant data from the participants (history teachers) in the sample for the identification and analysis of their preference programmes as formats for distance learning programmes.

Behavioural science researchers such as Kerlinger (1978), Osuala (1987), Direnzo (1991), Daramola (2019), Okunloye (2000) and Evuti (2015) had adjudged the technique of survey as the most appropriate for the study of this nature given the potency and suitability for research involving the measurement of people or subjects in terms of systematic analysis of their attitudes, values, opinions, beliefs and customary practices.

Sample and Sampling Techniques

The target sample for this study consisted of one thousand and two hundred (1200) secondary school history teachers randomly selected from two hundred and forty (240) schools drawn from six states of the north central geo-political zone. Two hundred (200) teaches were randomly selected from forty (40) secondary schools in each of the six states. Two variables were considered in the study. These are teachers' qualification and teachers' teaching experience.

Instrumentation

The researchers adapted the instrument for data gathering in this Teachers' Interactives tudy. The instrument was tagged “History Radio and Television Programmes Preference Scale (HRTPPS). It was an adapted form of Dubey and Barth (1980). History Checklist pattern which had been used in conducting researches in history at Usman Danfodio University, Sokoto, and Purdue University, United State of America.

The HTIRATPPS preference checklist consisted of sixty items which sought for demographic information in terms of personal data of each of the respondents including gender, educational qualification (s) and years of teaching experience. The personal data were collected for the purpose of identifying the different categories of history teachers in the study sample, namely, the qualified and unqualified and the experienced and inexperienced. The sixty (60) items on interactive instructional radio and television programmes in history were structured using a 4-point Likert scale.

Validity of Instruments
Although the adapted instrument of Dubey and Barth (1980) history checklists had been given face-validity, the researcher gave instrument to four educational technology and history specialists for evaluation and validation. All the items were reviewed based on the appropriateness of the contents, accuracy level and structure of instruments and meaningful of expression.

Reliability of Instruments
A trial testing of the instrument was carried out to establish its reliability. The instrument was administered on two hundred (200) randomly selected history teachers drawn from twenty-four (24) secondary schools in Niger state.

The first (test) and second (re-test) administration of instrument were carried out within three weeks. The scores obtained during the first and second administration of instruments on the test sample were correlated using Pearson product-moment correlation. The obtained result was 0.77 correlations co-efficient. The research instrument was therefore adjudged reliable because of its high correlation co-efficient which Zimbardo (1979) considered as significant indication of reliability

Data Collection Procedure
The administration of the instruments was carried out on one thousand two hundred (1200) randomly selected secondary school history teachers - drawn from two hundred and forty (240) randomly selected secondary schools in Niger, Kogi, Kwara, Nasarawa, Plateou and FCT Abuja. The researcher administered the questionnaire personally with the assistance of six Research Assistance.

The data collected were collated and used to measure history teachers' preference for interactive radio and television instructional programmes in history in relation to the selected teachers' characteristics identified for the study.

Procedure for Data Analysis
The data collected from the respondents were analyzed with t-test statistical tool which was used to test the two hypotheses formulated.

Hypothesis One ($H0_1$)
Hypothesis one states that there is no significant difference in the preference of professionally qualified and less qualified secondary school history teachers' preference for interactive radio and television instructional programme in history.
T-test statistical tool was used to test this hypothesis and result is presented in table one of this study.

Table 1: T-test analysis showing professionally qualified and unqualified history teachers' preference for interactive radio and television instructional programmes in history.

Variable	N	x	S.D	S2	Df	t-calculated	t-table	P
Qualified teachers	705	2.04	1.73	2.99	1198	2.76	1.96	S
Unqualified teachers	495	1.79	1.38	1.90				

Table 1 above revealed that the mean score recorded by qualified secondary school history teachers (2.04) is greater than that of unqualified secondary school history teachers (1.79). The value of t-calculated (2.78) is greater than the t-table (1.96) at 0.05 level of significance. The null hypothesis (Ho1) was hereby rejected. That is, there is a significant difference, in the professionally qualified and unqualified secondary school history teachers' preference for interactive radio and television instructional programmes in history, Thestudy therefore, shows that secondary school history teachers' qualifications have influence on their preference for interactive radio and television instructional programmes in history

Hypothesis Two

The second hypothesis states that there 1s no significant difference between the experienced and less experienced secondary school history teachers' preference for interactive radio and television instructional programmes in history.

T-test statistical tool was used to test this hypothesis. The result isstated in table two of this study.

Table 2: T-test analysis showing experience and less experience secondary school history teachers preference for interactive radio and television instructional programme

Variable	N	x	S.D	S2	Df	t-calculated	t-table	P
Qualified teachers	862	2.99	1.44	2.07	1198	11.86	1.96	S
Unqualified teachers	338	1.33	2.45	6.00				

Table 2 revealed that the mean score recorded by experience secondary school history teachers (2.99) is greater than, the mean score of the less experienced secondary school history teachers (1.33). The value of t-calculated (11.86) is greater than the t-table (1.96) at 0.05 level of significance. The null hypothesis (Ho2) which stated that "there is no significant relationship between experienced and less experienced secondary school history teachers' preference, for interactive radio and television instructional programme in history was rejected. This result indicated that teaching experience of the social studies teachers determine their preference for interactive radio and television instructional programmes in history.

Summary of Findings

The following results were obtained from the testing of the two
hypotheses of this study:

1. The result of hypothesis one clearly showed that secondary school history teachers' qualifications have influence on their preference for interactive radio and television instructional programme in history.
2. The result of hypothesis two also shows that secondary school history teachers' teaching experience have influence on their preference for interactive radio and television instructional programme in history

Discussion

The preference score recorded for qualified and unqualified secondary school history teachers for interactive radio and television instructional programme indicated that teacher's qualification has significant influence on their preference for interactive radio and television instructional programme in history for distance learning. Similarly, the study reveals preference scores which indicated that the secondary school history teachers' experiences influence their preference for interactive radio and television instructional programme in history for distance

learning. The implication is that the experience secondary school history teachers' preference for interactive radio and television instructional programme differ from the less experienced teachers. Therefore, experiences and qualifications of history teachers are parameters for their preference for interactive radio and television instructional programme in history for distance learning.

Conclusion

From the fore-going discussion, it could be concluded that secondary school history teachers' qualification influences their preference for interactive radio and television instructional programme in history for distance learning. Also, their teaching experience influence their preference for interactive radio and television instructional programme in history for distance learning

Recommendation

1. Government at different levels should endavour to equip the schools with different types of interactive radio and television equipment to ensure that secondary school history teachers are well-equipped and trained in the use of the equipment forteaching history for distance learning programmes.

2. The establishment of the Notional Open University of Nigeria marks the beginning of improved development in distance learning. Governments should fund the programme adequately to ensure that distance learning history facilitators are trained and retrained on the use of modern interactive radio and television instructional programmes equipment and machines.

3. The National Open University of Nigeria (NOUN) should always organize retraining and refresher courses for different categories of teachers especially history teachers on the use of the new interactive radio and television instructional programmes and on the use of other interactive equipment such as the internet and other web-based interactive instructional programmes.

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THE EVOLUTION OF DIGITAL ECONOMY IN NIGERIA: AN OPPORTUNITY FOR YOUTH EMPOWERMENT

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Abstract
This paper examines the rapid development of the digital economy in Nigeria and its potential as a catalyst for youth empowerment. By analyzing the growth trajectories of key digital sectors such as fintech, e-commerce, and digital services, the study investigates how technological advancements and increased internet penetration have reshaped the economic landscape. Utilizing a mixed-methods approach, including quantitative data analysis and qualitative findings from industry experts and young entrepreneurs, the research identifies the primary drivers of digital economic growth and the challenges faced by the youth in harnessing these opportunities. The findings highlight that while the digital economy presents significant opportunities for job creation, skills development, and entrepreneurship, barriers such as inadequate digital infrastructure, limited access to funding, and policy constraints must be addressed. The paper underscores the role of government initiatives, private sector investment, and educational reforms in creating an enabling environment for the digital economy to thrive and empower the youth. The study concludes that a strategic focus on digital literacy, innovative financing solutions, and supportive regulatory frameworks can unlock the full potential of Nigeria's digital economy. This, in turn, can lead to substantial socio-economic benefits, including reduced youth unemployment and enhanced economic resilience. By providing a comprehensive analysis of the intersection between digital economic growth and youth empowerment, this research offers valuable insights for policymakers, educators, and stakeholders aiming to leverage the digital revolution for sustainable development in Nigeria.

Keywords: Digital Economy, Fintech, E-commerce, Digital Services

Introduction
The digital economy has become a significant driver of economic transformation globally, with the potential to reshape industries and create new opportunities for innovation, entrepreneurship, and employment. In Nigeria, the digital economy is rapidly evolving, driven by technological advancements, increased internet penetration, and the growth of key sectors such as fintech, e-commerce, and digital services. This paper aims to explore the development of the digital economy in Nigeria and its potential as a catalyst for youth empowerment. Through a mixed-methods approach, the study examines the factors driving digital economic growth, the challenges faced by Nigerian youth in harnessing these opportunities, and the role

of government and private sector initiatives in creating an enabling environment for the digital economy to thrive.

The digital economy is a dynamic and multifaceted value-driven employment landscape. Even attempts to define the concept have only left investigators interestingly curious about its ongoing evolving facets. According to OECD, the Digital Economy can be defined in three different approaches:

The Bottom-up approach: characterizing industries' and firms' output or production processes to decide whether they should be included in the Digital Economy. These industries could be considered actors based on the proportion of digital inputs used in their production processes.
Top-down or Trend-Based approach: first identifying the key trends driving the digital transformation. And then analyzing the extent to which these affect real economy and its interruptions of global employment landscape. Unlike the bottom-up, the top-down approach examines beyond firms, industries and sectors, but also includes individual, communities and societies. While the latter is more inclusive, the IMF notes that is subjective, qualitative and open-minded, thus limiting meaningful comparative analysis.[1]

Flexible or Tiered approach: breaking the digital economy into core and non-core components, and thereby coming to a compromise between adaptability and the need to arrive at some common ground on the meaning of the term. To reconcile the bottom-up and top-down definitions of the digital economy, Bukht and Heeks stated that:

Digital Economy consist of all sectors making extensive use of digital technologies (i.e their existence depends on digital technologies), as opposed to sectors making intensive use of digital technologies (i.e. simply employing digital technologies to increase productivity).
From the above definition, the Digital Economy is stratified into three nested tiers:

Core: the digital sector and associated core technologies. Example includes hardware manufacturing, software and IT consulting, information services, and telecommunications.
Narrow scope: the digital economy comprising digital services and the platforms-based economy.

Broad scope: the digitalized economy comprising digitalized sectors such as e-Business, e-Commerce, advanced manufacturing, precision agriculture, and gig economy. These digitalized sectors phenomenologically give rise to the Fourth Industrial Revolution.

Extrapolating from the ongoing narrative, it could be deduced that Digital Economy is a largely inclusive concept. The Digital Economic sector could be said to comprise both the principal players; those participants whose core production processes and output is Digital Technology based. And those who only leverage on the technology for better production output or market space. There is also a large stream of consumers who together forms a formidable community for the digital economy market. The impact DE has on production, market and employment landscape is in several specific areas. It is against this outlook that this papers seeks to examine the Nigeria digital economy; how the citizenry, specifically – the youth, could maximize the many available and emerging opportunities of the sector.

Background to the Emergence and Growth of Digital Economy in Nigeria
The Introduction of mobile phone networks in Nigeria in 2001 by the Obasanjo administration could be posited to form the backbone for the growth of digital economy in Nigeria. The

deregulation of the Telecommunication sector by Nigerian Communications Commission (NCC), broke-down the monopoly of Nigerian Telecommunications Limited (NITEL). Licenses were issued to companies like MTN Nigeria, Econet Wireless (now Airtel), and later, Globalcom and Etisalat (now 9mobile). These companies have now invested into the installation of fiber optics amongst other network types that are now used for internet and telecommunications.

By 2010, Nigeria was said to have metamorphosed into one of the fastest growing mobile phones markets in the world, with millions of subscribers and widespread network coverage, including rural areas.[3] This advent has largely expanded the digital economy market in Nigeria and has further encouraged other facets of the sector to leverage upon.

Nigeria's digital economy has continued to witness remarkable growth over the past decade, with significant advancements in fintech, e-commerce, and digital services. The fintech sector, in particular, has emerged as a leading force in the country's digital transformation. Companies such as Paystack, Flutterwave, and Interswitch have revolutionized the financial services industry by providing innovative solutions that enhance financial inclusion and accessibility.[4] The rise of mobile money platforms and digital payment systems has made it easier for individuals and businesses to conduct financial transactions, leading to increased economic activity and the formalization of previously informal sectors. Other fintech companies in Nigeria whose success stories remains an inspiration for aspiring entrants include PAGA, Paystack, Piggyvest, Carbon, Kuda, Jumiapay, Opay, Remita, eTransact, Fairmoney, KiaKia Bits Limited, Moniepoint Inc. Palmpay and Appzone.

The fintech industry in Nigeria is growing and expanding its scope of operation and market coverage. The industry is expanding her footage into more areas such as payment infrastructure, alternative lending marketplaces, blockchain technology and cryptocurrency trading, electronic money transfers and remittances, online business loans and software infrastructural designs to power financial applications. All these areas have remained opportunities for the expansion and growth of the Nigeria economy at large. The skillset for innovations and investment into these digital economy opportunities can also to harnessed more easily through increased access to internet network and Information Technology tools.

E-commerce is another critical component of Nigeria's digital economy. With the proliferation of online marketplaces such as Jumia, jiji and Konga among others, consumers have greater access to a wide range of products and services, often at competitive prices. This has not only transformed the retail landscape but has also created new opportunities for small and medium-sized enterprises (SMEs) to reach a broader customer base[5] as posited by Okoye. Additionally, the growth of digital services, including online education, telemedicine, and digital marketing, has further expanded the scope of the digital economy, enabling the delivery of essential services to a more extensive and diverse population.

Technological Advancements and Internet Penetration

Technological advancements and increased internet penetration have been critical drivers of the digital economy in Nigeria. The expansion of mobile networks and the proliferation of affordable smartphones have significantly increased internet access, particularly among the youth. According to recent data, Nigeria has one of the largest internet user populations in Africa, with over 100 million active users as of 2023.[6] The widespread connectivity has facilitated the growth of digital platforms and services, providing young people with unprecedented opportunities to engage in the digital economy.

The youth, who constitute a significant portion of Nigeria's population, are particularly well-positioned to benefit from these developments. Many young Nigerians are tech-savvy and entrepreneurial, leveraging digital tools to create innovative solutions and start new businesses. For instance, the rise of social media influencers and digital content creators has opened up new revenue streams for young entrepreneurs, enabling them to monetize their online presence and reach global audiences.[7]

Challenges Faced by Youth in the Digital Economy

Despite the significant opportunities presented by the digital economy, Nigerian youth face several challenges that hinder their ability to fully harness these opportunities. According to Adesina, one of the most significant barriers is inadequate digital infrastructure. While internet penetration has increased, many areas, particularly in rural regions, still lack reliable and affordable internet access. This digital divide exacerbates existing inequalities and limits the ability of young people in underserved areas to participate in the digital economy.[8]

Access to funding is another critical challenge. Many young entrepreneurs struggle to secure the financial resources needed to start or scale their digital ventures. Ibrahim pointed that traditional financing options, such as bank loans, are often inaccessible due to stringent requirements and high-interest rates. Additionally, there is a lack of awareness and understanding of alternative financing options, such as venture capital and crowdfunding, among Nigerian youth.[9] This funding gap stifles innovation and limits the potential for youth-led digital enterprises to grow and contribute to the economy.

Policy constraints also pose significant challenges. The regulatory environment in Nigeria is often complex and unpredictable, creating uncertainty for digital entrepreneurs and investors. Issues such as inconsistent enforcement of regulations, bureaucratic red tape, and a lack of clarity on emerging areas like digital taxation and data protection can deter investment and stifle innovation.[10] Without a supportive regulatory framework, it becomes difficult for the digital economy to thrive and for young entrepreneurs to succeed.

The Role of Government, Private Sector, and Educational Reforms

To unlock the full potential of Nigeria's digital economy and empower the youth, coordinated efforts from the government, private sector, and educational institutions are essential. Government initiatives that focus on improving digital infrastructure, promoting digital literacy, and creating an enabling regulatory environment are critical. For instance, programs aimed at expanding broadband access, particularly in rural areas, can help bridge the digital divide and ensure that more young people can participate in the digital economy[11] (Nigerian Communications Commission 12).

According to a World Bank diagnostic report in 2019, Nigeria has made some significant progress and strategic investments, but is yet covering only a fraction of itsw digital economic potential.[12] That Nigeria needs a strategic pragmatic approach for a dynamic transformation of her digital economy. Hence

The Muihammed Buhari led administration had come up with a robust National Digital Economy Policy and Strategy (2020-2030).[13] Very little policy impact was felt or recorded by the President Tinubu regime began. Another major problem of policy formulation and implementation has been an age long discontinuity of policy of one government by her successor. For instance, the Tinubu regime rather adopted a new Digital Economy Policy under the title: “The Digital Economy: Taking Advantage of the Fourth Industrial Revolution”[14]

which meant an abrupt abandonment of the former. Such policy inconsistencies have rather resulted into weakening of the effort to scale-up the Digital Economic growth in Nigeria.

The private sector also plays a crucial role in driving digital economic growth. Investments in fintech, e-commerce, and digital services by private companies have already contributed significantly to the expansion of these sectors. However Bello and Johnson subscribed that, more can be done to support young entrepreneurs, such as providing mentorship, funding, and access to markets. Collaborations between the private sector and educational institutions can also help align educational curricula with the skills needed in the digital economy, ensuring that young people are adequately prepared for the jobs of the future.[15]

Educational reforms are particularly important in equipping Nigerian youth with the skills and knowledge needed to thrive in the digital economy. Digital literacy programs that focus on coding, data analysis, and digital marketing can help young people develop the technical skills required to succeed in digital careers. Additionally, fostering a culture of innovation and entrepreneurship within educational institutions can encourage more young people to explore opportunities in the digital economy.[16]

The recent unbundling on the Higher National (HND) in computer science programme into four separate specializations: artificial intelligence, network/cloud computing, software and web development and cyber security and data protection[17] typifies the type of collaborative effort proposed by this study toward preparing the Nigeria youth to harnessing digital economy opportunities. The collective efforts of robust public-private sector partnership will proliferate high volume of youth participation and entry into the IT industry, in the long-run rapidly reducing unemployment and on the flip side, the youth will be empowered.

Conclusion

The digital economy in Nigeria presents significant opportunities for youth empowerment, offering pathways for job creation, skills development, and entrepreneurship. However, realizing the full potential of the digital economy requires addressing the challenges of inadequate digital infrastructure, limited access to funding, and policy constraints. By focusing on digital literacy, innovative financing solutions, and supportive regulatory frameworks, Nigeria can create an enabling environment for the digital economy to thrive and empower its youth. This, in turn, can lead to substantial socio-economic benefits, including reduced youth unemployment and enhanced economic resilience. As the digital economy continues to evolve, it is essential for policymakers, educators, and stakeholders to collaborate and leverage the digital revolution for sustainable development in Nigeria.

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SOCIO-CULTURAL FACTORS AND THE PROLIFERATION OF SMALL AND MEDIUM SCALE ENTERPRISES IN ILORIN METROPOLIS

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Abstract
In bo*th developed and developing countries, governments are giving attention to small and medium scale industries as a means of economic development and veritable means of solving socio-economic problems .It is also a seedbed of innovations ,inventions and employment. At present in Nigeria ,small and medium scale enterprises assist in promoting the growth of the country's economy ,hence government at all levels at different times promulgated policies promoting the growth and sustenance of small and medium scale enterprises.It is on the basis of this that the study inverted that the Ilorin metropolis four areas were selected using convenient sampling technique (Taiwo-road,Sabo-Oke,Maraba and Oja-Tuntun ,a total of three hundred (300) respondents were selected through the use of stratified sampling technique .The major research instrument used in this study was questionnaire .Thus ,three hundred questionnaires were administered to the respondents to collect quantitative data .Frequency distribution method and percentile methods were used to perform descriptive analysis of data ;while chi-square and pearson moment correlation co-efficient techniques were used to test the hypotheses.The result of the analysis showed that there is a significant relationship between culture and the proliferation of small and medium scale enterprises in Ilorin metropolis and based on the results,this study concluded that socio-cultural factors are important determinants of entrepreneuship in Ilorin metropolis. Therefore, the study recommended government should help the people in developing small and medium scale enterprise ventures by providing loan to young people going forward.*

Keywords; Small and Medium Scale Enterprises; Socio-Cultural Factors; Proliferation.

Introduction

In almost all economies ,Small and Medium Scale Enterprises are paramount for sustainable growth and development (Salako ,2014).A high failure rate is high negativity for an economy ,especially a developing economy with limited capital(Okpara and Wynn ,2017).Recognizing the indispensable role of small and medium scale enterprises in general economic development ,many countries have instituted enterprises support network and structure to fuel the development of these enterprises (Okpara and Wynn ,2017) Nigeria is no exception.

Small and Medium scale enterprises activity is a vital source of innovation, employment and economic growth (Birch , 2019. Carree and Thurik 2018;Parker ,2019;Storey,2020; Van Stel et al.,2021; Wennekers and Thurik ,2019 among others). Scholars who study small and medium scale enterprises have learnt great value by continuing to explore the factors that explain how enterpreneurs best create new business and thus, how societies and economies grow and prosper .With the entrepreneurial turn of the 1990s,during which universities invested in building high- quality faculties to teach and research entrepreneurship and governments increasingly viewed small and medium scale enterprises as a solution to many

social and economic problems ,there ha considerable growth in new research from psychological and economic points of view .In spite of this growth in the literature and salience of entrepreneurship in public policy ,the influence of social and cultural factors on small enterprises development remains understudied.

Also scholars have long pointed out the importance of socio-cultural factors in the decision to create businesses ,arguing that small small and medium scale enterprises is embedded in a social context (Aldrich and Zimmer ,2016).However our review of literature reveals that it is persona and economic factors that have received lion's share of attention with a focus upon either individual small and enterprises behviour or activity of new small and medium enterprises behaviour generally refer to the individual pursuit of new economic endeavours ,ranging from self -employment to the creation of substantial organizations (Carsrud and Johnson ,2019;Collins et al .,2018; McClelland,2016).Others studies have typically focused on the economic approach of small and medium scale enterprises (Audretsch and Keilbach,2014; Audretsch and Thurik ,2011;Parker ,2014 ,Wennekers et at 2015).

Nonetheless ,scholars continue to argue that small and medium scale enterprises variation are better undetstood by considering the social environment in which the firm is created because ,in addition to economic activity ,small and medium enterprises is a social phenomenon (Berger ,2011; Shaperol and Sokol , 2014;Steyaert , 2027).While the economic conditions may explain some of the variation ,any convincing explanation must take account of the social and cultural aspects of small and medium scale enterprises activity (Drakopoulou and A ndserson ,2017).Therefore the Nigeria government has introduced measures tp promote and enhance small and medium scale enterprises development ,the measures include fiscal,monetary and export incentives (Wikipedia ,2019).

In respect of the various past support and incentives programs or initiatives, it would seem rationa to expect that small and medium scale enterprises would proliferate ,grow and flourish in Nigeria .However ,the effectiveness of the programs remain vague and the rate of business failure continue tp escalate (Chea ,2019). Accordingly the present study had explored socio-cultural factors and the proliferation of small and medium scale eneterprises in Ilorin metropolis.

Statement of the Problem.

It has been historically noted that small and medium scale enterprises are conclusively denoted as the driving force of economic growth, employment creation as ell as poverty panacea in developing countries. They have been the yardsticks through which accelerated economic growth and rapid industrialization have been achieved (Harris and Gibson ,2012; Sauser, 2015; Van, Eeden , Viviers and Venter ,2014; Arinaitive ,2012; Kigguwdu,2012;Monk ,2011).

The contributions of small and medium scale enterprises to development are generally acknowledged, enetrepreneurs and small business owners' face plenty obstacles that inhibit their long term survival and development .Research on small business development has shown that the rate of failure in developing countries is higher than in the developed world (Arinaitive ,2012).

It is also of paramount importance to understand the problems facing small business development in Ilorin metropolis because they are significantly different from those facing other states in developed countries .These obstacles include a lack of capital resources ,lack pf

good and vibrant management experience ,poor location ,laws and regulations ,general economic conditions as well as critical factors such as poor infrastructure ,corruption ,low demand of products and services together with poverty.

0ur quest for past literature relevant to the study revealed that up to recent, verylittlr scholarly work has been conducted on the socio-cultural factors affecting the proliferation of small and medium scale em] nterprises in Ilorin metropolis .It should also be noted that socio-cultural factors are also fundamental in the sustenance of small and mefium scale enterprises in Nigeria.

Research Questions and Hypotheses.

This study was planned to provide meaningful answers to the following critical questions:

- What are the socio-cultural factors inhibiting the proliferation of small and mediun scale enterprises in Ilorin metropolis?
- What are the contributions of small and medium scale enterprises towards the economic and industrial development in Ilorin metropolis?
- What are the paramount constraints to the growth and development of small and medium scale enterprises in Ilorin metropolis?
- What policy measures and programs should be set forth to enhance the proliferation, growth and development of small and medium scale enterprises?

In the course of this study, the following hypotheses were revised to to guide this work:

Hypothesis I

Ho: There is no significant relationship between culture and the proliferation of small and medium scale enterprises in Ilorin metropolis.

Hi: There is a significant relationship between culture and the proliferation of small and medium scale enterprises in Ilorin metropolis.

Hypothesis II

Ho: There is no significant relationship between poverty and the proliferation of small and medium scale enterprises in Ilorin metropolis.

Hi: There is significant relationship between poverty and the proliferation small and medium scale enterprises in Ilorin metropolis.

Socio-Cultural Factors Influencing the Development of Small and Medium Scale Enterprises.

Socio-cultural realities remain an important component of the Nigeria business environment as they influence business activities, technology and performance (Odekunle, 2014; Olaoye, 2018; Aghalino 2021; Odetola and Ademola, 2016). Characteristically ,most African enterpreneurs are owners of SMEs and they are confronted with the challenges of nurturing their businesses and promoting the tradition of innovation and entrepreneurship (OECD,2019) .However ,rapid changes in the global business landscape such as technology, transport ,trade , commerce ,communication are currently affecting African entrepreneurs ,who intrinsically attitudinal and sedentary (Ekelido and Bewayo ,2019).Similarly ,anectodal evidence indicated that African entrepreneurs are concentrated mainly on their local market spheres ,with a low potential for long –term growth and development (Beyene ,2014).This reveals that SMEs owners are embedded in a socio-cultural and individual aspect of culture (Dorfmnan and Howel ,2015).Likewise , Ndrich and Zimmer (2012) specify the importance of socio-cultural and individual aspect of cultural realities innthe creation of new businesses and entrepreneurship which they contend is entrenched in social perspective .The

socio-cultural aspect deals with the institution ,norms, roles and values as they exist outside the individuals perception of the component of the cultural system.
Cultural system can be likened to an iceberg .The external or conscious as well as the internal or subconscious aspect where the former is the visible aspect that can be seen ,such as behaviour and some beliefs ,while the subconscious aspect include that part that is not seen such as value and norms (Hall ,2016).Similarly ,Hofstede (2012) noted that human behaviors are influenced by socio-cultural practice and some actions that cannot be divorced fro their socio-cultural context (Bloodgood et al ,2012).Research and past studies have examined factors that differentiate small businesses from large firms (Longnecker et al ,2013; Vitell et al ,2014)They discovered that small firms are embedded in unique circumstance and prone to social and ethical issues .

Weatherly (2014) describe the socio-cultural environment as consisting everything that is not contained within the economy or political system .According to him,socio-cultiral setting is mad up of collection of activities and the relationships people engage in their personal and private lives which include population features ,age,ethnicity .religion ,values ,attitude.lifestyles and associates .These environmentally relevant patterns of behavior lead to the creation of different cultural values in different societies ,some of which influence the decision to create new businesses .Therefore ,culture as distinct from political ,technological or economic context has relevance for economic behaviour ,business performance and proliferation of businesses (Shane 2012;Shapero &Sokol ,2013)

Methodology
A survey design which has been mainly quantitative in nature has been used for the study .The survey design is usually appropriate where researchers seek the opinion of participants (David and Sutton, 2014) with the aim of describing the nature of existing phenomenon (Cohen et al, 2014) This study had seek to establish the impact of socio-cultural factors on the proliferation of small and medium scale enterprises in Ilorin metropolis, hence the sustainability of the design.

Stratified random sampling technique was adopted in selecting (300) three hundred small and medium scale business owners from four areas(Taiwo-road,Sabo-oke,Maraba and Oja-tuntun) in Ilorin metropolis ,as sampling size for the study ,seventy-five (75) small and medium scale owners were randomly selected from each area. In a convenient sampling procedure, participants were selected on the basis of easy availability or access (David and Sutton,2014; Mcmillan and Schumacher, 2020).The above four areas were conveniently selected from the list of areas Ilorin metropolis.

The study used questionnaires hich consist mainly closed items .Questionnaires are normally used in survey designs (Cohen et al ,2012).The reliability of the instruments were established through test-re-test procedure with fifty (50) small and medium scale business owners in Ilorin metropolis thereby ,a pearson correlation coefficient was enumerated in order to access the reliability of these insruments.

Furthermore, the researcher personally administered the questionaires to participants in the respective places. Visitation was made to the above four selected areas to personally administer the questionaires to participants. The SPSS (Statistical Package for the Social Sciences) was used to analyze the collected data .Chi-square (X2) test had been used to test the formulated hypotheses .Simple percentage method was used to reduce the extremity of values of the itmes.

Results and Discussion of Findings

Hypothesis 1

Ho: There is no significant relationship between culture and the proliferation of small and medium scale enterprises in Ilorin metropolis.

Hi: There is significant relationship between culyure and proliferation small and medium scale enterprises in Ilorin metropolis.

Ethnic Affillition who influences you to start business	YES	NO	TOTAL
Family members	125	39	164
Personal flair	58	9	67
Friends and associates	23	20	43
None	0	26	26
TOTAL	206	94	300

X^2C =15.54; df=3; Alpha level =0.05

X^c= 7.82

The above table shows that the calculated value is greater than the critical value. Therefore the null hypotheses is rejected, which means that there is a significant relationship between culture and proliferation of small and medium scale enterprises. This therefore agrees with the findings of Akpor and Masoje (2017), that the impact of culture can be seen in the peculiarity of occupation to different human societies . a case in mind Nigeria.

Pearson moment justifying the relationship between culture and the proliferation small and medium scale enterprises

X(Culture)	125	58	23	0
Y(SMEs)	39	09	20	26

r =0.85; df = 2 alpha level =0.25 ; critical value 0.32

The calculated value (0.85) is greater than the critical value (0.32); suggesting that Ho is rejected . In other words , 0.there is positive relationship between culture and proliferation of small and medium scale enterprises ($r = 0.85$; $df = 2$; $p< 0.32$)

Hypothesis II

Ho : There is no significant relationship between poverty and the proliferation of small and medium scale enterprises in Ilorin metropolis .

Hi : There is a significant relationship between poverty and the proliferation of small and medium scale enterprises in Ilorin metropolis.

Cross tabulation of relationship between poverty and the proliferation of small and medium scale enterprises.

What makes you take up business	**Yes**	**No**	**Total**
Underemployment	134	8	142
Retrenchment from work	1	0	1
Parental orientation	32	38	70

TOTAL	206	94	300

X2c =20.35; Alpha level =0.05; df =6 X2t =12.59

The above table shows that the calculated value is greater than the crititical value .Therefore , the null hypothesis is rejected ,which means that there is a significant relationship between poverty and proliferation of small and medium scale enterprises .This therefore agrees with the findings of Akpokerere(2019), where he stated that unemployment beget poverty and pauperized persons are forced to be creative.

Pearson moment justifying the relationship between poverty and the proliferation of small and medium scale enterprises

X Poverty	134	39	01	32
Y (SMEs)	08	48	0	38

r =7.1; df =2 ; Alpha level =0.05 ;critical value =0.32

The calculated value (7.1) is greater than the critical value (0.32) suggesting that Ho is rejected. In other words , there is a positive relationship between poverty and the proliferation small and medium scale enterprises(r =7.1,df =2, p<0.32).

It is of paramount importance to discuss the findings of this study. Thefindings are highlighted below:

Firstly, the study reveals that majority of those who ventured into small and medium scale enterprises did so as a result of unemployment ,for example ,142 (47%) of the respondent s decided to take up small and medium scale as compared to 1 (0.3%) of the respondents that came into business ,as a result of retrenchment from previous plac e of work .This could be regarded as a socio-cultural push for the proliferation small and medium scale eneterprises.

Secondly, the study reveals that lack of capital is a major constraint to small and medium scale enterprises proliferation in the study area .This tallies with the work of Ekezie (2015), Akpokerere (2020) , Backdam (2014) and Iromaka (2016) in that lack of financial capital remain a cankerworm to the sustenance and development of small businesses .

And finally,the study reveals that there is a significant relationship between culture and proliferation of small and medium scale enterprises Ilorin metropolis.

Conclusion and Recommendation.

The analysis revealed primarily that socio-cultural factors can influence both positively and negatively the proliferation of small and medium scale enterprises in Ilorin metropolis .Also opinions in the theories of entrepreneurial emergence which are rooted in the theory of social behaviour which explains that socio-cultural values and circumstances of a peoole would influence their behavior and decision as a people and as individuals not only in terms of their social lives but also in their economic lives and this includes their decision about entrepreneurship. An individual is a unique personality; he is nevertheless a product of his society. He is subject to the values and influences of his society. In other words socio-cultural factors have significant impact in shaping individual values which directly influence his deisions and action in all endeavours.

Though limited social researcher have written on the socio-cultural factors and proliferation of small and medium scale enterprises in Ilorin metropolis. The following recomedations will serve as solutions based on the findings of study.

Since the employment opportunities are decreasing day by day in government sector. Government should help the people in establishing small and meidum scale enterprise ventures by providing loan to young people, so as to encourage proliferation of small and medium scale enterprises. This can contribute positively to enage people in business related activities at all levels.

Government should make flexible policies to attract young graduates to be an entrepreneur to develop their socio-economic status.

Government on it part must set an agenda for a positively changing social behaviour and societal expectation. It must come to terms with the new world order of values and trend, be committed to enthroning societal values and behaviour that are consistent with requirement for small and medium scale enterpreises program and independence for individuals.

Government must evolve comprehensive enlightment programmes to enable people know the new values, appropriate their essence, cherish them and key into them and habitually act on them. This can be achieved through the establishment of socio-cultural orientation and change agencies that consist of sociologists and psychologists who can design and complement relevant and effective value reengineering and reservation programmes that can usher in and inculcate in individual and groups a new set of described values.

Furthermore, there is also the need to manage the current socio-cultural factors based on its silver content such that the weaknesses and negative failure are converted to opportunities for samll and medium scale enterprises and business proliferation.

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A REVIEW ON LIBRARIANS' ATTITUDE TO MOBILE TECHNOLOGY DEVICES AND PROVISION OF INFORMATION SERVICES FOR THE RESEARCH ACTIVITIES OF POSTGRADUATE STUDENTS IN UNIVERSITIES IN NIGERIA: A DIGITAL LIBRARIAN PERSPECTIVE

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Abstract

Mobile technology devices have become integral to modern research practices, offering new possibilities for information access and academic collaboration. This study explores an empirical and theoretical review of the attitudes of librarians towards mobile technology devices and how these attitudes influence the provision of information services for postgraduate students' research activities in Nigerian universities. Ideally, mobile devices such as smartphones, tablets, and various applications should facilitate research activities and promote productivity. However, preliminary investigations reveal that these technologies are underutilized for academic purposes, with a significant proportion of usage dedicated to social and personal engagements. To address this issue, the study employs a descriptive survey research design, gathering both quantitative and qualitative data through structured questionnaires and observation checklists. The population includes 15,041 postgraduate students across 10 universities in North-central Nigeria, selected through a multistage sampling technique. A sample size of 1,024 postgraduate students was determined to ensure representativeness. The findings indicate a gap between the potential of mobile technology and its actual use in research activities. While there is moderate availability of mobile devices in university libraries, challenges such as cost, lack of awareness, and infrastructural limitations hinder their effective use for academic research. Nonetheless, there is a positive attitude among postgraduate students towards leveraging mobile technology for research, suggesting an opportunity for libraries to enhance their services. Librarians play a crucial role in this transformation. Their attitudes towards mobile technology directly impact the effectiveness of information services. The study highlights the need for training and professional development to improve librarians' competence with mobile technologies. Furthermore, collaboration among librarians, IT departments, and academic staff is essential to ensure seamless integration and support for postgraduate students' research endeavours. The study concludes

that proactive measures are needed to bridge the digital divide and promote equitable access to mobile technology resources. Continuous assessment and adaptation of library services are critical to meeting the evolving needs of postgraduate students. By understanding librarian attitudes and current usage patterns of mobile devices, this research provides valuable insights into enhancing library services and improving the academic experience for postgraduate students in Nigerian universities.

Keywords: Mobile Technology Devices, Librarian's Attitude, Provision of Information Services, Technology Acceptance Model, Postgraduate Students, Nigeria Universities, North-Central.

Introduction

Background to the study

Universities in Nigeria were established with the primary aim of promoting learning, teaching, research and community services. This statement highlights the foundational goals of Nigerian universities, emphasizing their role in advancing education and research. From a researcher's perspective, the focus on research and community service is crucial, as these elements drive societal development and innovation. However, the challenge often lies in aligning these aims with the actual resources, policies, and support systems available to researchers within the universities. Ensuring that the infrastructure and funding mechanisms are adequate to support high-quality research is essential for fulfilling this foundational objective.

Postgraduate students are engaging in diverse research activities, contributing to the intellectual and scientific growth of the society. The involvement of postgraduate students in diverse research activities is a positive indicator of a vibrant academic environment. For researchers, this engagement is vital as it contributes to the knowledge economy and addresses societal issues. However, the diversity of research topics should also be matched with rigorous training in research methodologies, access to necessary resources, and opportunities for collaboration. The extent to which universities support these activities through mentorship, funding, and infrastructure determines the effectiveness of postgraduate research in contributing to societal growth. There is a noticeable trend towards interdisciplinary research among postgraduate students. Interdisciplinary collaboration allows researchers to address complex societal challenges by integrating insights from multiple disciplines. For example, a study by Smith and Johnson (2024) demonstrates how postgraduate students in environmental science collaborate with experts in economics and policy analysis to develop sustainable solutions for environmental conservation. Furthermore, advances in technology have facilitated interdisciplinary research by providing tools for data integration, analysis, and visualization. Through the use of machine learning algorithms and artificial intelligence (AI), postgraduate students can investigate big data sets and find hidden patterns in a variety of disciplines. (Jones & Wang, 2024). This interdisciplinary approach not only enhances the quality of research outcomes but also fosters creativity and innovation among students.

Technological Innovations continue to revolutionise research methodologies in offering new possibilities for postgraduate students. The well-known implementation of virtual reality (VR) and augmented reality (AR) platforms has transformed data visualisation and simulation techniques, allowing researchers to immerse themselves in virtual environments (Chen et al., 2024). For instance, postgraduate students in healthcare fields utilise VR simulations to conduct surgical training and medical diagnosis, enhancing their practical skills and decision-making abilities. Moreover, advancements in data analytics and computational tools have expedited the process of hypothesis testing and experimentation. Cloud computing platforms

enable postgraduate students to access vast computing resources and collaborate on large-scale research projects in real-time (Gupta & Lee, 2024). Big data analytics allows academics to gain important insights from large databases and solve urgent societal challenges like urban planning, public health, and climate change using their power. Stated differently, the definition of research activities consists in defining and re-defining problems, formulating hypotheses or suggested solutions; gathering, organising, and evaluating data; making deductions and reaching conclusions; and at last, carefully testing the conclusions to ascertain whether they fit the forming hypothesis. Anyim (2020) claims that research activities—including research development, testing, and evaluation designed to produce or contribute to generalisable knowledge are systematic investigations. These activities comprise designing research, guiding research, conducting experiments, recruiting research subjects, deciding on eligibility to take part in research, engaging in observational registry programs, analysing or reporting research data, or turning in manuscripts on research for publication.

Similarly, Manuwa (2019) reported that there are other types of research activities that postgraduate students can engage in to find out new ideas or trends in their profession or field of specialisation, which may include; master theses or dissertation writing, attending workshops, seminars as well as conferences both nationally and internationally. The need and importance of research activities especially among postgraduate students in universities cannot be over-emphasized because they enhance innovation and productivity academically as they carry out other types of research activities such as basic research aimed at expanding fundamental knowledge in various fields. This type of research involves theoretical inquiries, experimental investigation and hypothesis testing. For instance, the studies in Physics, Chemistry, Biology and Mathematics explore fundamental principles and phenomena, contributing to the foundational understanding of these disciplines (Okonkwo, 2022). Another significant focus for postgraduate students is applied research. This type of research aims to address practical and develop solutions with direct application in industry, technology, healthcare and other sectors. For example, studies on renewable energy technologies, agricultural innovations, healthcare interventions and engineering designs (Adelabu & Salako, 2023). With the growing recognition of the interconnectedness of various disciplines, interdisciplinary research has gained prominence among postgraduate students. These studies transcend traditional disciplinary boundaries, integrating insights and methodologies from multiple fields to address complex issues. For instance, research at the intersection of health and technology explores the development of wearable devices for remote health monitoring (Oladapo et al., 2024). Translational research focuses on bridging the gap between scientific discoveries and their implementation in real-world settings. Postgraduate students undertake translational research to facilitate the transfer of knowledge from the laboratory to clinical practice, policy-making, and community interventions. Examples include studies on drug development, public health interventions, and policy evaluations (Adeyemi et al., 2023).

There are also different levels of research activities carried out by postgraduate students in Nigerian universities such as Master's Level Research, master's level, postgraduate students typically undertake research projects as part of their degree requirements (Obi & Ibrahim, 2022). PhD students engage in more extensive and in-depth research, often leading to the production of original contributions to knowledge (Ogunleye & Adegbite, 2023). Collaborative research is common among postgraduate students in Nigeria, involving partnerships with academic institutions, government agencies, non-governmental organizations, and industry stakeholders (Okafor et al., 2023). Recognizing the importance of engaging with local communities, some postgraduate students undertake community-based research initiatives. These projects involve active participation from community members in problem

identification, data collection, and decision-making processes (Oluwatobi et al., 2024). Research activities among postgraduate students in Nigeria encompass a diverse range of types and levels, reflecting the multifaceted nature of scholarly inquiry. From basic laboratory investigations to interdisciplinary collaborations and community-based initiatives, these research endeavours contribute to knowledge generation, innovation, and societal development.

In recent years, the proliferation of mobile technology devices has revolutionised various aspects of academic life, including research activities. Postgraduate students in Nigeria, like their counterparts worldwide, are increasingly relying on smartphones and tablets to streamline their research processes, enhance productivity, and access scholarly resources on the go. The prevalent use of mobile devices, including smartphones and tablets, by postgraduate students for various research-related tasks such as information retrieval, data collection, collaboration, and academic writing. According to a survey conducted by Adeoye et.al. (2024), approximately 85% of postgraduate students in Nigerian universities own smartphones, while 45% possess tablets. These devices have become indispensable tools for accessing academic databases, e-books, scholarly journals, and other educational resources. Moreover, they facilitate seamless communication and collaboration among peers and mentors, thereby fostering a conducive environment for scholarly exchange and knowledge dissemination (Oyewumi & Oladosu, 2024). The utilisation of mobile technology devices offers several advantages to postgraduate students engaged in research activities in Nigeria.

Postgraduate students in Nigerian universities exhibit diverse attitudes towards mobile technology devices, which are influenced by factors such as technological proficiency, perceived usefulness, and ease of access. Research by Adekannbi et al., (2019) found that a majority of postgraduate students view mobile technology devices positively, considering them convenient tools for accessing information and enhancing academic performance. Additionally, studies by Oyelekan and Oyelekan (2020) emphasized the significance of perceived usefulness and ease of use as determinants of postgraduate students' attitudes towards mobile technology devices. These findings suggest a favourable disposition towards mobile technology devices among postgraduate students in Nigerian universities. In recent years, mobile technology has become ubiquitous, permeating various aspects of daily life, including educational and research domains (Jones & Czerniewicz, 2024). As such, understanding the attitudes of postgraduate students towards mobile technology is crucial, particularly in the context of their research activities.

Libraries are social establishments that link individuals with knowledge and with other people. This is the moment libraries should seize mobile technologies. Mobile technology will enable novices as well as experienced Postgraduate students to remain relevant in the mobile society as it will affect the library information services for successful and efficient research activities of both levels. If postgraduate students want to increase research output, they must be commensurate with this trend and merge themselves into the mobile sphere. This claim is consistent with the works of Bitagi & Garbo, 2014 and Inyang & Mngutayo, 2017 as the writers argued that open and flexible library policies and services should be used. Understanding postgraduate students' views on mobile technology devices is crucial to make sure they are ready to satisfy the changing demands of their research projects. Additionally, postgraduate students in Nigerian universities, like their counterparts worldwide, face several challenges when it comes to integrating mobile technology into their research activities. These challenges include inadequate infrastructure, limited budgets, and the need for continuous training to stay

updated with the latest technologies. Moreover, concerns regarding information security, data privacy, and digital literacy also affect librarians' approach to mobile technology.

Statement of the Research Problem

In an ideal situation, mobile technology devices such as smartphones, iPads, iPods, and tablets and applications like WhatsApp, Gmail, Messengers, Twitter, Chat Generating Pre-trained Transformer (GPT), Dropbox, Udemy, Zotero, and Coursera would significantly enhance the research activities of postgraduate students. Postgraduate students would have a positive attitude towards using these technologies to access and utilize library information services, leading to greater research innovation and productivity. They would use these tools primarily for academic purposes, rather than personal chatting or social engagement.

Preliminary investigations have revealed that the actual use of mobile technology for research among postgraduate students is suboptimal. Research by Charles and Kevin (2017) indicates that while students spend considerable time on their smartphones, the majority of this time is dedicated to personal communication and social networking rather than academic activities. Specifically, only 24% of students use their smartphones for academic purposes, with the remainder primarily engaging in personal and social activities. Gaffar, Abdul, and Kumar (2019) support these findings, noting that despite the potential of mobile technology to boost research productivity and innovation, its use in facilitating research activities is still limited. Academic libraries in Nigeria are also seen as being in the early stages of integrating mobile technology effectively for information services.

The study aims to address the gap between the ideal usage of mobile technology for educational purposes and the actual low involvement noted among postgraduate students in Nigerian institutions. The study will look at librarians' opinions on mobile technology devices and their role in offering information services to assist postgraduate students' research activities. By understanding these attitudes and current practices, the research seeks to identify barriers and develop strategies to enhance the use of mobile technology in academic research, ultimately improving research productivity and innovation, hence, the need for this study to investigate A Review on Librarians' Attitudes to Mobile Technology Devices and the Provision of Information Services for Research Activities of Postgraduate Students in Nigeria Universities: A Digital Librarian Perspective.

Aim and Objectives of the Study

The study aims to carryout a review of librarians' attitudes to mobile technology devices and the provision of information services for research activities of postgraduate students in universities in Nigeria

To achieve this, the following specific objectives were set to:

1. find out the extent of use of mobile technology devices for research activities of postgraduate students in universities in Nigeria.
2. ascertain the Postgraduate students' attitude towards the use of mobile technology devices for research activities in universities in Nigeria.
3. find out the influence of the provision of Information Services on research activities of postgraduate students in universities in Nigeria.
4. investigate the challenges faced by postgraduate students in the use of mobile technology devices for their research activities in universities in Nigeria.

Research Questions

The following research questions were asked and answered in the study.

1. What is the extent of use of mobile technology devices (smartphone, iPod iPad, GPS, and personal digital assistant.) for research activities of postgraduate students in universities in Nigeria?
2. What is the postgraduate students' attitude towards the use of mobile technology devices for research activities in universities in Nigeria?
3. What is the influence of the provision of Information Services on the research activities of postgraduate students in universities in Nigeria?
4. What are the challenges faced by postgraduate students in the use of mobile technology devices for their research activities in universities in Nigeria?

Research Hypotheses

The following null hypotheses were formulated and tested at a 0.05 level of significance.

HO1: There is no significant relationship between the Provision of information services and research activities of postgraduate students in universities in Nigeria.

HO2: There is no significant relationship between mobile technology devices and the research activities of postgraduate students in universities in Nigeria.

HO3: There is no significant composite effect of Librarian attitudes, mobile technology devices, and Provision of information services on research activities of postgraduate students in universities in Nigeria.

HO4: There is no significant relative effect of Librarian attitudes, mobile technology devices, and Provision of information services on research activities of postgraduate students in universities in Nigeria.

Scope and Significance

The general scope of the study is to investigate Librarians' Attitudes to mobile technology devices, and the provision of information services for the research activities of postgraduate students in universities in Nigeria. The geographical scope of the study covers universities in North-central, Nigeria. the study is limited to some selected federal, state and private Universities in North-central Nigeria. The content scope of the study includes research activities, mobile technology devices, librarian's attitude, provision of information services and postgraduate students.

Similarly, the study will be of great benefit to the following: University Libraries, Librarians, Information Managers, Postgraduate students, Researchers, and IT Specialist/Database Administrators. Technologists, Educationist, Telecommunication Industries, Information Service Providers and Policy Makers

Research Methodology

The research design adopted for the study was the descriptive survey design. The total population of the study was 15,041 from 10 Universities in North-Central, Nigeria.

The multistage sampling procedure was adopted for the study. The determined sample size based on the PGD 336, the MSc. was 380, and the PhD was 308. Therefore, the determined sample size was 1024. postgraduate students by using the Krejcie and Morgan (1970) table to determine the sample size of a large population. This became possible taking cognizance of the fact that the population is a standardized population of PG students. Corroboratively, scholars of note like Krejcie and Morgan (1970) asserted that using a population as vast as 75,000, a sample of 0.51% could be used.

The data collection instrument was the questionnaire supported by an observation checklist. The research instrument was validated by two experts in test and measurement in the Department of Science Education Federal University of Technology, Minna and an independent staff in the department for clarity of instruction, proper wording, and appropriateness and adequacy of the items for the study, (Ibrahim, 2013).

The improved and modified version of the instrument was subjected to a pilot test at Bayero University Kano and Ahmadu Bello University, Zaria. To achieve this, 40% of the sample size (205) copies of the questionnaire were administered to postgraduate students in the universities. The researcher adopted the split-half method for the analysis. According to Chelsea (2015), split-half is used to evaluate the consistency or internal uniformity of a set of balance or test items. The analysis was carried out and the following reliability coefficient was obtained: 0.905, 0.891, 0.816, 0.877, 0.969, 0.958 and the overall reliability score is 0.979. This was done variable by variable, SSPS version 27.0 with this result, it is evident that the instrument is reliable and can be used for the study

Data were analysed using descriptive statistics such as mean, frequency and standard deviation while the inferential statistics were analysed using the Pearson Product Moment Correlation Coefficient and Multiple Regression.

Data Interpretation and Presentation

4.2 Objective 1: Find out the extent of use of mobile technology devices (smartphone, iPod iPad, GPS, and personal digital assistant etc.) for research activities of postgraduate students in universities in Nigeria

The extent of use of mobile technology devices (smartphone, iPod iPad, GPS, and personal digital assistant etc.) for research activities of postgraduate students in universities in Nigeria is the response to the objective. Several items were assessed. The views of the postgraduate students were sought on the items concerning the objective. The decision was based on a benchmark mean of 2.50. Their responses are presented in mean and standard deviation in

Table 4.2.

Table 4.2: The extent of use of mobile technology devices (smartphone, iPod iPad, GPS, and personal digital assistant etc.) for research activities of postgraduate students in universities in Nigeria.

S/N	ITEMS	MEAN	STD	Decision
1.	I used my mobile phone to help in my research activities	2.94	1.18	High Level
2.	I also use an iPad to enhance my research growth.	2.78	1.16	High Level
3.	The use of the iPod has made my research activities easier.	2.76	1.08	High Level
4.	Global positioning systems (GPS) allow me to locate my areas of research activities using Google Maps on my phone.	2.88	1.10	High Level
5.	The Personal Digital Assistant (PDA) allow me to have real-time information about workshops and conferences that will support my research activities	2.65	1.22	High Level
6.	Bluetooth makes it easier for me to retrieve both audio and video information from the mobile devices of my colleagues.	2.88	1.12	High Level
7.	Wireless Fidelity (Wi-Fi) helps me to connect my phone to the internet and another research database as fast as possible	3.04	1.09	High Level

8.	The multi-touch screen allows me to easily access research links on my mobile phone	2.80	1.15	High Level
9.	Using my mobile phone I can easily access mobile-enabled websites	2.96	1.10	High Level
10.	Media creation and capture tools have been made easy when I use my mobile devices	3.06	1.00	High Level
11.	The pocket personal computer allows me to have real-time access to essential information materials for my research activities.	2.76	1.13	High Level
	Average Weighted Mean	**2.86**	**1.12**	

Source*:* Author's Fieldwork (2023)

Table 4.2 revealed the results of 796 respondents from the 10 universities selected for the study. The result showed the extent of the use of mobile technologies for social science research activities by postgraduate students. The extent of the use of mobile technology devices by postgraduate students' average mean score is 2.86 and an average standard deviation of 1.12. The items include: Item 1: I used my mobile phone to help in my research activities (mean = 2.94; StD = 1.18), Item 2: I also use iPad to enhance my research growth (mean = 2.78; StD = 1.16), Item 3: The use of the iPod has made my research activities easier (mean = 2.76; StD = 1.08), Item 4: Global positioning systems (GPS) allow me to locate my areas of research activities using Google Maps on my phone (mean = 2.88; StD = 1.10), Item 5: The Personal Digital Assistant (PDA) allow me to have real-time information about workshops and conferences that will support (mean = 2.65; StD = 1.22), Item 6: Bluetooth makes it easier for me to retrieve both audio and video information from the mobile devices of my colleagues (Mean = 2.88; StD = 1.12), Item 7: Wireless Fidelity (Wi-Fi) helps me to connect m phone to the internet and another research database as fast as possible (Mean = 3.04; StD = 1.09), Item 8: the multi-touch screen allows me to easily access research links on my mobile phone (Mean = 2.80; StD = 1.15), Item 9: Using my mobile phone I can easily access mobile-enabled websites (Mean = 2.96; StD = 1.10), Item 10: Media creation and capture tools have been made easy when I use my mobile devices (Mean = 3.06; StD = 1.00)., and Item 11: The pocket personal computer allows me to have real-time access to essential information materials for my research (Mean = 2.76; St.D = 1.13). This implies that the extent of use of mobile technology devices is high among postgraduate students for research activities.

4.3 Objective 2: Ascertain the Librarians' attitude towards the research activities in universities in Nigeria.

Librarians' attitude towards the research activities in universities in Nigeria is the response to the objective. Several items were assessed. The views of the postgraduate students were sought on the items concerning the objective. The decision was based on a benchmark mean of 2.50. Their responses are presented in mean and standard deviation in **Table 4.3.**

Table 4.3: Librarians' Attitude Towards Use of Mobile Technology Devices and Library Information Services for Research Activities

S/N	STATEMENT	MEAN	ST.D	Decision
1.	Librarians have a positive attitude towards research activities	2.86	1.09	Agreed
2.	Librarians'do not allow their feelings and emotions to interfere with their research activities	2.78	1.11	Agreed
3.	Librarians ensure that they have access to library information services that will aid their research activities more effectively.	3.02	0.96	Agreed

4.	Librarians use mobile technology devices to ensure that they share information resources for the benefit of achieving their research activities.	2.82	1.15	Agreed
5.	Librarians'ensure that have the right resources for their research activities	2.88	0.98	Agreed
6.	Librarians ensure that their feelings and thinking are in line with best practices in supporting the research activities.	2.74	1.10	Agreed
7.	Librarians ensure that they carry out their research activities through collaboration.	2.80	1.05	Agreed
8.	Librarians also ensure that they get relevant information materials for their research activities.	2.72	1.14	Agreed
9.	Librarians use mobile technology devices to have access to online journals to facilitate their research activities	2.88	0.98	Agreed
10.	Having a positive attitude allows Librarians' to carry out their primary research functions	2.82	1.13	Agreed
11.	Librarians encourage the use of new technologies like mobile technology in supporting their research activities in terms of using library information services.	2.96	0.97	Agreed
	Average Weighted Mean	**2.84**	**1.06**	

Table 4.3: revealed the results of 796 respondents from the 10 universities selected for the study. The result showed that respondents agreed with Librarians' attitude towards the use of mobile technology devices for their research activities in universities in Nigeria with an average mean score of 2.84 and an average standard deviation of 1.06. The items include Item 1: Postgraduate students have a positive attitude towards research activities (mean = 2..86; StD = 1.09), Item 2: Librarians do not allow their feelings and emotions to interfere with their research activities (mean = 2.78; StD = 1.11), Item 3: Librarians' ensure that they have access to library information services that will aid their research activities more effectively. (mean = 3.02; StD = 0.96), Item 4: Librarians use mobile technology devices to ensure that they share information resources for the benefit of achieving their research activities (mean = 2.82; StD = 1.15), Item 5: Librarians' ensure that have the right resources for their research activities (mean = 2.88; StD = 0.98). Item 6: Postgraduate students ensure that their feelings and thinking are in line with best practices in supporting the research activities (Mean = 2.74; StD = 1.10), Item 7: Librarians' ensure that they carry out their research activities through collaboration (Mean = 2.80; StD = 1.05), Item 8 Librarians' also ensure that they get relevant information materials for their research activities (Mean = 2.72; StD = 1.14), Item 9: Postgraduate students use mobile technology devices to have access to online journals to facilitate their research activities (Mean = 2.88; StD = 0.98), Item 10: Having a positive attitude allows Librarians' to carry out their primary research functions (Mean = 2.72; StD = 1.12), and Item 11: Librarians' encourage the use of new technologies like mobile technology in supporting their research activities in terms of using library information services (Mean = 2.96; StD = 0.97). This implies that Librarians' have a positive attitude towards research activities in universities in North Central Nigeria.

4.4 : Objective 3: Find out the influence of the provision of information services on research activities of postgraduate students in universities in Nigeria

The answer to the aim is the library information services for research activities of postgraduate students at Nigerian institutions for social science postgraduate students. Several things were evaluated. One solicited the opinions of the postgraduate students on the objects related to the purpose. The ruling rested on a benchmark mean of 2.50. Their responses are presented in mean and standard deviation in **Table 4**

Table 4.4: Influence of Provision Information Services for Research Activities of Postgraduate Students in Universities in Nigeria.

S/N	STATEMENT	MEAN	ST.D	Decision
1.	Current Awareness Services helps to provide the latest information for Postgraduate students' research activities	2.88	1.17	Agreed
2.	Selective dissemination of information has helped me greatly in finding the right resources for my research activities	3.00	0.99	Agreed
3.	Reference services have helped in making PG students' research activities easier	2.92	1.12	Agreed
4.	Copies of relevant information resources through reprography to support their research have been made easier.	2.96	1.01	Agreed
5.	Information technology-related services have also helped in effective service provision for PG students' research activities	2.82	1.15	Agreed
6.	User training has greatly influenced my information-searching skills positively	2.88	1.04	Agreed
7.	Referral services have a positive impact on my research activities	2.74	1.13	Agreed
8.	Circulation services played a vital role in research activities	2.92	1.03	Agreed
9.	Literature search has helped me identify gaps in knowledge	2.70	1.21	Agreed
10.	Print and non-print services have made it possible for me to have access to e-books, e-journals etc. for my research writings	2.85	0.94	Agreed
	Average Weighted Mean	**2.87**	**1.08**	

Source*:* Author's Fieldwork (2023).

Table 4.4; revealed the results of 796 respondents from the 10 universities selected for the study. The result showed that the provision of information services influences the research activities of social science postgraduate students in universities in Nigeria with an average mean score of 2.87 and an average standard deviation of 1.08. The items include Item 1: Current Awareness Services helps to provide the latest information for Postgraduate students' research (mean = 2..88; StD = 1.17), Item 2: Selective dissemination of information has helped me greatly in finding the right resources for my research activities (mean = 3.00; StD = 0.99). Item: 3 Reference services have helped in making PG students' research activities easier (mean = 2.92; StD = 1.12), Item 4: Copies of relevant information resources through reprography to support their research has been made easier (mean = 2.96; StD = 1.01), Item 5: Information technology-related services have also helped in effective service provision for PG student's research activities (mean = 2.82; StD = 1.15), Item 6: User training has greatly influenced my information-searching skills positively (Mean = 2.88; StD = 1.04), Item 7: Referral services have a positive impact on my research activities (Mean = 2.74; StD = 1.13), Item 8: Circulation services played a vital role in research activities (Mean = 2.92; StD = 1.03), Item 9: Literature search has helped me in identifying gaps in knowledge (Mean = 2.70; StD = 1.21), and Item 10: Print and non-print services have made it possible for me to have access to e-books, e-journals etc. for my research writings (Mean = 2.85; StD = 0.94). This implies that the provision of information services influences the research activities of postgraduate students in universities in North Central Nigeria.

: Objective 4: **Investigate the challenges faced by postgraduate students in the use of mobile technology devices for their research activities in universities in Nigeria.**

The challenges faced by social science postgraduate students in the use of mobile technology devices for their research activities in universities in Nigeria is the response to the objective. Several items were assessed. The views of the postgraduate students were sought on the items concerning the objective. The decision was based on a benchmark mean of 2.50. Their responses are presented in mean and standard deviation in **Table 4.5**

Table 4.5: Challenges faced by postgraduate students in the use of mobile technology devices for their research activities in universities in Nigeria.

S/N	STATEMENT	MEAN	STD	Decision
1.	The cost of computerising information services is a major challenge to the use of mobile technology devices	2.80	1.12	Agreed
2.	Lack of knowledge of mobile technology services can also be a constraint to its use in facilitating research activities	2.88	1.08	Agreed
3.	Bandwidth problems resulting in low speed and connectivity can cause frustration among users and librarians	2.84	1.18	Agreed
4.	Privacy concerns may be another challenge faced by PG students in using mobile technology for their research activities.	2.92	1.01	Agreed
5.	Limited memory of mobile devices could be another factor impeding the use of mobile technology for research activities	3.00	0.99	Agreed
6.	Digital right management	2.88	1.10	Agreed
7.	The dearth of technical expertise among library staff	2.82	1.12	Agreed
8.	Management, training and funding challenges could also be a challenge	3.02	1.02	Agreed
9.	Incompatibility of digital content loaded on the mobile phone platform could also be a challenge	2.80	1.05	Agreed
10.	Challenges in providing mobile information services to an increasing number of mobile library users.	2.92	0.99	Agreed
	Average Weighted Mean	**2.89**	**1.07**	

Source: Author's Fieldwork (2023).

Table 4.5; revealed the results of 796 respondents from the 10 universities selected for the study. The result showed the challenges faced by postgraduate students in the use of mobile technology devices for their research activities in universities in Nigeria with an average mean score of 2.89 and an average standard deviation of 1.07. The items include Item 1: The cost of computerising information services is a major challenge to the use of mobile technology (mean = 2..80; StD = 1.17), Item 2: Lack of knowledge of mobile technology services can also be a constraint to its use in facilitating research activities (mean = 2.88; StD = 1.08). Item 3: Bandwidth problems resulting in low speed and connectivity can cause frustration among users and librarians (mean = 2.84; StD = 1.18), Item 4: Privacy concerns may be another challenge faced by PG students in using mobile technology for their research activities. (mean = 2.92; StD = 1.01), Item 5: Limited memory of mobile devices could be another factor impeding the use of mobile technology for research activities (mean = 3.00; StD = 0.99), Item 6: Digital right management (Mean = 2.88; StD = 1.10), Item 7: The dearth of technical expertise among library staff (Mean = 2.82; StD = 1.12), Item 8: Management, training and funding challenges could also be a challenge (Mean = 3.02; StD = 1.02), Item 9: Incompatibility of digital content loaded on the mobile phone platform could also be a challenge (Mean = 2.80; StD = 1.05), and

Item 10: Challenges in providing mobile information services to an increasing number of mobile library users. (Mean = 2.92; StD = 0.99). This implies that there are challenges faced by postgraduate students in the use of mobile technology devices for their research activities in universities in North Central Nigeria.

Summary of Findings

The findings of the study are enumerated as follows:

1. The extent of use of the available mobile technology devices by postgraduate students for research purposes in universities in Nigeria is high, (Singh, *et al.,* (2020).

2. Librarian attitude towards postgraduate students' research activities through the use of mobile technology devices and the provision of information services is quite encouraging and supportive (Larson, 2019)

3. Provision of Information services such as Selective Dissemination of Information (SDI), Current Awareness Service (CAS), referral services, information technology-related services, literature search, circulation services, and reprography services are the services provided by the librarians to positively influence the research activities of postgraduate social science students in universities in Nigeria (Saxena and Yadav, 2013)

4. This is supported by Saxena and Yadav (2013) who asserted that the cost of information technology devices, lack of knowledge of mobile technology services, low bandwidth, limited memory, privacy concerns and digital rights management are the challenges faced in the use of mobile technology devices towards the research activities of postgraduate students in universities in Nigeria.

Conclusion

The research shows that postgraduate students in Nigerian universities are widely using mobile technology devices for their research, indicating a strong adoption of these tools. Librarians play a crucial role in supporting these research activities by providing various information services, which enhance the effective use of mobile technology. Despite this, several challenges limit the full potential of these devices, including high costs, insufficient knowledge about mobile technology services, poor internet bandwidth, limited device memory, and concerns about privacy and digital rights management.

Recommendations

1. **Make Technology More Affordable:** Universities in Nigeria under study should collaborate to provide subsidies or financial aid to reduce the cost of mobile technology devices for postgraduate students.
2. **Increase Training and Knowledge**: Universities in Nigeria under study should organize regular workshops and training sessions to enhance students' understanding and use of mobile technology devices in research.
3. **Upgrade IT Infrastructure:** Universities under study should Improve internet bandwidth and expand digital storage capacities to facilitate more efficient use of mobile technology.
4. **Enhance Support and Policies**: Universities under study should promote ongoing professional development for librarians, address privacy and digital rights issues, and expand information services to better support postgraduate research.

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PRACTICES AND EFFECTIVENESS OF TEACHER–MADE TEST FOR ASSESSING PRACTICAL SKILLS IN MOTOR VEHICLE MECHANIC WORK IN NORTH-WEST, NIGERIA

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Abstract
The study determined the practices and effectiveness of teacher–made test for assessing practical skills in Motor Vehicle Mechanic Work (MVMW) in North-West, Nigeria. Three research questions and three null hypotheses guided the study. The study adopted descriptive survey research design. The target population of the study consisted of 63 MVMW technical college teachers from seven states in North-west, Nigeria. The instrument used in the study were was Practices and Effectiveness of Teacher-made Test Questionnaire (PETMTQ)". The instrument was subjected to face validation by three experts. To ascertain the reliability of the validated instrument, a pilot study was conducted by administering the validated questionnaire (PETMTQ) to eight MVMW teachers in four technical colleges in Kogi State. Cronbach Alpha statistic was used to determine the internal consistency of the quantitative instrument which yielded an overall reliability coefficient of 0.85. Data were collected by administering copies of PETMTQ to the respondents. The data collected were analyzed using mean, standard deviation and z-test. Based on the analyses, the findings of the study revealed that the test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works include: preparing table of specification, determining weightage to different content and setting difficulty level of the test items among others with the grand mean (X = 4.40). The findings also revealed that the test administration practices in teacher-made test for assessing practical skills in motor vehicle mechanic works include: removing potential source of cheating, verifying students' identities and distributing test materials to students among others *with the grand mean (X = 4.50). The findings also revealed that the test scoring practices in teacher-made test for assessing practical skills in motor vehicle mechanic works include: developing scoring rubric or answer key, organizing tests for efficient scoring, and calculating raw scores for each test section among others with the grand mean (X = 4.38). Based on the findings it was recommended among others that technical school administrators should organize workshops and seminars focused on incorporating the test planning practices in teacher-made test for MVMW teachers to create more effective and reliable assessments for practical skills. The study also recommended among others that National board for technical education (NBTE) should develop and implement standardized guidelines for test preparation in motor vehicle mechanic works across educational institutions to guide teachers in creating more effective assessments for practical skills.*

Keywords: Practices, Teacher-Made Test, Practical Skills, Motor Vehicle Mechanic Work

Introduction
Motor vehicle mechanic work is one of the trade programmes offered as a course in Nigerian technical colleges. According to the National Policy on Education (NPE, 2014), the objective of the programme is to produce craftsmen and master craftsmen who are competent and

skillful enough to carry out repair work and maintenance on all types of vehicles. Achievement of the stated objective requires that teachers must constantly teach and evaluate students' using teacher-made classroom tests to get feedback on performance and instruction. The essence of this constant testing is to ascertain the level of students' acquisition of knowledge and mastery of practical skills that will determine the progression of the students to the next level, preparedness for standardized examination, certification and practice after graduation (Salend, 2021). Unfortunately, the performance of Motor Vehicle Mechanics Work (MVMW) students in standardized examinations and practice after graduation has not been encouraging. In support of this, Adebayo and Jimoh (2015) reported an unsatisfactory cognitive achievement and practical skills achievement respectively of MVMW students in examinations in technical colleges. Narita (2019) also revealed that several stakeholders in the education and private sector have questioned the effectiveness of teacher-made tests in schools.

Teacher-made tests are tests developed and administered to the students by a classroom teacher before, during, or after classroom instruction. It is one of the two types of achievement test that measures the achievement of a particular unit of work and helps the teacher match learning objectives with contents (Narita, 2019). According to Ugwu and Mkpuma (2019), it is an achievement test that measures the degree of success attained in a specific area of learning. It is a test that can be used to determine learning outcomes, compare students' performance and give feedback on a lesson. Teacher-made tests can be administered by use of paper and pencil or a computer, where the test taker is required to perform a predetermined task or set of tasks. Esomeonu *et al.* (2019) revealed that the quality and effectiveness of teacher-made test can significantly be influenced by teachers' level of experience, which can be categorized under highly and moderately experience. However, Narita (2019) revealed that due to lack of time and appropriate training on practical skill assessment, the scoring of most teacher-made tests by teachers is subjective and usually biased. Improving teacher competence in the construction of teacher-made test will enhance the quality of instruction, learning and assessment among trade students of motor vehicle mechanic works. The success of students in practical skills of motor vehicle mechanic works is essential for the overall success of the students in the subject as well achievement of the goals of motor vehicle mechanic work in technical colleges where students are expected to acquire the practical skills.

Practical skills are skills that are performed by hand or with human intervention using equipment, tools, or technology requiring guidance, force, or movement (Mhango, 2020). These skills require physical dexterity, understanding of the underlining principles, processes, and sequences. Esomeonu *et al*. (2019) is of the view that practical skills are those skills whose mastery increases a student's competence to undertake any type of practical learning activity. City and Guild (2023) opined that, though practical skills are rarely explicitly defined, they include a person's competency in manipulating a particular piece of equipment. Practical skills are taught in schools for subjects requiring practical knowledge, and students are expected to be competent in them (Bakaira, 2023). Effective learning of motor vehicle mechanic works practical skills as contained in the curriculum involves observing and manipulating motor vehicles and their components. Some of these motor vehicle components require basic skills to manipulate them effectively. The teacher assesses these practical skills often using teacher-made test to determine the success of the students as the students may also be required to exhibit their mastery of these skills when taking standardized examinations and at the work place after graduation. The practices of teachers in constructing teacher-made tests are salient factors in test construction.

The effectiveness of teacher-made tests in assessing practical skills in motor vehicle mechanic works relies on the skills and experience of the individual teachers who constructed the tests and grade them. This means that the teacher-made test can be unreliable and less valid when designed by teachers who have fewer years of experience in testing and teachers who possessed inadequate competence in test construction practices such as item construction, test specification, scoring, and result interpretation. The implication of teachers' inadequacies in test construction practices may likely affect students' achievement negatively, and the acquisition of practical skills in motor vehicle mechanic works in technical colleges. Hence, this study seeks to determine the practices and effectiveness of teacher-made test for assessing practical skills in motor vehicle mechanics works in North-West, Nigeria.

Statement of the Research Problem

The motor vehicle mechanics work programme in Nigerian technical colleges is designed to produce competent auto-mechanics' craftsmen for technological and industrial development. To achieve the objectives of the programme, teachers constantly have to teach practical motor vehicle maintenance and repair work then evaluate the practical skills of their students using teacher-made tests.

However, there seems to be a disparity in the performances of students in the teacher-made classroom test and standardized examination as it has been revealed that students' achievement in motor vehicle mechanics works in standardized examinations has not been encouraging (Salend, 2021; Tyav *et al.,* 2017). This disparity in the performances of students in the teacher-made classroom test and standardized examination has been called to question the teachers' competence and effectiveness in the use of teacher-made tests in assessing the practical skills of students in motor vehicle mechanics work (Sierma, 2024). Also, studies have shown that most teachers in Nigerian schools including motor vehicle mechanics work teachers possessed inadequate test construction skills (Heni, *et al.,* 2020).

The inadequacies of test construction skills among motor vehicle mechanics work teachers in practical skills may not only contribute to the continued production of half-baked auto craftsmen whose services often inflict more damages on the vehicles than repairs but also affect the realization of the objectives of motor vehicle mechanics works programme in technical colleges in Nigeria. Hence, this study was designed to determine the practices and effectiveness of teacher-made tests for assessing practical skills in motor vehicle mechanics work in North-West, Nigeria.

Aim and Objectives of the Study

The aim of the study was to determine the practices and effectiveness of teacher-made test for assessing practical skills in motor vehicle mechanic work in North-West, Nigeria. Specifically, the study was sought to determine the:

1. Test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works.
2. Test administration practices in teacher-made test for assessing practical skills in motor vehicle mechanic works.
3. Test scoring practices in teacher-made test for assessing practical skills in motor vehicle mechanic works.

Research Questions

The following research questions were formulated to guide the study:

1. What are the test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works?
2. What are the test administration practices in teacher-made test for assessing practical skills in motor vehicle mechanic works?
3. What are the test scoring practices in teacher-made test for assessing practical skill in motor vehicle mechanic works?

Hypotheses

The following null hypotheses were formulated to guide the study and were tested at 0.05 level of significance.

H_{01}: There is no significant difference between the mean responses of highly experienced and moderately experienced MVMW teachers on the test planning practices in teacher-made test for assessing practical skills in MVMWs.

H_{02}: There is no significant difference between the mean responses of highlyexperienced and moderately experienced MVMW teachers on the test preparation practices in teacher-made test for assessing practical skills in MVMWs.

H_{03}: There is no significant difference between the mean responses of highly experienced MVMW teachers and moderately experienced MVMW teachers on the test scoring practices in teacher-made test for assessing practical skills in MVMWs.

Methodology

The study adopted descriptive survey research design. The study was carried out in North-west, Nigeria which includes states such as; Jigawa, Kaduna, Kano, Katsina, Kebbi, Sokoto, and Zamfara. The target population of the study consisted of 63 motor vehicle mechanic works teachers teaching in technical colleges in North-west, Nigeria. Two instruments were used in the study. They include: Practices and Effectiveness of Teacher-made Test Questionnaire (PETMTQ)" and Practices and Effectiveness of Teacher-made Test Interview Protocol (PETMTIP)". The instruments were subjected to face validation by three experts. To ascertain the reliability of the validated instruments, a pilot study was conducted by administering the validated questionnaire (PETMTQ) to eight MVMW teachers in four technical colleges in Kogi State. Cronbach Alpha's statistical technique was used to determine the internal consistency of the quantitative instrument which yielded an overall reliability coefficient of 0.85. The reliability of qualitative instrument (PETMTIP) was achieved as two respondents agreed with the transcribed contents of the face-to-face interview. The data collected was analyzed using mean, standard deviation and z-test. Mean and standard deviation were used to answer the research questions while z-test was used to test the null hypotheses at 0.05 level of significance. Also, qualitative data collected was collected using thematic analysis.

Research Question 1: What are the test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works?

The data for answering research question one is presented in Table 1.

Table 1: Mean and Standard Deviation of Respondents on the Test Planning Practices in Teacher-Made Test for Assessing Practical Skills in MVMWs N = 58

S/N	Items	Mean ($\bar{x}$)	SD	Remark
1	Defining the purpose of the test	4.53	0.50	SA
2	Identifying the target audience	4.50	0.49	SA
3	Specifying the objectives of the test	4.04	0.70	A
4	Analyzing the target audience	4.20	0.64	A

5	Determining the test format	4.32	0.59	A
6	Preparing table of specification or test blueprint	4.60	0.61	SA
7	Preparing of item types to be included	4.48	0.64	A
8	Determining the weightage to different content areas	4.55	0.70	SA
9	Developing a scoring scheme for the test items	4.30	0.61	A
10	Setting the difficulty level of the test items	4.52	0.58	SA
11	Planning the test length by estimating the time	4.54	0.68	SA
12	Writing test items that are clear and unambiguous	4.37	0.71	A
13	Creating answer options or model responses	4.60	0.69	SA
14	Arranging questions in a logical order	4.36	0.55	A
15	Creating instructions and guidelines for the test	4.67	0.75	SA
16	Developing answer sheets or response format for the test	4.55	0.64	SA
17	Planning for test security by developing measures to prevent cheating	4.11	0.70	A
18	Conducting an initial review of the test items	4.14	0.68	A
19	Reviewing of the test by subject matter experts	4.39	0.88	
20	Gathering feedback on content difficulty and clarity from subject matter experts	4.33	0.59	A
21	Making necessary adjustments to items, instructions or structure based on feedback	4.22	0.60	A
22	Administering the test to a small group of representative students	4.62	0.74	SA
23	Conducting item analysis to identify problematic questions	4.55	0.78	SA
	Grand Mean/SD	**4.40**	**0.65**	**Agreed**

Key: N = Number of respondents; SD = Standard Deviation; SA = Strongly Agree; A = Agree

Table 1 shows the mean responses of the respondents on 23 items posed to determine the test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. The mean values of the respondents ranged from 4.04 to 4.67, with a resulting grand mean of 4.40 which implies that the respondents collectively agreed to the 23 items as the test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. Also, the standard deviation of the items ranged from 0.49 to 0.88 with a resulting average standard deviation of 0.65, which implied that the 23 items had their standard deviation less than 1.96, indicating that the respondents were not too far from the mean and were close to one other in their responses. This closeness of the responses adds value to the reliability of the mean.

Research Question 2: What are the test administration practices in teacher-made test for assessing practical skills in motor vehicle mechanic works? The data for answering research question two is presented in Table 2.

Table 2: Mean and Standard Deviation of Respondents on the Test Administration Practices in Teacher-Made Test for Assessing Practical Skills in MVMWs N = 58

S/N	Items	Mean ($\bar{x}$)	SD	Remark
1	Preparing the testing environment by removing any distracting materials or potential source of cheating	4.68	0.63	SA
2	Gathering all necessary materials for the test	4.64	0.58	SA
3	Reviewing the test administration manual to understand specific instructions and procedures	4.54	0.65	SA
4	Setting up any required technology to ensure proper functioning	4.03	0.50	A
5	Providing clear instructions to proctors or assistants on how to handle various situations during the test	4.82	0.49	SA
6	Verifying students' identities	4.58	0.55	SA
7	Organizing students to follow the seating arrangements specified in the test protocol	4.60	0.44	SA

8	Distributing test materials to students	4.70	0.60	SA
9	Providing general instructions which covers test purpose, format and duration of the test	4.30	0.66	A
10	Guiding students through practice questions	4.22	0.74	A
11	Demonstrating how to mark answers correctly	4.64	0.58	SA
12	Announcing the start of test and the expected end time	4.45	0.49	A
13	Circulating the room to observe students	4.66	0.58	SA
14	Addressing procedural questions as needed	4.55	0.64	SA
15	Following predetermined break schedules	4.38	0.50	A
16	Providing time updates at regular intervals	3.98	0.85	A
17	Handling unexpected interruptions according to protocol	4.20	0.66	A
18	Collecting materials systematically to ensure all test booklets and answer sheets are accounted for.	4.75	0.73	SA
19	Dismissing students appropriately to ensure they do not discuss the test as they leave	4.57	0.64	SA
20	Storing all test booklets and answer sheets in a secure location	4.65	0.60	SA
	Grand Mean/SD	**4.50**	**0.61**	**Strongly Agreed**

Key: N = Number of respondents; SD = Standard Deviation; SA = Strongly Agree; A = Agree

Table 2 shows the mean responses of the respondents on 20 items posed to determine the test administration practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. The mean values of the respondents ranged from 3.98 to 4.75, with a resulting grand mean of 4.50, which implied that the respondents strongly agreed to the 20 items as the test administration practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. Also, the standard deviation of the items ranged from 0.44 to 0.85 with an average standard deviation of 0.61, which implied that the 20 items had their standard deviation less than 1.96, indicating that the respondents were not too far from the mean and were close to one other in their responses. This closeness of the responses adds value to the reliability of the mean.

Research Question 3: What are the test scoring practices in teacher-made test for assessing practical skills in motor vehicle mechanic works?
The data for answering research question three is presented in Table 3.

Table 3: Mean and Standard Deviation of Respondents on the Test Scoring Practices in Teacher-Made Test for Assessing Practical Skills in MVMWs N = 58

S/N	Items	Mean ($\bar{x}$)	SD	Remark
1	Developing a clear scoring rubric or answer key	4.54	0.59	SA
2	Establishing a secure environment for scoring to maintain test integrity	4.43	0.65	A
3	Organizing tests for efficient scoring	4.55	0.74	SA
4	Implementing a system for tracking scored and unscored tests	4.22	0.85	A
5	Beginning scoring with objective items (multiple choice)	4.64	0.48	SA
6	Implementing quality control measures, such as random rescoring	4.64	0.66	SA
7	Entering scores into a secure database or scoring system	4.52	0.71	SA
8	Double-checking data entry for accuracy	4.46	0.54	A
9	Calculating raw scores for each test section	4.37	0.56	A
10	Applying any necessary score adjustments or curves	4.24	0.62	A
11	Converting raw scores to scaled or standardized scores if required	4.29	0.51	A
12	Performing statistical analyses to assess test reliability and validity	4.10	0.67	A
13	Generating individual score reports	4.69	0.52	SA
14	Storing all test materials and scoring data securely	4.40	0.65	A

15	Performing item analysis to evaluate question effectiveness and difficulty	4.54	0.49	SA
16	Conducting post-scoring debriefings to identify areas for improvement	4.31	0.66	A
17	Developing a procedure for handling score appeals or rechecks	4.11	0.70	A
	Grand Mean/SD	**4.38**	**0.62**	**Agreed**

Key: N = Number of respondents; SD = Standard Deviation; SA = Strongly Agree; A = Agree

Table 3 shows the mean responses of the respondents on 17 items posed to determine the test scoring practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. The mean values of the respondents ranged from 4.10 to 4.69, with a resulting grand mean of 4.38, which implied that the respondents unanimously agreed to the 17 items as the test scoring practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. Also, the standard deviation of the items ranged from 0.48 to 0.85 with an average standard deviation of 0.62, which implied that the 17 items had their standard deviation less than 1.96, indicating that the respondents were not too far from the mean and were close to one other in their responses. This closeness of the responses adds value to the reliability of the mean.

Hypothesis 1: There is no significant difference between the mean responses of highly experienced and moderately experienced MVMW teachers on the test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works (P<0.05).
The result of null hypothesis one is presented in Table 4.

Table 4: Z-Test Result of the Significant Difference between the Mean Responses of Highly Experienced and Moderately Experienced MVMW Teachers on the Test Planning Practices in Teacher-Made Test for Assessing Practical Skills in MVMWs

		Levene's Test for Equality of Variances		Z-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	Z	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper
Test Planning Practices	Equal variances assumed	9.102	.429	3.402	56	.690	.26404	.05140	.08290	.38704
	Equal variances not assumed			3.018	22.043	.402	.26404	.07429	.06184	.45802

(p>0.05) NS = Not significant

Table 4 shows the z-test analysis for the test of significant difference between the mean responses of highly and moderately experienced MVMW teachers on the test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. The Levene's test was carried out to determine equality of variance. The test showed an F value of 9.10 with a p-value of 0.43 which means equal variances was assumed. Also, the z-test analysis showed a value of 3.40 and a p-value of 0.69 which is greater than the bench mark of 0.05. Hence null hypothesis one was upheld. This implied that there was no significant difference between the mean responses of highly and moderately experienced MVMW teachers as regards the test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works.

Hypothesis 2: There is no significant difference between the mean responses of highly experienced and moderately experienced MVMW teachers on the test administration practices in teacher-made test for assessing practical skills in motor vehicle mechanic works (P<0.05). Null hypothesis two was tested and the result is presented in Table 5.

Table 5: Z-Test Analysis Result of Significant Difference between the Mean Responses of Highly Experienced and Moderately Experienced MVMW Teachers on the Test Administration Practices in Teacher-Made Test for Assessing Practical Skills in MVMWs

		Levene's Test for Equality of Variances		Z-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	Z	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper
Test Administration Practices	Equal variances assumed	12.056	.319	4.220	56	.478	.16024	.07481	.07634	.50849
	Equal variances not assumed			3.704	21.480	.049	.16024	.05484	.04568	.24716

(p>0.05) NS = Not significant

Table 5 shows the z-test analysis for the test of significant difference between the mean responses of highly and moderately experienced MVMW teachers on the test administration practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. The Levene's test was carried out to determine equality of variance. The test showed an F value of 12.06 with a p-value of 0.32 which means equal variances was assumed. Also, the z-test analysis showed a value of 4.22 and a p-value of 0.48 which is greater than the bench mark of 0.05. Hence null hypothesis three was upheld. This implied that there was no significant difference between the mean responses of highly and moderately experienced MVMW teachers as regards the test administration practices in teacher-made test for assessing practical skills in motor vehicle mechanic works.

Hypothesis 3: There is no significant difference between the mean responses of highly experienced and moderately experienced MVMW teachers on the test scoring practices in teacher-made test for assessing practical skills in motor vehicle mechanic works (P<0.05). The data for testing null hypothesis three is presented in Table 6.

Table 6: Z-Test Result of the Significant Difference between the Mean Responses of Highly Experienced and Moderately Experienced MVMW Teachers on the Test Scoring Practices in Teacher-Made Test for Assessing Practical Skills in MVMWs

		Levene's Test for Equality of Variances		z-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	Z	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper
Test Scoring Practices	Equal variances assumed	7.674	.204	3.252	56	.302	.19194	.05902	.07475	.30914

	Equal variances not assumed	2.794	21.520	.251	.19194	.06869	.04889	.33499

(p>0.05) NS = Not significant

Table 6 shows the z-test analysis for the test of significant difference between the mean responses of highly and moderately experienced MVMW teachers on the test scoring practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. Levene's test was carried out to determine equality of variance. The test showed an F value of 7.67 and a p-value of 0.20, which implied that equal variances was assumed. The z-test analysis indicated a value of 4.22 and a p-value of 0.48 which is greater than the bench mark of 0.05. Hence, null hypothesis four was upheld. This implied that there was no significant difference between the mean responses of highly and moderately experienced MVMW teachers as regards the test scoring practices in teacher-made test for assessing practical skills in motor vehicle mechanic works.

Discussion of Findings

Findings of research question one revealed that the test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works include: defining the purpose of the test, preparing table of specification, determining the weightage to different content areas and setting the difficulty level of the test items among others. These test planning practices are essential for assessing practical skills in motor vehicle mechanic works in technical colleges. Also, findings of hypothesis one revealed that there was no significant difference between the mean responses of highly and moderately experienced MVMW teachers on the test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. The findings implied that irrespective of the level of experience of MVWM teachers their opinion regarding test planning practices for assessing practical skills in motor vehicle mechanic works were the same.

These findings are in conformity with the findings of Muzenda (2017) who in the study of the effectiveness of teacher-made tests on the performance of pupils in Goromonzi District in Mashonaland East Province in Zimbabwe revealed that the test planning practices for improving the performance of pupils include; defining the objective of the test, preparing table of specifications and setting the difficulty level of the test items among others. The findings also revealed that there no significant difference between the mean responses of teachers and administrators regarding the test planning practices for improving the performance of pupils. More so, the findings was in resonance with the findings of Esomeonu *et al*. (2019) which revealed that the test planning practices for practical skill assessment among radio television and electronic work teachers in Federal Capital Territory, Abuja and Nassarawa State include: defining the purpose of the test, preparing table of specification, determining the weightage to different content, setting the difficulty level of the test items, creating answer options or model responses and creating instructions and guidelines for the test among others. These findings affirm the result of this study on the test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works are true.

Findings of research question two revealed that the test administration practices in teacher-made test for assessing practical skills in motor vehicle mechanic works include: removing potential source of cheating, verifying students' identities and distributing test materials to students among others. These test administration practices are crucial for effectively assessing practical skills in motor vehicle mechanic works in technical colleges. Also, findings of

hypothesis two revealed that there was no significant difference between the mean responses of highly and moderately experienced MVMW teachers on the test administration practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. The findings implied that irrespective of the level of MVWM teachers' experience, their opinion regarding test administration practices for assessing practical skills in motor vehicle mechanic works were the same.

The findings are in agreement with the findings of Esomeonu *et al.* (2019) who conducted a study on practical skill assessment practices among radio television and electronic work teachers in Federal Capital Territory, Abuja and Nassarawa State. The study revealed that the test administration practices for practical skill assessment among radio television and electronic work teachers in Federal Capital Territory, Abuja and Nassarawa State include: removing all subject related materials, arranging students to seat properly, providing clear test instructions to students and distributing test materials to students among others. However, in terms of hypothesis, the findings do not correlate with the findings of Galle (2019) which also revealed that there was a significant difference between the mean responses of public and private school Economics teachers regarding test administration practices of teacher-made test in senior secondary schools in Nasarawa State, Nigeria. The variations in the findings could be because of that both studies did not use the same set of respondents.

Findings of research question three revealed that the test scoring practices in teacher-made test for assessing practical skills in motor vehicle mechanic works include: developing a clear scoring rubric or answer key, organizing tests for efficient scoring, beginning scoring with objective items, and calculating raw scores for each test section among others. These test scoring practices are essential for assessing practical skills in motor vehicle mechanic works. Also, findings of hypothesis three revealed that there was no significant difference between the mean responses of highly and moderately experienced MVMW teachers on the test scoring practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. The findings implied that MVWM teachers had the same opinion as regards test scoring practices for assessing practical skills in motor vehicle mechanic works.

These findings are in accordance with the findings of Muzenda (2017) which revealed that the test scoring practices for determining the performance of pupils in Goromonzi District in Mashonaland East Province in Zimbabwe include; developing a clear marking guide or scoring rubric, gathering tests for efficient scoring, scoring objective items first, and calculating raw scores for each test section among others. The findings also goes in line with the findings of Ogbeide and Idusogie (2016) which revealed that the test scoring practices of secondary schools teachers for measuring students' learning behavioural outcome include: choosing appropriate item type, identifying the specific content to be assessed, determining the cognitive level of each test item, creating plausible distractors and writing the test items. The findings of Ogbeide and Idusogie (2016) gave credence to the findings of this study on hypothesis four regarding the test scoring practices in teacher-made test for assessing practical skills in motor vehicle mechanic works. Therefore, this finding is a true reflection of the test scoring practices in teacher-made test for assessing practical skills in motor vehicle mechanic works.

Conclusion

Based on the findings from the opinions of highly and moderately experienced MVMW teachers regarding the effectiveness and practices of teacher-made test for assessing practical skills in motor vehicle mechanic works, the study concludes that the test planning practices in teacher-made test for assessing practical skills in motor vehicle mechanic works include:

defining the purpose of the test, preparing table of specification, determining the weightage to different content areas and setting the difficulty level of the test items among others. These findings collectively point to a structured and thoughtful approach to test development among MVMW teachers. The identified practices shows that teachers are cognizant of the importance of carefully planning their assessment instruments.

Recommendations

The following recommendations were made based on the findings of the study.

1. Technical school administrators should organize workshops and seminars focused on incorporating the test planning practices in teacher-made test for MVMW teachers to create more effective and reliable assessments for practical skills.
2. Workshops and seminars on proper test administration techniques for assessing practical skills in motor vehicle mechanic works should be organized for MVMW teachers to create a more secure testing environment for learners and keep them updated with the strategies of detecting and preventing academic dishonesty among students.
3. Workshops and conferences on how to develop and implement standardized scoring rubrics for practical skills assessments should be organized for MVMW teachers to improve their test scoring practices.

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INFLUENCE OF TRANSACTIONAL AND TRANSFORMATIONAL LEADERSHIP ON MOTIVATION AND JOB PERFORMANCE AMONG METALWORK TECHNOLOGY EMPLOYEES IN TERTIARY INSTITUTIONS IN NORTH-WEST NIGERIA

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Abstract
The study determined the influence of transactional and transformational leadership on motivation and job performance among metalwork technology employees in tertiary institutions in North-west Nigeria. Three research questions and three null hypothesis guided the study. The study adopted a mixed method known as explanatory sequential research design and was carried out in the North-West region of Nigeria. A total population of 138 metalwork technology employees in tertiary institutions of learning in North-West Nigeria was considered for the study. The instruments used for data collection were a structured questionnaire and an interview protocol. The instruments were face validated by three experts. The internal consistency of the instrument was determined using Cronbach's Alpha formula and an overall reliability index of 0.89 was obtained. Mean and Standard deviation were used to answer research questions one and two, while thematic content analysis was used to analyse the qualitative data to answer research question three. Z-test was used to test the null hypotheses at 0.05 level of significance. Based on the analyses, the study found out among others that the influence of transactional and transformational leadership on motivation of metalwork technology employees in tertiary institutions in North-West Nigeria includes promoting competition and fostering collaboration, emphasizing efficiency and inspiring a sense of purpose among others with a grand mean of 4.01. Based on the findings, the study recommended among others that the government should organize leadership training programme for metalwork technology employees in tertiary institutions in North-west Nigeria so that they can be educated on influence of transactional and transformational leadership on motivation.

Keywords: Transactional leadership, Transformational leadership, Motivation, Job performance

Introduction
Tertiary institutions are post-secondary institutions in Nigeria where medium skilled and higher-level manpower such as teachers, civil servants, engineers, humanists, entrepreneurs, scientists and myriads of other personnel are produced for economic and national development. Tertiary institutions are collection of higher institutions of learning that include Universities, Polytechnics, Monotechnics and Colleges of Education. Tertiary education according to Federal Republic of Nigeria (2016) is designed to contribute to national development through high-level relevant manpower training, to develop and inculcate proper values for the survival of the individual and society, to develop the intellectual capability of individual to understand and appreciate their local and external environment, to acquire both physical and intellectual skills which will enable individuals to be self-reliant and useful members of the society among other goals. One of the educational programmes in tertiary institutions in Nigeria is metalwork technology education.

Metalwork technology education involves the application of scientific knowledge in the process of designing and construction of objects out of metal in an artistic and skillful way. Measuring, cutting, drilling, grinding, shaping, boring, assembling, as well as fabrication of objects are part of activities usually carried out in metalwork (Ekpoh & Akeke, 2021). At tertiary level, the programme is usually under the leadership of an highly experienced employee as head of department or head of section with other moderately experienced teaching and non-teaching employees who all work in various capacities to achieve the objectives of the programme. However, it is unfortunate that the aim of metalwork technology in tertiary institutions in Nigeria does not seem to be adequately achieved (Dupe *et al.*, 2020). The study further stated that several stakeholders in education, public and private sector as well as studies have blamed the worrisome situation majorly on poor leadership in tertiary institutions.

Leadership is the process by which a superior person influences subordinate to work toward the actualization of organizational goals and objectives. Ajibade *et al*. (2017) described leadership as a dynamic process of influencing people which, in certain organizational conditions, can have an effect on other members, with the aim of meeting the objectives of the group. Many different leadership styles are exhibited by leaders. Leadership style is the way human resources are manipulated in furtherance of personal and organizational goals. Leadership in relation to tertiary institutions involves the process of directing, coordinating the activities and efforts as well as motivation of employees and students towards the attainment of educational objectives for which the institution or department is set to achieve. Leadership needs vary across employee levels of work experience. Issues of leadership in tertiary institutions in Nigeria have been raised in many instances as it has been linked to the observed poor standard and quality of tertiary education in Nigeria (Ajibade *et al*., 2017). Most public and private tertiary institutions in Nigeria are bedeviled with various leadership crises which most times results in closure of schools and adversely affect employee motivation and job performance as well as students' academic performance. Vigoda-Gadot (2021) noted that leadership styles such as transactional and transformational significantly influence employee job performance.

Transactional leadership style is the process of appealing to employee needs to increase motivation and job performance. Transactional leadership according to Ohunakin *et al.* (2020) was introduced for the first time by Max Weber in his work on socio-economic considerations of the organization. Furthermore, a transactional leader according to Weber is a leader who earns leadership through normative rules and regulations, strict discipline and systematic control. Followers' obedience relied not only on rational values and rules, but also on laid down agreements. They are guided and at the same time limited to the tasks assigned to them. Remuneration is fixed on hierarchical order and organization's bureaucracy. A transactional leader clarifies and lays much emphasis on goals. A Study by Vigoda-Gadot (2021) revealed that transactional leadership has positive correlation with employee job performance in the Banking institution. Transformational leadership style just like transactional leadership style is associated with employee job performance.

Transformational leadership is a style of leadership where the leader works with employees to identify the needed change, creating a vision to guide the change, and executing the change (Vigoda-Gadot, 2021). A transformational leader pays attention to concerns and developmental needs of individual followers, they change follower's awareness of issues by helping them to look at old problems in a new way and they are able to arouse, excite and inspire followers to put out extra effort to achieve group goals. Contrary to use force of personality (charismatic) or bargaining (transactional) to persuade followers, transformational leaders use knowledge, expertise and vision to change those around them in a way that makes them followers with

deeply embedded buy-in that remains even when the leader that created it is no longer on the scene. The leadership style promotes high performance, motivation and morale among followers. This therefore suggest that transformational leadership may likely aid in enhancing metalwork technology education employee job performance in tertiary institutions in Nigeria.

Employee job performance, refers to the efficiency and effectiveness of employees in achieving organizational, institutional or departmental goals and objectives. It consists of the observable behaviors that employees do in their jobs that are relevant to the goals of the institution or department. Employee job performance according to Donohoe (2019) refers to how employees behave in the workplace and how well they perform the job duties obligated to them. In this study employee job performance will be considered as how metalwork technology employees meet expected standards and how well they perform their job duties assigned to them in tertiary institutions. Job performance of employees in tertiary institutions is important because good quality tertiary education is an important avenue towards nurturing the manpower needed in Nigeria.

Motivation can be defined as the complexity of forces that inspires a person at work to intensify his desires and willingness to use his potential to perform in order to achieve organizational objectives (Ekundayo, 2018). Motivation can be either extrinsic or intrinsic. Extrinsic motivations are those that are external to the task of the job, such as pay, work condition, fringe benefits, contract of service, the work environment and conditions of work. While intrinsic motivations are non-financial benefits such as recognition, security, title, promotion, appreciation, praise, involvement in decision making, flexible working hours among others. Motivation is a critical ingredient in employee performance and productivity. Motivated employees are enthusiastic to exert a certain level of effort (intensity), for a certain amount of time (persistence), toward a distinct goal or direction. A motivated employee feels less stress, enjoy their work, and as a result have better physical and mental health. This implies that job performance of metalwork technology employees can be significantly improved when motivated. Hence, this study determined the influence of both transactional and transformational leadership on motivation among metalwork technology employees (highly experienced and moderately experienced) in tertiary institutions in Nigeria.

Highly experienced employees are individuals who have accumulated a significant amount of practical work experience, typically spanning several years or even decades in a particular field, industry or job role. These employees possess a deep and comprehensive understanding of their domain, developed through hands-on exposure to a wide range of situations, challenges and tasks (Rosen *et al.,* 2019). In field of metalwork technology, they include employees who have 10 years and above practical work experience as either a teaching or a practicing metalwork personnel. Also, moderately experienced employees are individuals who have acquired a reasonable amount of practical work experience in their field or typically ranging from a few years to around a decade. These employees possess a solid foundation of knowledge and skills but their level of expertise and exposure may not be as extensive as that of highly experienced employees. Moderately experienced employees have a considerable amount of time, ranging from three (3) to nine (9) years of experience in their respective fields or industries (Switzer, 2020). In field of metalwork technology, they include both the academic and non-academic employees with three to nine years of experience in the field. These employees (highly and moderately experienced employees) are best fashioned to provide valid responses regarding the influence of transactional and transformational leadership on motivation and job performance of among metalwork technology employees in tertiary institutions.

Tertiary institutions are higher educational institutions that provide post-secondary education such as universities, polytechnics, colleges of education innovation and vocational enterprise institutions. These institutions offer a variety of academic programmes and degrees beyond secondary educational level. The success of tertiary institutions in Nigeria is highly dependent on the leadership style they adopt. Through an effective leadership, employees are motivated to contribute to the growth and development of their various institutions. However, it is worrisome to note from the reviewed literature that poor leadership and poor job performance among some employees (including metalwork technology education) of tertiary institutions in Nigeria appears to be a common thing. The need for leadership that will help motivate metalwork technology employees in tertiary institutions improve on job performance and to ensure that their graduates attain a minimum level of competence in their fields of study becomes imperative. This study therefore, needs to investigate the influence of transactional and transformational leadership on motivation and job performance among metalwork technology employees in tertiary institutions.

Statement of the Problem

The primary aim of metalwork technology is to equip students with practical skills and technical knowledge in various metalwork processes such as welding, fabrication, machining, casting and forging. The programme is expected to produce medium and higher skilled manpower (such as technical teachers) with the intellectual and professional background adequate for teaching basic technology and metalwork or metalwork technology. According to National board for Technical Education (NBTE, 2022), the programme is expected to produce skilled, knowledgeable and industry-ready graduates or professionals who can contribute to the growth and development of various sectors that rely on metalwork processes and products. Tertiary institutions offering this programme assign leadership roles to some employees to direct, coordinate the activities and efforts as well as motivation of employees and students towards the attainment of educational objectives of the programme.

However, it is observed that there is a huge gap between the skills possessed by metalwork technology graduates and the skills required of metalwork industries for employment in industries (Ekpo & Akeke, 2021). The quality of metalwork technology graduates produced from tertiary institutions is drastically declining due to the poor leadership styles of several stakeholders in tertiary institutions which cuts across teaching and non-teaching staff (Rosen *et al.,* 2019). Dupe *et al.* (2020) also reported that most public and private tertiary institutions in Nigeria are bedeviled with various leadership crises which often times results in closure of schools, loss of academic activities and consequently having a negative influence on students' academic performance as well as employee motivation and job performance. Hence, a large numbers of metalwork technology graduates have continuously been found incapable of meeting up with the employment requirements of the workforce and have thus been unsuccessful in either securing or keeping a job.

The observed situation if left on address may continue to pose serious threats to the realization of the objectives of Metalwork technology education programs in particular, tertiary education and security of Nigeria in general. These unemployed and frustrated graduates are left with little options and most of them get involved in kidnapping, banditry, cyber crime, robbery and all forms of social vices just to earn a living. Metalwork technology program leaders in tertiary institutions need to adopt effective leadership styles with the potentials of influencing employee motivation and job performance that may reverse the present unsatisfactory situation. Therefore, the study had to determine the influence of transactional and transformational leadership on motivation and job performance among metalwork technology employees in tertiary institutions in North-west Nigeria?

Aim and Objectives of the Study

The aim of this study was to determine the influence of transactional and transformational leadership on motivation and job performance among metalwork technology employees in tertiary institutions in North-west Nigeria. Specifically, the study determined:

1. The influence of transactional and transformational leadership on motivation among metalwork technology employees in tertiary institutions in North-west Nigeria.
2. The influence of transactional and transformational leadership on job performance among metalwork technology employees in tertiary institutions in North-west Nigeria.
3. The techniques for improving transactional and transformational leadership among metalwork technology employees in tertiary institutions in North-west Nigeria.

Research Questions

The following research questions guided the study.

v. What is the influence of transactional and transformational leadership on motivation of metalwork technology employees in tertiary institutions in North-West Nigeria?
vi. What is the influence of transactional and transformational leadership on job performance of metalwork technology employees in tertiary institutions in North-West Nigeria?
vii. What are the techniques for improving transactional and transformational leadership among metalwork technology employees in tertiary institutions in North-west Nigeria?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

Ho_1: There is no significant difference between the mean responses of moderately experienced and highly experienced employees on the influence of transactional and transformational leadership on motivation among metalwork technology employees in tertiary institutions in North-west Nigeria.

Ho_2: There is no significant difference between the mean responses of moderately experienced and highly experienced employees on the influence of transactional and transformational leadership on job performance among metalwork technology employees in tertiary institutions in North-west Nigeria.

Ho_3: There is no significant difference between the mean responses of moderately experienced and highly experienced employees on the techniques for improving transactional and transformational leadership among metalwork technology employees in tertiary institutions in North-west Nigeria.

Research Methodology

The study adopted a mixed method known as explanatory sequential research design and was carried out in the North-West region of Nigeria. A total population of 138 metalwork technology employees in tertiary institutions of learning in North-West Nigeria was considered for the study. The instruments used for data collection were: A structured questionnaire titled "Influence of Transactional and Transformational Leadership on Motivation and Job Performance of Metalwork Technology Employees Questionnaire (ITTLMJPMTEQ)" and an interview protocol titled "Influence of Transactional and Transformational Leadership on Motivation and Job Performance Interview Protocol (ITTLMJPIP)". The instruments were face validated by three experts. The internal consistency of the instrument was determined using Cronbach's Alpha formula and an overall reliability index of 0.89 was obtained. Mean and Standard deviation were used to answer research questions one and two, while research question three was answered using thematic content analysis. Z-test was used to test the null

hypotheses at 0.05 level of significance. Statistical Package for Social Sciences (SPSS) version 26 was used for the analysis.

Results and Discussion

Research Question One

What is the influence of transactional and transformational leadership on motivation of metalwork technology employees in tertiary institutions in North-West Nigeria? The data for answering research question one is presented in Table 1.

Table 1: Mean and Standard Deviation of Responses on Influence of Transactional and Transformational Leadership on Motivation of Metalwork Technology Employees in Tertiary Institutions in North-West, Nigeria N =119

S/N	Items	$\bar{x}_1$	SD_1	$\bar{x}_2$	SD_2	$\bar{x}_A$	SD_A	Remark
1	Providing clear goals, and consequences while inspiring a shared vision	4.15	0.40	4.43	0.65	4.29	0.53	A
2	Offering contingent rewards and recognizing achievements	3.67	0.85	3.88	0.99	3.78	0.92	A
3	Monitoring performance and providing coaching and feedback.	4.06	0.73	4.29	0.52	4.18	0.63	A
4	Emphasizing adherence to procedures and encouraging creativity	3.28	0.83	3.40	0.58	3.34	0.71	D
5	Maintaining a structured hierarchy while empowering employees	3.51	0.81	4.02	0.96	3.77	0.89	A
6	Using disciplinary measures while building trust and respect	3.89	0.94	4.46	1.01	4.18	0.98	A
7	Focusing on task completion and promoting continuous improvement	3.82	0.66	3.90	0.80	3.86	0.73	A
8	Offering limited autonomy and encouraging risk-taking	4.11	0.88	3.72	0.46	3.92	0.67	A
9	Promoting competition and fostering collaboration	4.72	0.38	4.84	0.78	4.78	0.58	SA
10	Addressing immediate issues and promoting long-term development	3.81	0.74	4.00	0.59	3.91	0.67	A
11	Maintaining formal relationships and serving as a role model	2.82	0.67	3.40	0.48	3.11	0.58	D
12	Encouraging adherence to standards and promoting ethical behavior	4.52	0.72	4.74	1.02	4.63	0.87	SA
13	Providing structured training and opportunities for growth	3.48	0.45	4.33	0.86	3.91	0.66	A
14	Emphasizing efficiency and inspiring a sense of purpose	4.62	0.55	4.78	0.83	4.70	0.69	SA
15	Using positional power and promoting employee involvement	3.09	0.96	3.28	0.77	3.19	0.87	D
16	Focusing on short-term goals and promoting a shared vision	2.95	0.41	3.88	0.67	3.42	0.54	D
17	Offering little autonomy and encouraging critical thinking	4.56	0.46	4.78	0.68	4.67	0.57	SA
18	Promoting compliance and fostering a supportive environment	4.60	0.83	4.66	0.77	4.63	0.80	SA
19	Using negative reinforcement and recognizing achievements	2.88	0.47	3.45	0.81	3.17	0.64	D

20	Prioritizing immediate results and encouraging continuous learning	3.67	0.48	3.52	0.99	3.60	0.74	A

Table 1. Continues

21	Offering contingent rewards and promoting work-life balance	4.43	0.94	4.79	0.80	4.61	0.87	SA
22	Emphasizing productivity and promoting diversity and inclusion	4.75	0.63	4.80	0.75	4.78	0.69	SA
23	Promoting accountability and fostering a sense of ownership	3.47	0.82	4.01	0.96	3.74	0.89	A
	Grand Mean/Standard Deviation	**3.86**	**0.68**	**4.15**	**0.77**	**4.01**	**0.72**	**Agreed**

Key: $\bar{x}_1$ = Mean of moderately experienced employees, $\bar{x}_2$ = Mean of highly experienced employees, $\bar{x}_A$ = Average of the means, SD_1 = Standard deviation of moderately experienced employees, SD_2 = Standard deviation of moderately experienced employees, SD_A = Average Standard Deviation N = Number of respondents, SA = Strongly Agree, A = Agree, D = Disagree.

The result presented in Table 1 reveals the mean and standard deviation of responses from moderately and highly experienced employees regarding the influence of transactional and transformational leadership on motivation of metalwork technology employees in tertiary institutions in North-West Nigeria. The two groups of respondents strongly agreed with 7 items, agreed with 11 items and disagreed with 5 items. In summary, the respondents agreed that the highlighted items are influences of transactional and transformational leadership on motivation of metalwork technology employees with means ranging from 3.11 to 4.78 and a grand mean of 4.01 was obtained. Also, the standard deviation for the items ranged from 0.53 to 0.98, none of the standard deviations obtained by the items was above 1.96 which indicates that the responses were not too far from the mean. The closeness of responses to the mean adds value to its reliability.

Research Question Two

What is the influence of transactional and transformational leadership on job performance of metalwork education employees in tertiary institutions in North-West Nigeria? The data for answering research question two is presented in Table 2.

Table 2: Mean and Standard Deviation of Responses on Influence of Transactional and Transformational Leadership on Job Performance of Metalwork Technology Employees in Tertiary Institutions in North-West, Nigeria N =119

S/N	Items	$\bar{x}_1$	SD_1	$\bar{x}_2$	SD_2	$\bar{x}_A$	SD_A	Remark
1	Enhancing job performance through shared expertise	4.52	0.95	4.36	0.76	4.44	0.86	A
2	Enhancing job satisfaction among employees	4.09	0.77	3.95	0.43	4.02	0.60	A
3	Increasing the productivity of employees	4.47	0.50	4.80	0.47	4.64	0.49	SA
4	Improving overall organizational performance	3.62	0.88	3.51	0.97	3.57	0.93	A

5	Increasing organizational commitment	3.80	0.48	4.22	0.54	4.01	0.51	A
6	Improving employee well-being in the institution	4.66	0.59	4.70	0.66	4.68	0.63	SA
7	Enhancing creativity among employees	3.98	0.84	4.11	0.79	4.05	0.82	A
8	Improving problem-solving skills among employees	4.20	0.91	4.54	0.63	4.37	0.77	A
9	Increases employees' professional development	3.83	0.64	3.91	1.00	3.87	0.82	A
10	Improves quality of work	4.52	0.81	4.16	0.58	4.34	0.70	A
11	Empowering employees to take ownership of their work	3.40	0.59	3.29	0.44	3.35	0.52	D
12	Ignites passion and dedication	2.98	0.57	3.07	0.89	3.03	0.73	D
13	Fostering a sense of belonging and shared responsibility.	3.18	0.73	4.10	0.84	3.64	0.79	A

Table 2. Continues

14	Fosters a culture of continuous learning and improvement.	4.30	0.61	4.62	0.58	4.46	0.60	A
15	Improve morale and drive to excel	2.72	0.77	3.86	0.48	3.29	0.63	D
16	Encourages employee to embrace new technologies and techniques in their work	3.96	1.01	4.05	0.85	4.01	0.93	A
17	Leads to higher levels of job proficiency	4.22	0.46	4.19	0.69	4.21	0.58	A
18	Results in increased job satisfaction	4.68	0.88	4.73	0.76	4.71	0.82	SA
19	Creates a dynamic work environment for employees	4.07	0.53	4.33	0.74	4.20	0.64	A
20	Fosters efficiency and accountability	4.00	0.81	3.96	0.90	3.98	0.86	A
	Grand Mean/Standard Deviation	**3.96**	**0.72**	**4.12**	**0.70**	**4.04**	**0.71**	**Agreed**

Key: $\bar{x}_1$ = Mean of moderately experienced employees, $\bar{x}_2$ = Mean of highly experienced employees, $\bar{x}_A$ = Average of the means, SD_1 = Standard deviation of moderately experienced employees, SD_2 = Standard deviation of moderately experienced employees, SD_A = Average Standard Deviation N = Number of respondents, SA = Strongly Agree, A = Agree, D = Disagree.

The analysis result presented in Table 2 show the mean and standard deviation of responses from moderately and highly experienced employees regarding the influence of transactional

and transformational leadership on job performance of metalwork education employees in tertiary institutions in North-West Nigeria. Averagely, both respondents strongly agreed with 3 items, agreed with 14 items and disagreed with 3 items. In summary, the respondents agreed that the highlighted items are influences of transactional and transformational leadership on job performance of metalwork technology employees with means ranging from 3.03 to 4.71 and a grand mean of 4.04 was obtained. Also, the standard deviation for the items ranged from 0.49 to 0.93, no item had a standard deviation above 1.96 which indicates that the responses were not too far from the mean. The closeness of responses to the mean adds value to its reliability.

Research Question Three

What are the techniques for improving transactional and transformational leadership among metalwork technology employees in tertiary institutions in North-west Nigeria? The data for answering research question three is presented in Table 3.

Table 3: Summary of the Qualitative Response of Employees on Techniques for Improving Transactional and transformational Leadership among Metalwork Technology Employees in Tertiary Institutions in North-West, Nigeria N = 7

S/N	Themes	f	Percentage
1	Establishing achievable targets and goals.	7	100%
2	Motivate employees through effective communication.	7	100%
3	Developing a system for monitoring employee performance.	7	100%
4	Providing timely feedback on employees performance.	6	86%
5	Using disciplinary measures for non-compliance.	7	100%
6	Offering opportunities to improve employees' skills.	6	86%
7	Fostering a culture of accountability among employees.	5	71%
8	Building trust by being honest in taking decisions.	7	100%
9	Promoting collaboration among employees and departments.	6	86%
10	Challenging employees to take calculated risks.	5	71%
11	Promoting a culture of respect for individual differences.	6	86%
12	Encouraging good ethical behavior and social responsibility.	7	100%
13	Fostering a competitive environment among employees.	6	86%
14	Encouraging adherence to safety protocols.	7	100%
15	Promoting teamwork among employees.	7	100%

Key: N = Total number of Respondents, f = frequency of theme

The result presented in Table 3 shows the summary of qualitative data from respondents as regards the techniques for improving transactional leadership among metalwork technology employees in tertiary institutions in North-west Nigeria. The result of analysis show that 100% of the respondents identified themes 1, 2, 3, 5, 8,12,14 and 15 as techniques for improving transactional leadership among metalwork technology employees in tertiary institutions while themes 4, 6, 9 and 13 were identified by 86% of the respondents. Furthermore, themes 7 and 10 were mentioned by 71% of the respondents. No theme was less than 70%, therefore all themes are considered as techniques for improving transactional leadership among metalwork technology employees in tertiary institutions in North-west Nigeria.

Hypothesis One

There is no significant difference between the mean responses of moderately experienced and highly experienced employees on the influence of transactional and transformational leadership on motivation among metalwork technology employees in tertiary institutions in North-west Nigeria. The data for testing hypothesis one is presented in Table 4.

Table 4: Z-Test Analysis of Moderately and Highly Experienced Employees on the Influence of Transactional and Transformational Leadership on Motivation among Metalwork Technology Employees in Tertiary Institutions in North-West Nigeria

		Leven's Test for Equality of Variance		Z-test for Equality of Means						
						Sig. (2-tailed)	Mean diff.	Std. error diff.	95% interval of the difference	
		F	Sig.	Z	df				Lower	Upper
Transactional Transformational motivation	Equal variance assumed.	.935	.24	1.68	117	.512	4.15	2.96	-1.02	4.09
	Equal variance not assumed.			1.92	117	.776	3.86	3.44	-1.17	4.55

Table 4 shows z-test analysis that compares the mean response of moderately experienced and highly experienced employees on the influence of transactional and transformational leadership on motivation among metalwork technology employees in tertiary institutions in North-west Nigeria. The data presented shows Leven's test with a p-value of 0.24 which implies that equal variance is assumed. Furthermore, the z-value obtained from the analysis was 1.68 and a p-value of 0.512 which is greater than 0.05 level of significance. Therefore, the null hypothesis was accepted implying that there is no significant difference between the mean responses of moderately experienced and highly experienced employees on the influence of transactional and transformational leadership on motivation among metalwork technology employees in tertiary institutions in North-west Nigeria.

Hypothesis Two

There is no significant difference between the mean responses of moderately experienced and highly experienced employees on the influence of transactional and transformational leadership on job performance among metalwork technology employees in tertiary institutions in North-west Nigeria. The data for testing hypothesis two is presented in Table 5.

Table 5: Z-Test Analysis of Moderately and Highly Experienced Employees on the Influence of Transactional and Transformational Leadership on Job Performance among Metalwork Technology Employees in Tertiary Institutions in North-West Nigeria

		Leven's Test for Equality of Variance		Z-test for Equality of Means						
						Sig. (2-tailed)	Mean diff.	Std. error diff.	95% interval of the difference	
		F	Sig.	Z	df				Lower	Upper

Transactional Transformational Job Performance	Equal variance assumed.	.775	.041	0.53	117	.142	3.96	0.93	-0.72	1.39
	Equal variance not assumed.			0.81	117	.212	4.12	0.40	-1.01	1.45

Table 5 shows z-test analysis that compares the mean response of moderately experienced and highly experienced employees on the influence of transactional and transformational leadership on job performance among metalwork technology employees in tertiary institutions in North-west Nigeria. The Leven's test shows a p-value of 0.041 which implies that equal variance is not assumed. Also, the z-value obtained from the analysis was 0.81 and a p-value of 0.212 which is greater than the 0.05 bench mark. Hence, the null hypothesis was accepted implying that there is no significant difference between the mean responses of moderately experienced and highly experienced employees on the influence of transactional and transformational leadership on job performance among metalwork technology employees in tertiary institutions in North-west Nigeria.

Hypothesis Three

There is no significant difference between the mean responses of moderately experienced and highly experienced employees on the techniques for improving transactional and transformational leadership among metalwork technology employees in tertiary institutions in North-west Nigeria. The data for testing hypothesis three is presented in Table 6.

Table 6: Z-Test Analysis of Moderately and Highly Experienced Employees on the Techniques for Improving Transactional and transformational Leadership among Metalwork Technology Employees in Tertiary Institutions in North-West Nigeria

		Leven's Test for Equality of Variance		**Z-test for Equality of Means**						
						Sig. (2-tailed)	**Mean diff.**	**Std. error diff.**	**95% interval of the difference**	
		F	**Sig.**	**Z**	**Df**				**Lower**	**Upper**
Transactional Techniques	Equal variance assumed.	2.17	.221	1.53	117	.492	4.52	0.43	-0.81	2.46
	Equal variance not assumed.			1.22	117	.527	4.61	0.35	-1.14	3.27

Table 6 shows z-test analysis that compares the mean response of moderately experienced and highly experienced employees on the techniques for improving transactional leadership among metalwork technology employees in tertiary institutions in North-west Nigeria. The Leven's test shows a p-value of 0.221 which implies that equal variance is assumed. Also, the z-value obtained from the analysis was 1.53 and a p-value of 0.492 which is greater than the 0.05 bench mark. Therefore, the null hypothesis was accepted implying that there is no significant difference between the mean responses of moderately experienced and highly experienced

employees on the techniques for improving transactional leadership among metalwork technology employees in tertiary institutions in North-west Nigeria.

Discussion of Findings

The findings of research question one showed that the influence of transactional and transformational leadership on motivation of metalwork technology employees in tertiary institutions in North-West Nigeria includes promoting competition and fostering collaboration, emphasizing efficiency and inspiring a sense of purpose among others. The combination of transactional and transformational leadership styles has a positive influence on motivation of metalwork technology employees. Leveraging on the strengths of the two leadership styles translates into a lively work environment where employees are motivated and highly productive. The finding from hypothesis one revealed that there is no significant difference between the mean responses of moderately experienced and highly experienced employees on the influence of transactional and transformational leadership on motivation among metalwork technology employees in tertiary institutions in North-west Nigeria. Although the level of experience of the respondents was not the same, the opinions were similar, making the findings from research question one more credible. In support of this finding are studies carried out by Angriani *et al*. (2020) and Boateng and Ackon (2015), these studies also revealed the effect of both transformational and transactional leadership on motivation of employees in a work environment. Furthermore, the respondents also had similar opinions regarding the subject matter irrespective of their level of experience.

The findings from research question two revealed the influence of transactional and transformational leadership on job performance of metalwork education employees in tertiary institutions in North-West Nigeria includes increasing the productivity of employees, improving employee well-being in the institution among others. A blend of the two leadership styles would surely have a positive influence on the job performance of metalwork education employees. As educators possessing the right leadership qualities is very essential for effective job performance in tertiary institutions. The findings of hypothesis two show that there is no significant difference between the mean responses of moderately experienced and highly experienced employees on the influence of transactional and transformational leadership on job performance among metalwork technology employees in tertiary institutions in North-west Nigeria. Though highly experienced employees might have held more and higher leadership positions in these institutions but their opinions regarding the influence of the mentioned leadership styles on job performance was the same. This finding is in line with the assertion of Hoxha and Heimeher (2019) from the study conducted to examine the effect of leadership styles, namely transformational and transactional leadership on employee performance. It was found out that the leadership styles have a positive effect on employee performance. Similarly, Maskurochman *et al*. (2020) analyzed the effect of transformational leadership, organizational support, and job satisfaction on work motivation in improving employee performance. The study revealed that there is no difference in opinions of respondents regarding the influence of leadership styles on job performance of employees.

The findings from research question three revealed that the techniques for improving transactional leadership among metalwork technology employees in tertiary institutions in North-west Nigeria includes establishing achievable targets and goals, promoting open communication channels for employees among others. Though metalwork technology employees might posses some qualities of transactional leadership however, improving leadership qualities is crucial in enhance productivity. The techniques for improving transactional leadership would also help metalwork employees to overcome workplace challenges that hinder effective application of this leadership style. The finding from

hypothesis three revealed that there is no significant difference between the mean responses of moderately experienced and highly experienced employees on the techniques for improving transactional leadership among metalwork technology employees in tertiary institutions in North-west Nigeria. All respondents irrespective of the level of experience had the same opinion regarding techniques for improving transactional leadership among metalwork technology employees. They practically re-echoed the techniques for improving transactional leadership among metalwork technology employees. This finding is in line with that of Brahim *et al*. (2015) who found out that employees posse poor transactional leadership skills hence suggested techniques for improving them such as promoting teamwork, rewarding employees, encouraging adherence to safety protocols among several others. Similarly, Angriani *et al*. (2020) also mentioned strategies for improving transactional leadership skills among workers and further suggested that leadership training workshops should be organized for workers.

Conclusion

This study determined the influence of transactional and transformational leadership on motivation and job performance among metalwork technology employees in tertiary institutions. It also suggested the techniques for improving the adoption of transactional and transformational leadership among metalwork technology employees. This was achieved by collecting and analysing opinions of moderately experienced and highly experienced employees of metalwork technology in tertiary institutions in North-west Nigeria. Transactional and transformational leadership styles are capable of positively influencing motivation and job performance of employees which will translate to the production of skilled metalwork technology graduates.

Recommendations

Based on the findings of the study, the following recommendations were made.

1. The government should organize leadership training programme for metalwork technology employees in tertiary institutions in North-west Nigeria so that they can be educated on influence of transactional and transformational leadership on motivation.
2. The government should organize leadership training programme for metalwork technology employees in tertiary institutions in North-west Nigeria so that they can be educated on influence of transactional and transformational leadership on job performance.
3. Managements of tertiary institutions in North-west Nigeria should produce and share pamphlets or hand bills detailing the techniques for improving transactional leadership skills among metalwork technology employees.

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AN OVERVIEW OF THE ROLE OF INSTITUTIONAL POLICIES AND ICT COMPETENCY ON RECORDS MANAGEMENT PRACTICE IN TERTIARY INSTITUTIONS

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Abstract
This paper is an overview of the role of institutional policies and ICT competency on records management practice in tertiary institutions. Institutional policies serve as the backbone of records management, providing guidelines for data access, encryption standards, and retention protocols. The effective management of records relies heavily on the convergence of Information and Communication Technology (ICT) competency. The result of the paper reveled the key role of institutional policies related to records management are: Data security, Information privacy, Information governance, training and awareness and also discovered that ICT competency involves the effective use of Information and Communication Technology in various contexts, including educational, professional, and personal environments, which were identified as; technical proficiency, digital literacy, problem solving, and communication skills as the key role of ICT competency on record management. Based on the identified factors, the paper conclude and recommends that the tertiary institution develop and implement a comprehensive records management policy that addresses the creation, storage, retrieval, and disposal of records and encourage the use of emerging technologies such as artificial intelligence and blockchain to improve records management practices.

Keywords: Records Management, Institutional Policies, ICT Competency, `Tertiary Institutions, Niger State

Introduction
Records management is a critical function in organizations, particularly in the public sector, where transparency and accountability are paramount. In Nigeria, the effective management of records in tertiary institutions is essential for ensuring the integrity of academic and administrative processes. In the context of ICT and records management, institutional policies encompass the rules and standards that govern the use, management, and protection of digital information and technology resources within the organisation.

Records Management Practice provides institutional accountability and timely access to information, records management provides a framework that aims to ensure that organisation has the information that is needed so that it can reconstruct activities or transactions that have taken place, ensures that the organisation is accountable to its stakeholders (whether they are citizens, parliament or shareholders), ensure that the record can be accessed, the record can be interpreted, the record can be trusted, ensure the record will be disposed of as part of a planned system, through the implementation of disposal schedules to ensure the retention of the minimum volume of records consistent with effective and efficient operations.

Despite the numerous importance of record management, effective and efficient management remains an issue of great concern in Nigeria. Some of the key problems of record management practices includes: Weak Institutional Policies, the absence or inadequacy of institutional

policies governing the management of records within tertiary institutions may contribute to inconsistencies, confusion, and potential lapses in security protocols, posing significant threats to data integrity. Lack of ICT Competency, Many staff members and administrators in tertiary institutions may lack the necessary skills to effectively utilise Information and Communication Technology (ICT) tools for records management, leading to inefficiencies and potential breaches of records handling.

Records are kept by institutions to back up the work they do. However, if these records are not properly maintained, they won't offer the assistance that is required, and information may be lost, creating issues for the organisation to offer an effective and efficient administration that guarantees that the business operates as smoothly as possible. Therefore, proper record management is essential. Igwoku (2018) define records management as the area of management in charge of effectively and methodically managing the processes involved in creating, receiving, maintaining, using, and disposing of records. These processes also include the procedures for gathering and keeping track of information about business transactions and activities. Saffady (2021) define records management as the discipline of controlling those internal sources of information that originate from an organisation's own activities by using established processes and procedures. Unuigbe (2016) believed that the quality, quantity, and expense of records, as well as the processes, methods, activities, space, equipment, and personnel needed for record administration, were all included in records management. Elvas *et al.* (2023) acknowledged that records management is a dynamic science that deals with recorded information for affordable and effective utilisation now and in the future. Furthermore, Okolo *et al.* (2024) noted that records management involves developing and implementing standards for the creation, use, storage, retrieval, disposal, and archival preservation of recorded information. Records management is the methodical control of all records, whether in printed materials or media format, from the time of their creation until their final disposition. Saffady (2021) believe that a successful records management program will guarantee that documents are kept private and secret, that they are destroyed when they are no longer needed, that they are accessible when needed, and that they eventually support the provision of services.

Joseph and Gaba (2020) define Institutional policies as a formal guidelines, rules, regulations, and procedures established by an organisation to govern its operations, activities, and decision-making processes. In the context of ICT and records management, institutional policies encompass the rules and standards that govern the use, management, and protection of digital information and technology resources within the organisation. Institutional policies serve as the backbone of records management, providing guidelines for data access, encryption standards, and retention protocols. The alignment between these policies and their implementation is crucial for safeguarding against data breaches and unauthorized access. Government institutions all over the world are established to provide specialized functions and services to citizens and international communities to satisfy their basic needs.

In today's digital age, the effective management of records in tertiary institutions is paramount to ensuring data security, compliance with regulations, and maintaining institutional reputation. According to Qi *et al.* (2024) digital age, the effective management of records relies heavily on the convergence of Information and Communication Technology (ICT) competency, usage patterns, and institutional policies in the digital age. ICT competency encompasses not only technical proficiency but also the ability to leverage digital tools in a manner that enhances productivity, ensures data security and individual usage patterns influenced by factors such as frequency of ICT utilisation and preferred communication channels, further shape how records are managed within organisations. Competencies are useful in order to enhance performance

at work. Omar *et al.* (2020) defined competency as personal characteristics such as: skills, knowledge and attitudes, which an Individual possesses or need to acquire in order to perform an activity within a specific context. Wong (2020) also defines competency as a set of knowledge, skills, attitudes, and values that are needed to effectively perform an occupation or a productive role. Linking this concept to ICT Competencies, it refers to a group of skills, knowledge and attitudes that are applied to the use of Information and communication systems, as well as the devices that the activity involves. Therefore, ICT competency is defined as the knowledge and ability to use computers and related technology efficiently, with a range of skills covering levels from elementary use to advanced problem solving. Sutaguna *et al.* (2023) opined those competencies and individual characteristic predicted successful job performance. Rubach and Lazarides (2021) confirmed that ICT competency correlates with job performance, which can be measured and enhanced through training.

Role of institutional policies related to ICT competency on record management

According to Masilela and Nel-Sanders (2023), the key role of institutional policies related to ICT and records management are: Data security, Information privacy, Information governance, training and awareness.

Data security

Data security is an increasingly critical concern for tertiary institutions due to the sensitive nature of the data they handle, including academic records, personal information, and research data. Recent advancements in encryption technologies, such as advanced encryption standards (AES) and homomorphic encryption methods, have significantly enhanced the security of data storage and transmission, providing robust protection against unauthorized access (Al-Shaer *et al*., 2023). Additionally, the adoption of comprehensive cybersecurity frameworks, such as the Cybersecurity Framework, has been instrumental in reducing security incidents and improving resilience against cyber threats in higher education. Furthermore, artificial intelligence (AI) has emerged as a powerful tool in enhancing data security by offering advanced threat detection and real-time response capabilities, allowing institutions to proactively identify and mitigate potential breaches (Li *et al*., 2022). Together, these developments underscore the importance of a multi-faceted approach to data security in maintaining the integrity and confidentiality of institutional data.

Information privacy

Information privacy policies in tertiary institutions are essential for safeguarding personal data and ensuring compliance with legal and regulatory frameworks. Recent studies emphasize the importance of adhering to regulations such as the General Data Protection Regulation (GDPR), which mandates strict guidelines for data collection, storage, and processing to protect individuals' privacy rights (Jones *et al*, 2022). Furthermore, the implementation of robust privacy policies is crucial in preventing data misuse and unauthorized access, as highlighted by Smith and Kaye (2023), who note that institutions with comprehensive privacy frameworks experience fewer data breaches and higher levels of trust among stakeholders. Additionally, advances in privacy-enhancing technologies, such as differential privacy and anonymization techniques, are being increasingly adopted to protect sensitive information while allowing for data analysis and research (Brown & Lee, 2023). These developments illustrate the critical role of information privacy policies in maintaining the confidentiality and integrity of personal data within educational institutions.

Information governance

Information governance in tertiary institutions is critical for ensuring the effective and compliant management of information assets. Recent research underscores the importance of

integrating comprehensive governance frameworks that align with regulatory requirements and institutional objectives. According to Harris and Spencer (2023), implementing a robust information governance framework helps institutions manage data quality, compliance, and risk more efficiently, fostering a culture of accountability and transparency. Additionally, studies by Patel and Nguyen (2022) highlight that institutions adopting information governance practices experience improved data accuracy and accessibility, which support strategic decision-making and operational efficiency. Furthermore, advancements in information governance tools, such as automated compliance monitoring and data lifecycle management systems, are enhancing the ability of institutions to manage information effectively and mitigate risks associated with data breaches and non-compliance (Lopez and Martin, 2023). These insights illustrate the pivotal role of information governance in maintaining the integrity and value of information within tertiary education environments.

Training and awareness

Training and awareness programs are vital in tertiary institutions to ensure that staff, faculty, and students understand and adhere to data security, privacy, and acceptable use policies. Recent studies highlight the effectiveness of comprehensive training programs in reducing security incidents and promoting a culture of compliance. According to Williams and Johnson (2023), institutions that implement regular cybersecurity training for all stakeholders see a significant decrease in data breaches and cyberattacks. Additionally, Miller *et al*, (2022), emphasize the importance of customized training sessions that address specific roles and responsibilities within the institution, leading to better adherence to information governance policies. Furthermore, awareness campaigns that continually update the community about emerging threats and best practices are crucial, as noted by Rodriguez and Green (2023), who found that ongoing education efforts significantly enhance the overall security posture of educational institutions. These findings underscore the necessity of robust training and awareness initiatives in fostering a secure and compliant information environment in tertiary institutions.

Role of ICT competency on record management

ICT competency involves the effective use of Information and Communication Technology in various contexts, including educational, professional, and personal environments. Falloon (2020) identified technical proficiency, digital literacy, problem solving, and communication skills as the key role of ICT competency on record management.

Technical Proficiency

Technical proficiency refers to the ability to effectively use ICT tools and technologies. In the context of record management in tertiary institutions, this involves the use of electronic records management systems (ERMS), databases, and other digital tools essential for maintaining and retrieving records. Studies indicate that higher levels of technical proficiency among staff lead to more efficient management of digital records, as users can better navigate and utilize these systems for storing, organizing, and accessing records. Improved technical proficiency also reduces the time needed to train staff and decreases the likelihood of errors in record handling (Ayaz and Yanartas 2020).

Digital Literacy

Digital literacy encompasses the skills required to locate, evaluate, and use digital information effectively. For record management, digital literacy means understanding how to use electronic resources and repositories, search for specific records, and apply data security measures to protect sensitive information. In the same vein Ayaz and Yanartas (2020). Research shows that students and staff with higher digital literacy are more adept at managing digital records,

ensuring data accuracy, and complying with data protection regulations. Enhanced digital literacy contributes to better decision-making and policy development regarding record management practices.

Problem-Solving

Problem-solving skills in ICT competency are crucial for addressing and resolving issues related to digital record management. This includes troubleshooting technical problems, optimizing record management processes, and adapting to new technologies. Effective problem-solving skills ensure that institutions can maintain uninterrupted access to records, swiftly address any system failures, and continuously improve their record management systems. Liang and Cao (2021) highlight that staff with strong problem-solving abilities can quickly identify and mitigate issues, leading to more robust and resilient record management systems.

Communication Skills

Communication skills are vital for effectively sharing and disseminating information within an institution. In the realm of record management, this includes the ability to articulate technical issues, provide clear instructions for using record management systems, and facilitate collaboration among different departments. Good communication skills help ensure that all users are informed about best practices, updates to systems, and any changes in record management policies. Institutions with staff who possess strong communication skills tend to have more coordinated and efficient record management processes (Szromek and Wolniak 2020). Enhancing ICT competency through targeted training and development programs can significantly improve record management in tertiary institutions, leading to better data accuracy, security, and accessibility.

These key aspects form a comprehensive framework for assessing and developing ICT competency, crucial for effective participation in the digital age.

Conclusion

The institutional policies are important in optimizing record storage, enhancing data security, supporting accountability, and managing digital transformation. Institutional policies and ICT competency should be integrated to ensure effective records management practices in tertiary institutions. Institutional policies on record management are essential for ensuring that records are handled efficiently, securely, and in compliance with legal and regulatory requirements. These policies establish standards and procedures that guide record creation, maintenance, access, and disposal. By promoting consistency, compliance, confidentiality, and efficiency, institutional policies play a critical role in shaping effective record management practices in tertiary institutions.

Recommendation

The recommendations are based on the content of the paper.

1. Develop and implement a comprehensive records management policy that addresses the creation, storage, retrieval, and disposal of records.
2. Establish a records management unit or department to oversee records management practices.
3. Provide regular training and awareness programs for staff on records management best practices, ICT skills and competency.
4. Ensure that staff has access to the necessary technology and tools to manage records effectively.

5. Implement electronic records management systems (ERMS) to improve efficiency and accuracy.
6. Develop and implement digital preservation strategies to ensure long-term access to records.
7. Encourage the use of emerging technologies such as artificial intelligence and blockchain to improve records management practices.

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APPLICATION AND USE OF ARTIFICIAL INTELLIGENCE (AI) FOR EFFECTIVE LIBRARY SERVICE DELIVERY IN FEDERAL UNIVERSITY LIBRARIES IN NIGERIA

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Abstract
Artificial Intelligence (AI) is now applied with evidence in almost all aspects of disciplines, in the institutions of learning, health care services, the innovation in economic development as well as in the University library for efficiency and effectiveness. This study focused on the application and use of artificial intelligence (AI) for effective library services delivery in University libraries in Nigeria. (It was centered on how, and which areas in the University library that artificial intelligence (AI) is applied). It was found that artificial intelligence has different component such as the expert system, pattern recognition, natural language processing, as well robotics, and these different components of AI can be applied in Nigeria Academic libraries. For example, they could be applied in the area of acquisition of library materials, cataloguing, classification and indexing. Literature surveyed equally revealed that there are many is an example of artificial intelligence such as robotics, expert system, natural language and so on with advantages that could revolutionize service delivery in University libraries. Nigerian University libraries could use artificial intelligence in its operations conveniently. There are also the challenges that pose some barriers which should be looked into in order to ensure that Artificial Intelligence efficiency, effectiveness and quality University library service delivery is achieved.

Keywords: Artificial intelligence, expert system, natural language processing, robotics, University libraries

Introduction
University libraries are information centres established in support of the mission and vision of their parent institutions to generate knowledge and people equipped with knowledge in order to serve the society and advance the well-being of mankind. University Libraries are considered as the storage house of academic information and all the relevant information for the role of knowledge management in the welfare of the institutions. University considers knowledge as the key resource in the development of any society. University libraries are adopting digital technologies and services to provide improved access to modern information resources for effective research. University libraries are evolving which make it possible to offer a wide

range of services and resources beyond just books. Key aspects of University libraries to be able serve staff and students include automated systems, digital collections, and innovative services. This resulted in the introduction in Information and Communication Technology in University libraries.

The introduction of Information and Communication Technology (ICT) which is a generic terms that refers to the technologies that are used to collect, store, edit, and communicate information in various formats. University Libraries have become one of the institutions mostly used to manage, disseminate, and preserve knowledge (Jones & Umoh, 2022). The University library's ICT collection comprises both the physical materials and all digital or electronic information resources and services that the library provides to staff and students (Jones & Umoh, 2022). Information and Communication Technology is one of the wonderful gifts of modern science and technology, which has brought tremendous changes in Library and Information Science discipline. It has opened up a new window in library communication and facilitated global access to information across geographical limitations (Tomar, 2021). University libraries worldwide have embraced ICT solutions to modernize their services and improve users' experiences. These include the adoption and application of automated systems for cataloging, circulation, and resource management using library management software, the establishment of digital repositories and online databases for open access and through subscription, the implementation of virtual reference services, and the provision of remote access to library resources (Verma, 2015). However, despite the global advancements in ICT adoption in University libraries, challenges and disparities exist across different regions and institutions. Factors such as inadequate infrastructure, limited funding, lack of digital skills, and resistance to change pose obstacles to the full realization of the potential benefits of ICT revolution in University libraries (Chutia, 2015). University libraries are the nerve center of an educational institution and a place where information is provided to serve all patrons irrespective of their ages, political or ethical background, religion, sex, etc. It could be seen that the role of higher institutions cannot be achieved without the presence of libraries that are adequately equipped with printed materials, Information and Communication Technology (ICT) and its related facilities, well trained staffs and a high level of services to users that will satisfy their information needs (Ajibero, 2004).

Artificial simply means something that is not natural. Accordingly, Collins online dictionary (2021) defined artificial as "made in imitation of or as a substitute for something natural" it could be noted from the Collins dictionary that artificial can be known as man-made, a work or something made out of human knowledge and skills, for example an artificial leg, or artificial teeth, another example is artificial intelligence. Intelligence can therefore be defined in several ways, from the layman perspective, intelligence could simply mean ability to comprehend and apply knowledge, however, the definition of intelligence can be understood from different point of view. The concept of intelligence is not a recent term, thus, Hindes, Schoenberg & Saklofske , (2011) defined intelligence in terms of judgment, practical sense, initiative, and adaptability, this definition stills suit this current generation and it could be noted that intelligence has different types such as moral intelligence, emotional intelligence, human intelligence, spatial intelligence, musical intelligence, linguistic intelligence, naturalistic intelligence as well as artificial intelligence. Artificial Intelligence (AI) therefore is the capability of a device to perform functions that are normally associated with human intelligence such as reasoning and optimization through experience. AI can be said to be the intelligence of machines.

The application of Artificial Intelligence in University libraries will influence connectivity of information technology and actively support information usage as well as easing staff and students' search and immediately address their needs. The impact of artificial intelligence and advanced computer technology on the nature of future University libraries will be enormous and the quality difference varies from different researchers (Vijayakumar & Sheshadri, 2019). Asefeh and Asemi (2018) list various ways in which Artificial Intelligence technologies can be used to improve library services delivery to include the followings: circulation services, shelving of books, cataloguing of library materials, among others. Many University libraries, most especially those in the developed countries make use of Artificial Intelligence for the provision of library services to the academic and students.

Conceptualizing Artificial Intelligence (AI)

Artificial Intelligence (AI) is the ability of a digital computer or computer-controlled robot to execute tasks often associated with intelligent beings (Abdullahi ,2023). This phenomenon is widely given to the endeavor of producing systems with human-like cognitive processes, such as the ability to reason, discover meaning, generalize, or learn from past experience. Since the development of the digital computer in the 1940s, it has been proved that computers can be taught to perform extremely complex jobs with great proficiency, such as discovering proofs for mathematical theorems or playing chess. Despite ongoing increases in computer processing speed and memory capacity, no programs can yet match human adaptability across broader fields or in activities requiring extensive everyday knowledge. On the other hand, some programs have surpassed the performance levels of human experts and professionals in performing specific tasks, so artificial intelligence in this limited sense can be found in applications ranging from medical diagnosis to computer search engines and voice or handwriting recognition (Abdullahi ,2023). AI research has mostly focused on the following aspects of intelligence: Learning, reasoning, problem solving, to discuss a few.

The Learning Stage: The learning stage is the first stage in the growth process of artificial intelligence, just as it is with humans. There are several types of artificial intelligence learning. The most basic method is trial and error. In the context of artificial intelligence development, the learning process entails memorizing of particular things such as different issue solutions, vocabulary, and foreign languages, among others. Through this learning process, artificial intelligence algorithms can keep track of any activities or moves that resulted in favorable outcomes, allowing the program to harness this knowledge within its data if similar situations emerge in the future (Abdullah, 2023).

Reasoning Stage: The second fundamental component of artificial intelligence is reasoning. While the concept of mental thinking has mainly been limited to the human mind for much of recorded history, much of the development of artificial intelligence is based on software programs that can draw conclusions and inferences from a situation without the need for human intervention. Furthermore, these inferences are classified into two types: inductive and deductive reasoning. The most significant difference between these forms of reasoning is that in the deductive case the truth of the premises guarantees the truth of the conclusion, whereas in the inductive case the truth of the premise lends support to the conclusion without giving absolute assurance. It has been quite successful to train computers to make conclusions, particularly deductive inferences. True reasoning includes more than just making assumptions; it entails making assumptions that are pertinent to finding a solution for the specific problem or circumstance.

Problem Solving: The third major component that makes up the development of artificial intelligence programs and systems is problem-solving. Problem solving, particularly in artificial intelligence, can be defined as a methodical search through a set of feasible actions to achieve a stated goal or solution. Problem-solving techniques are classified as either special purpose or general purpose. A special-purpose method is tailored to a specific problem and frequently takes advantage of highly unique elements of the setting in which the problem is embedded. A general purpose approach, on the other hand, is applicable to a wide range of problems. 3 AI Application for Academic Library Services Delivery Academic libraries are to re-position themselves to take relative advantage of artificial intelligence's potentials by refining the quality of library services in this era of the information age (Tella, 2020). Nigerian Universities may adopt a combination of traditional and online teaching methodologies like their counterparts in developed countries (Atayero, 2020).

Application of Artificial Intelligence in University Libraries

Librarianship is a branch of information provision and dissemination concerned with the timely and effective delivery of information to users on demand and in advance Idemodia and Makinde, (2022). In other words, they put information and its sources at the users'/clientele's "fingertips" and "doorsteps." Librarians should aid their patrons in completing research on specialized topics as well as in selecting recreational reading resources. In other words, they provide reference services to inexperienced clients who are not sure on how to conduct a successful library search, this encourage people to value reading, improve their reading habits, and consider University libraries, as essential resources for the development of knowledge. The higher institutions libraries particularly the University libraries are seen as the heart of the institutions because of the essentialities of the services they provide. Laboratories, equipment, teachers/classrooms, and libraries are the four key pillars in higher learning, and they all contain vast and comprehensive information and resources that can support teaching, learning, and research. University Libraries are the central hub of an educational institution, serving all clients regardless of their generations, philosophical and moral beliefs, religion, sex, and other characteristics Idemudia and Makinde, (2022). It can be seen that the role of institutions of higher learning cannot be realized without libraries that are integrated strategy with print, information and communications technologies and supporting facilities, well-trained staff, and a high level of support to clients that will meet their information requirements. In the view of Dawa, (2021), it could be noted that the University library is no longer just a physical structure that house information resources, it could be any platform either physical or in cloud space whose primary aim is to make accessible and available information materials to different users to satisfy and meet their information need through a sequence of a systematic classified and organized pattern, the University library as a cloud space which functions simultaneously as the digital library of today have harness and deploy emerging technologies in its workspace, emerging technologies such as mobile technologies, cloud computing, software packages, robotics and other areas of artificial intelligence applications such as expert system, natural language processing, machine learning, pattern recognition, neural network. According to Dawa, (2021), the different areas that can be deployed in carrying out library services in the University such as the reference services, acquisition services, cataloguing services, classification, indexing etc (Dawa, 2021).

1. **Applications of Expert Systems in Reference Services:** Reference services are personal assistance given by libraries to users who are in pursuit of information. Ayanlola & Uchendu (2017) The implication of this is that the reference unit of a University library serve as the compass of the library for instance for every user to adequately utilize the information resources in the library, the clients should be provided with some reference services such as current awareness services, translational

services, information services, user education, selective dissemination of information, to mention but a few. Thus, Reference service is one of vital services rendered in any library and the Expert System has to be used so as to substitute the reference librarian, the different ways in which expert systems can be used as cited by Mogali (2015) are stated below:

- Research: It is a designed system that supplies clients with recommended sources to lookup for certain question. This is a system that teaches reference skills or computerized aid for practicing reference librarians and information specialists.
- Answerman: It is a Knowledge based system that aid users for reference questions on topics of agriculture. It has series of menus that narrow down the subject of the questions and the type of tool needed. It can function as either a consultation system or as a front end to external databases and CD-ROM reference tools
- Online Reference Assistance (ORA): This system intended to stimulate the services of an academic reference Librarian for questions of low and medium level by using several technologies: Examples are videotext like database, computer assisted instruction modules and knowledge-based system. ORA consist of directional transactions like library locations, services and policies (Dawa, 2021).
- Pointer: It is also known as knowledge-based system but acting as computer assisted reference program. It directs patrons to reference sources.
- PLEXUS: This is a referral tool used in Public Libraries. It includes knowledge about the reference process, information retrieval about certain subject areas, reference sources, and library users. All the above systems are advisory systems for locating reference source books and factual data

2. **Application of Expert System in Cataloguing:** Cataloguing is the systematic arrangement of information materials pointing out their bibliographic details such as the author, title, imprint etc. Cataloguing as a means to enable easy retrieval of information, it is carried out by a professional librarian. Cataloguing is known as the oldest library crafts. Recent attempts to automate cataloguing through Expert Systems have focused on descriptive cataloguing because it is considered as rule-based. There are two approaches for applying artificial intelligence techniques to cataloguing as stated by Adejo and Misau, (2021) below:
   - An Expert System with full cataloguing capability linked into electronic publishing system so that as a text is generated on-line, it can be passed through knowledge-based systems and cataloguing process done without any intellectual input from an intermediary.
   - A human-machine interface, where the intellect effort is divided between the intermediary and the support system.

3. **Application of Expert System in Classification:** Classification is the fundamental activity in the organization of knowledge. For this reason, it is prominent in all systems for organizing knowledge in libraries and information centres. Application of Expert System in the area of classifications in libraries as stated by Adejo and Misau, (2021) includes the following:
   - Coal SORT: It is a conceptual browser designed to serve either as a search or an indexing tool. Coal SORT consists primarily of a frame-based semantic network and the software needed to allow users to display portions of it and to move around in the conceptual structure. The expert knowledge in the system is embodied almost entirely in the semantic network.

- BIOSIS: BIOSIS uses knowledge-based devices including a significant amount of procedural knowledge that automatically assigns documents to various categories. It is designed as an indexer aid. BIOSIS uses the information in the titles of biological documents to assign many categories as possible of those that would be assigned by human indexers. The indexing languages are structured and practical representation of information that can be used to very good advantage of AI applications.
- EP-X: The Environmental Pollution Expert (EP-X) has certain things in common with coal SORT in that both are concentrating on enhancing interface using a knowledge-based approach. The knowledge base of EP-X consists of hierarchical frame-based semantic network of concepts and a set of templates that expresses the patterns called the pragmatic relationship among concepts. These patterns are referred to as conceptual information.

4. **Application of Expert System in Indexing:** The systematic technique of arranging entries to enable information consumers to locate objects in a document is known as indexing. It's a method for giving a roadmap to the data and knowledge contained in papers. In indexing, subject terms, headings, and descriptors that describe the intellectual substance of texts or cover the major theme are carefully picked. In essence, indexing is the process of constructing substitutes for information items by analyzing the content of documents, revealing the main elements of the document item in a simplified form, and showing the location of the information. Indexing of periodicals is another area where expert systems are being developed. Indexing a periodical article involves identification of concepts to translate these concepts into verbal descriptions by selecting and assigning controlled vocabulary terms that are conceptually equivalent to verbal descriptions. The reason for automating the intellectual aspects of indexing is to improve the indexing consistency and quality. Based on the information provided by the indexer, the systems can arrive at appropriate preferred terms to automatically assign relevant subdivisions. The system can make inferences and based on those inferences; it can take appropriate action. "'Med Index' is the best example of indexing system used in the library Indexing activity".Mogali (2015). Very few library users have interacted with knowledge-based systems. Generally, users have had very little contact with these systems due to the fact that most of them are not perfect enough to be used by the everyday library patron.

5. **Application of Expert System in Acquisition:** The collection development area is another integral unit of the University library. The librarian or the information officer is the key person in this activity. University Library users have a significant role to play in building electronic collections and that their help and advice should be solicited in the process. Umoh, Effiom and Igaja (2021), opines that the quality and quantity of collection development in the library is a necessary measure or criteria for accrediting new faculties/ programmes in universities and other related higher institutions of learning in Nigeria. Moreover, resource development is a very important service in the University library because without adequate and appropriate resources; no University library can claim to be effective in serving her users. The process of adding to the University library's collections is known as acquisition or collection development. As a result, it comprises the order, gift, exchanges, and other procedures in an institution library that present the true character of acquisition through the coordination of these events. The acquisition of information materials and tools for University library operations is an aspect of collection development. According Mogali, (2015) diverse means have been implemented in the application of expert system in acquisition.

Monograph Selection Advisor is a pioneering effort in applying this emerging technology in another area of library science i.e. building library collection. Specifically, the task modelled is the item by-item decision that a subject bibliographer makes in selecting monographic details. The knowledge base has to be broad enough and the interfacing aspect must be easy enough for the University library to get the desired information from the machine.

6. **Applications of Natural Language Processing in Library Activities:** Natural Language Processing basically means the ability of a system or device to understand man's everyday language, NLP can be applied in different field, and this could be applied to the field of library and information science and more specifically in the area of searching database such as Online Public Access Catalogues (OPAC). Indexing is the basis for document retrieval. "The aim of indexing is to increase precision, the portion of the retrieved documents that are relevant; and recall, the proportion of relevant documents that are retrieved" Pattern Recognition as Applied to University Library operations New and rising types of information system applications have rushed into the life of office workers in this era of the Internet and information distribution, multimedia computing. Digital libraries, multimedia systems, geographic information systems, collaborative computing, and electronic commerce are just a few of the new applications that have opened up huge prospects for information researchers and practitioners. Robotics

7. **Applications in Library Operations (circulation):** A robot is an automatically controlled, re - programmable, multi-purpose manipulator programmable in three or more axes that can be fixed in place or mobile for use in automation application. Robotics is generally referred to as a subset of Artificial Intelligence that deals with perceptual and motor tasks as well as machine learning. A robot is a machine that can perform a complex series of tasks automatically, particularly one that can be programmed by a computer (Abraham, 2019). According to Tella (2020), University libraries feature huge print collections in addition to a growing array of digital library services and resources. It's time-consuming to keep track of huge volumes in libraries, but automation can help. Robots are already in certain University libraries in both rich and poor countries, which is no longer news. Graham (2019) in his research identified four types of robots currently used in University libraries. These are shelf-reading robots, telepresence robots, humanoid robots and Chatbots. These are described as follows along with the tasks they perform in University libraries. Tella (2020) defined Telepresence as a sophisticated form of robotic remote control in which a human operator has a sense of being present themselves. Similarly, Decker (2015) opined that telepresence are technologies that allow the user to see, hear, and speak to another individual from a remote location, virtually replicating presence. Shelf reading robot that can critically analyze the books on the shelves and would indicate if any books is wrongly shelved or missing in the library. According to Liau (2019), he was of the opinion that robots can autonomously scan the print collection after the library closes by detecting RFID tags embedded in the textbooks. The implication of this is that the shelf reading robot will reduce the work of librarian and save their work time as well as the tedious work of shelf reading which is required almost every day before users start coming. According to Nguyen (2020), humanoid robots' or "social robots" are an emerging generation of robots that have the ability to perceive their environment, recognize faces, read emotions and communicate with people. Similarly, Schaffhauser (2019) explained "humanoid", as a human-like robot, which can strike up a

conversation, tell a story and also teach kids and adults coding. Humanoid robots are those machines that are super intelligent and code tell the gender of the client/user, it masters its environment. Chatbots assist with scanning on a library website, create an alert when a particular textbook is due, directs users to relevant University library resources, answer simple queries and redirects more complex reference queries to a reference librarian (Tella, 2020). Chatbots are simply messaging platform, the libraries in developed world are already using chatbots. Many libraries, particularly academic research libraries especially the Universities, are experiencing severe space restrictions as a result of the demand to provide both electronic and print-based resources and services. The goal of the Comprehensive Access to Printed Material (CAPM) is to build a robotic on demand and batch scanning system that will allow for real-time browsing of printed material through a web interface. The user will engage the CAPM system that, in turn, will initiate a robot that will retrieve the requested item. The robot will deliver this item to another robotic system that will open the item and will automatically turn the pages. By using existing scanners, optical character recognition (OCR) software and indexing software developed by the Digital Knowledge Centre, the CAPM system will not only allow for browsing of images of text, but also for searching and analyzing of full-text generated from the images.

Advantages of Artificial intelligence in Nigerian University Libraries

The advantages of artificial intelligence in libraries was summarized by Dawa, (2021) are as follows:

1. Artificial intelligence in libraries can make research more discoverable which can boost research productivity among faculty members.
2. Constant and timely accessibility to the information.
3. The space occupied by piles of books, journals, bound newspaper and other information materials has been reduced by the introduction of digitization, electronic copies and use of robotic cranes that stores and retrieve books from a compact off-site storage location
4. It will maximize the efficiency of library operations: selection and acquisition of materials, technical services, circulation services, reference services, serial management etc.
5. Effective delivery of library services and elimination of human errors in library operation
6. The efforts of librarian in technical services, circulation services, reference services and serial management etc. can be minimized
7. User services can be enhanced

Challenges for the application of Artificial Intelligence in Nigerian University libraries.

According to Idemudia and Makinde, (2022), the challenges of applying artificial intelligence in Nigerian Academic Libraries are quite numerous. Artificial Intelligence is still tied up with several technological, social and economic challenges. Language readiness, system requirements, privacy concerns, and a threat to intellectual freedom are all key problems in the application of artificial intelligence technologies in University libraries. They have been briefly described as follows:

- Privacy: Artificial Intelligence when fed with massive amounts of data, eventually learns toidentify certain data sets with the help of machine learning. Personal data becomes a commodity that might get misused for illicit purposes. Librarians need to secure privacy by providing anonymous ways of interacting with artificial intelligence systems.
- Linguistic styles: Chatbots have limited memory and processing power does not support extensive vocabulary or the ability to deal with diverse conversational styles. Developers need

to predict the types of interactions and develop suitable responses to them, which is a challenging task for a country like India as the dialect varies in every state, prescribed conversation styles might not be suitable for all kinds of interactions.

- Bias: The transparency and accountability of artificial intelligence systems are being questioned; the algorithms may function based on developer bias or commercial organizations which may lead to disparity in the academic sector.
- Quality of Intelligence: The quality level of a particular artificial intelligence system is determined by two main factors i.e. logical algorithms which are technical related and corpus capacity which is related to data. With technological advancements taking place at a skyrocketing pace more and more complicated algorithms are being formulated and more and more crawlers would be required to obtain the internet and improve its quality of intelligence.
- Intellectual freedom: Seeking and receiving information from Artificial Intelligence systems lead to intellectual freedom at threat, as personal data is sought through machine learning. Queries and search history get saved which can be used against people.
- Cost: Cost is one of the major barriers to the implication of Artificial Intelligence (AI) in the information sector; Most of the AI systems are in the form of proprietary software. Investment in AI-based technologies has not become a trend in libraries and require more dialogue and clarity among professionals. Conclusion Artificial intelligences is an emerging technology that is programmed to have human behavioral characteristics, Artificial Intelligence (AI) is gradually and at the same time rapidly taking root in the different sectors of the world, the library is not an exception, the use of Robotics have a great prospects for quality library services delivery, the use of cha

Conclusions

The application and use of Artificial Intelligence technology in Federal University libraries is setting a new level of accurate and effective library services delivery that has been shown to be very valuable in this study. This study concluded that the use of Artificial Intelligence enhances security of University library resources and enabling access to information from any geographical location. It is of no news that University libraries have greatly benefitted from Artificial Intelligence as it has proven to be time effective and job efficient in almost all sections of the University library. However, despite the various benefits associated with the application and use of Artificial Intelligence in University library services delivery, there are some challenges facing the University library as regard application such as financial constraints, lack of technical skills, loss of job, epileptic power supply still hinder application and use of Artificial Intelligence in Federal Universities libraries. This study can ascertain that the application and use of Artificial Intelligence shape the future of Federal University libraries in Nigeria.

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EMERGING MEDIA UTILISATION FOR INFORMATION DISSEMINATION ON POLITICAL CAMPAIGNS BY POLITICIANS IN KANO STATE

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Abstract
The study investigates emerging media utilisation for information dissemination on political campaigns by politicians in Kano state Nigeria. The study is guided by 2 research questions. The population of the study consists of 1,464 politicians of 20 political parties in Kano States. The study employed a descriptive survey research design to elicit information from the respondents. Purposive as well as proportionate sampling procedures were used to select the sample size of 306 politicians. 306 copies of the questionnaire were administered, out of which 276 copies were filled out, returned and found useful. Data was analysed using descriptive. The findings of the study revealed that the majority of the respondents to a high extent to disseminate information about the accountability and transparency of their party candidates and use media platforms to repel oppositions or critics by stimulating meaningful discussions and debates during campaigns. Also, Billboards/posters, Facebook and WhatsApp were the major media platforms utilised by politicians in disseminating political information during campaigns. The study recommended that Aspirants should provide training to their campaign team on best practices for engaging with critics and opponent on media platforms. Thus, a well-trained media team can handled opposition more effective without escalating conflicts and politicians should develop a cohesive communication strategy that integrates newspapers and television to reinforce campaign messages across all platforms.

Keywords: Politicians, Media Utilisation, Information Dissemination on Political Campaigns, Kano State

Introduction
Politicians disseminate information in pursuit of convincing and persuading voters. They use different media to communicate their ideas or manifestos to the electorate. However, politicians in this context refer to political advertisers who engage in the practice of promoting political messages, candidates, parties, or issues to the public through various forms of advertising. These advertisements are typically designed to influence public opinion, shape voter perceptions and sway electoral outcomes. It was observe that political advertisers from a communication perspective; are mostly paid to use media to promote or oppose political issues in favour of their clients (Nasidi, 2022). In light of the above, there are numerous benefits of disseminating information during political campaigns.

Political campaign is an old democratic tradition through which people get informed and motivated to participate and take certain political decisions. Besides the analogue campaign, now we have digital campaign which involves using mass media such as radio, television and social media to reach the target voters (Nasidi, 2022). It is a multidimensional concept that means different thing to different people within other political systems. Political campaign according to Golden (2018) is a series of strategies and tactics largely communicational, planning and managed by ace party leaders and professionals, to make a candidate or issue

known and influence the targets decisions and action in a favorable manner. This infers that political campaigns are an act of gathering information about electorates, set party candidate policies and device media for gigantic information dissemination.

In this direction, information dissemination has become critical to both strategy and success. Campaign teams and prospective political candidates are constantly searching for fresh and inventive approaches to connect with people, sway public opinion, and win elections. It aims to elucidate how concepts of information dissemination are harnessed to craft persuasive narratives, engage diverse audiences, and ultimately influence electoral outcomes. Information dissemination in politics involves the transmission and circulation of political massages, campaign information and policy positions through various media platforms and communication strategies to voters and mobilise support (Farrell & Drezner, 2018). This signifies that information dissemination is the systematic distribution of promoting political party and it candidate aspiring for various political posts. With this, information dissemination refers to transferring processed data to the intended recipients while satisfying certain information needs. Information dissemination is to distribute or broadcast processed data (Shonhe & Jain, 2018). Information dissemination can be done by politicians verbally, through writing, or via new media.

The media is a vital source of information, a forum for participation, and a force behind public opinion during political campaigns. Candidates can obtain an electoral edge by using the media to their benefit. This allows them to connect with people, influence their opinions, and eventually win their support at the polls. In light of the above, Oluwatosin *et al*. (2020) defined media as those channels of communication that are capable of reaching heterogeneous audiences simultaneously with uniform messages.''. According to Oparaugo (2021), the term media, which is the plural of medium, refers to the communication channels through which information is disseminated.

The importance of media in a modern democracy has been a subject of discussion among participants in the political space of every democratic society, especially Nigeria as a growing democracy (Oduola and Olajumoke, 2022). In the view of Abdollahyan and Machika (2017), media coverage is the very lifeblood of politics because it shapes the perceptions that form the reality on which political action is based. This is due to the media's commitment to fulfilling their obligation as spelled out in Section 39, Subsection 1, of the 1999 Nigerian Constitution as amended (Okon and Okogbule, 2016). From the foregoing, politicians use different types of media to among others convince and influence people to vote their party and its candidate

It is plausible to note that, the media is a diversified communication technology divided into three forms: newspapers, television, and radio, while the Internet and mobile mass communication social media like Facebook, Twitter, and WhatsApp are referred to as the new or digital media (Oluwatosin *et* al., 2020). Chioma *et al.* (2015) allege that political parties enlist the services of creative agencies with the sole aim of packaging persuasive messages to woo the electorate through the use of tools such as pamphlets, fliers, bumper stickers, magazines, newspapers, radio, television, billboards, and many more. It is noteworthy that political advertising gives political parties and their candidates the platform to persuade voters (Esuh and Umanah, 2019).

Finally, literatures revealed a deficiency of studies on emerging media use for information dissemination on political campaigns by politicians, particularly on their combined effects in

the study area. On this basis, this research study seeks to establish merging media use for information dissemination on political campaigns by politicians in Kano State.

Statement of the Problem

Political campaigning is one of the essential commodities that help electorates analyse and make sound decisions during elections. Poor political campaigns can negatively affect aspirants, as potential voters may not be aware of their campaign promises and the position they are aspiring to. Media when use for political campaigns by politicians can reach a wider audience convey political messages and interact with electorate. From the researchers' existing search of literature, there seems to be no study on emerging media use for information dissemination on political campaigns by politicians in Kano State.

Research Questions

1. What are the types of media use by politicians for information dissemination on political campaigns by politicians in Kano State?
2. What is the extent of media utilisation for information dissemination on political campaign by politicians in Kano State?

Literature Review

A number of studies, including a study conducted by Bello (2018) investigated the social media and elections in Nigeria: a case study of Kano State, reflections from 2015 elections. The study revealed that majority of Kano residents from the sample used agreed that social media have influenced their level of engagement with the electoral processes (especially voting) in the state as a result of the contents they read from the platform. The current study shared some similarities on location, theory, and methodologies; the two studies used multiple media, although the current study is descriptive and inferential, the former used descriptive only.

This is corroborated with the findings of Oluwatosin *et al*. (2020) who examined the influence of the media on political knowledge among undergraduate students. The findings identified social media are the most frequently use media, followed by radio; television and newspaper.31% of the respondents had very high political knowledge while 3% had no political knowledge. Access to radio is the only significant correlate ($r = 0.42$, $p<0.05$) and independent predictor ($\beta= 0.43$, $t=-3.98$, $p<0.05$) of political knowledge although access to radio, television, newspaper and social media are significant joint predictors of political knowledge ($R2= .18$, $F (4, 241) = 4.32$). Therefore, the study concludes that radio is the foremost source of political knowledge amongst undergraduate students in Ibadan, Nigeria. This study shared somehow similarities on the variable influence of media on political knowledge, research design, instrument, and method of data analysis. Also, the study was anchored on the same theory, although the current study is anchored on three theories, despite variations in population and study area.

Additionally, Carlos (2022) surveyed the effects of social media on political communication. A survey questionnaire was developed through Google forms and was answered by 30 randomly selected resident voters of Jaen, Nueva Ecija. The result of the study found that the majority of the respondents were female (57.77%) and the age bracket of 18-27 (33.33%) years old, 80% college were college graduates. Respondents were equally distributed in the top 3 most populous barangays which were Niyugan, Dampulan, and Sto. Thomas South. In terms of social media platforms and devices used, most of the respondents use Facebook (71.44%) and their mobile phones (68.88%) on connecting to the Internet and accessing news regarding politics. 70% of the respondents spend 3 hours and below using social media.

This research found out that respondents believe that social media has a good impact on the politics such as providing necessary news on politics, and platform for discussion, and influence in the encouragement to vote. On the other hand, they also believe in the negative impact such as the widespread misinformation and biased news. The current study is differed in location because the former was conducted at Jaen, Nueva Ecija, while the letter is in Kano State, Nigeria. Also, the previous study is similar in methodology to the current study.

Also Omotayo and Folorunso (2020) investigated the use of social media for political participation among youths in Oyo state, Nigeria; specifically, the types of social media used for political participation, the types of political activities social media are used for, as well as factors influencing use of the media for political participation. Findings reveal that social media was highly used by the youths for political participation. Facebook (98.8%) was found to be the most used, followed by Whatsapp (93.8%), Instagram (60.2%), Twitter (55.3%), and Yahoo Messenger (50.9%) respectively. Majorly, the youths used social media to participate in political advocacy (95.3%), political campaigns (91.9%), communicating with politicians (90.7%), political discussions (87.3%), monitoring and reporting electoral malpractices (85.1%), public consultations (80.4%), joining interest groups that engage in lobbying (64.9%), blogging about political issues (64.9%), and writing letters to public officials (51.2%).

Perceived usefulness, perceived ease of use, subjective norms, and computer self-efficacy significantly influence use of social media for political participation, which suggests that these factors could be considered when promoting use of social media for political participation among youths. This research shared some similarities of being conducted on the social media for political participation among youths. Although, the two studies differed on location and audience, the former was conducted at three universities in Oyo state, Nigeria, while the latter would be conducted on politicians of three political parties in Kano State.

Specifically, Abdollahyan and Machika (2017) investigated the impact of radio political campaign messages on Kano-Nigeria voters' voting behaviour during the 2015 general elections. The findings indicate, among other things, that the majority (90.0%) of electorates in Kano were exposed to political campaign messages on radio. Explaining further, respondents (58.3%) said they listen to political party related campaigns and were influenced by them while casting their ballot. The findings further revealed that respondents (65.5%) were influenced by opinion leaders in their choice of political parties or candidates during elections as they perceived their advice/instruction as credible. The current study shared similarities with the previous study in the areas of variable (Radio), location, research design, instrument, hypothesis, and method of data analysis. But they differed in population, sampling techniques, theory and method of analysing the hypothesis.

Ajasa, *et al* (2023) conducted a study on the effect of radio political broadcast on awareness of Ogun state electorates towards Nigeria 2023 general election. From the result of the data gathered, findings indicate that the selected radio political broadcasts (Citizens Forum and Gbangbalawa) do not give adequate prominence to the 2023 general election (β=. .108, t= 10.656, p>0.05) but educate and mobilise electorates in Ogun state on their civic responsibilities. The study concluded that radio political broadcasts do not influence the voting habit of the electorates in Ogun state; however, agreed that radio political broadcasts inspire them to vote for any party of their choice.

Fathurrijal and Fathurrijal (2023) investigated the utilisation of Facebook as a media for political literacy in building political awareness of the voters in the regional elections in the

province of West Nusa Tenggara, Indonesia, the Nahdlatul Wathan organisation on the island of Lombok used Facebook accounts as a media for political literacy in welcoming the regional head elections in the Province of West Nusa Tenggara (NTB) Indonesia. This research reveals that political literacy activities carried out by the Nahdlatul Wathan organisation are to raise the political awareness of its members in choosing regional heads. Through the Facebook page, messages and information on the political choices of the Nahdlatul Wathan organisation are disseminated to members and the voting public. This research shared some similarities with the current study of being conducted on Facebook as a medium. Although the two studies differ on location, the former was conducted in West Nusa Tenggara, Indonesia, but the latter would be in Kano State, Nigeria. The former study used only qualitative analysis to analyse its data, but the current study would consist of both descriptive and inferential statistics.

Methodology

The study adopted the survey research design method. Population of the study consists of 1464 politicians that are in the trade of information dissemination in three (3) selected political parties in Kano State. Purposive as well as proportionate sampling techniques were used to draw 306 respondents out of which 276 copies were filled, returned and found useful. Questionnaire was the instrument for data collection. Simple frequency, percentage and mean and standard deviation were used for data analysis.

Results

A total of three hundred and six (306) copies of questionnaire were administered to politicians in Kano State, Nigeria. Out of the three hundred and six (306) copies of the questionnaire administered two hundred and seventy-six (276) copies were properly filled, retrieved and valid for the purpose of the research. This represent 90% returned rate; that is [(276/306) *100 = 90.1961%].

Table 1.1 Research Question One: What is the Extent of Media Utilisation by Politicians for Information Dissemination on Political Campaigns?

Statement	Very High extent (4)	High Extent (3)	Low Extent (2)	Not Applicable (1)	Weighted Sum	Mean	Std	Decision
I utilise media platforms to disseminate information about accountability and transparency of my party candidates	254	14	8	0	1074	3.89	0.39	High Extent
I utilise media platforms to repel opposition critics by stimulating meaningful policy discussions and debates during political campaigns	254	14	0	8	1066	3.86	0.54	High Extent
I utilise media platforms during political campaigns to enhance voter engagement and participation in the electoral process	254	14	0	8	1052	3.81	0.66	High Extent
I utilise media platforms to focus on trending problem(s) that affect voters and present my candidate or party as the solution to the issues	241	27	8	0	1061	3.84	0.44	High Extent

I utilise media platforms to influence voter perceptions of candidates' credibility, competence, and suitability for office during political campaigns	241	27	8	0	1061	3.84	0.440	High Extent
I utilise media platforms to disseminate propaganda which shape public opinion	249	13	0	14	1036	3.75	0.770	Low Extent
I utilise media platforms to threatens, or encourages violent acts against oppositions	246	16	0	14	1046	3.79	0.690	Low Extent
I utilise media platforms to share fabricated or fake information that can mislead voters	246	8	0	22	1030	3.73	0.820	Low Extent
I utilise media platforms to share persuasive information to voters with the aims to sale my party's ideologies and manifestos	246	8	8	14	1038	3.76	0.740	Low Extent
I utilise media platforms to disseminate craft political slogans that express the character or aims of my candidate	241	35	0	0	1069	3.87	0.330	High Extent
Overall Mean						**3.816**		

Source: Field Survey (2024

The result from table 1.1 shows the extent of media utilisation by politicians for information dissemination on political campaigns in Kano state, Nigeria. From the data on the Table, it is observed that majority of the respondents utilise media platforms to a high extent to disseminate information about the accountability and transparency of their party candidates (mean=3.89) and utilise media platforms to disseminate craft political slogans that express the character or aims of my candidate (mean=3.87) and utilise media platforms to repel opposition critics by stimulating meaningful discussions and debates during political campaigns (mean=3.86).

Table 1.2 Research Question Four: What are the Types of Media Politicians Utilised for Information Dissemination on Political Campaigns?

Types of media	Used	Not Used
Radio	207 (75%)	69 (25%)
Television	72 (26%)	204 (74%)
Newspaper	6 (2%)	270 (98%).
Facebook	221 (80%)	55 (20%)
WhatsApp	210 (76%)	66 (24%)
X	152 (55%)	124 (45%)
Billboards/Posters	257 (93%)	19 (7%)

Source: Field Survey (2024)

The result from Table 4.5 shows the percentages of types of media politicians utilise for disseminating information on political campaigns in Kano State, Nigeria. From this Table, it is

observed that the following media platforms had the highest percentages media platforms that were utilised Billboards/Posters 257(93%), Facebook 221(80%) and WhatsApp (76%).

Discussion of Findings

Regarding research question one; the study revealed that the majority of the respondents to a high extent disseminate information about the accountability and transparency of their party candidates and use media platforms to repel oppositions or critics by stimulating meaningful discussions and debates during campaigns. This indicates that most politicians in Kano State, Nigeria, highlight a deliberate use of media to strengthen their candidate's image while countering opposition narratives. However, the use of media for repelling opposition highlights its role as a battleground for political influence, where managing perception and controlling the narrative are critical for campaign success.

The study finding is line with that of Omotayo and Folorunso (2020) investigated the use of social media for political participation among youths in Oyo state, Nigeria. Findings reveal that social media was highly used by the youths for political participation. Facebook (98.8%) was found to be the most used, followed by Whatsapp (93.8%), Instagram (60.2%), X (55.3%), and Yahoo Messenger (50.9%) respectively. Majorly, the youths used social media to participate in political advocacy (95.3%), political campaigns (91.9%), communicating with politicians (90.7%), political discussions (87.3%), monitoring and reporting electoral malpractices (85.1%), public consultations (80.4%), joining interest groups that engage in lobbying (64.9%), blogging about political issues (64.9%), and writing letters to public officials (51.2%).

In the same vein, the finding is slightly in line with that of Onyebuch *et al.* (2016) who investigated preying on platforms: a comparative analysis of social media and traditional mass media advertisements in the 2015 presidential election campaign in Nigeria. The results revealed that respondents use social media apps extensively, disclosing that they frequently come across politically related stories over time and that the rate at which significant political stories, both real and fake, are released onto online platforms is on the rise, casting doubt on the existence of media gatekeepers.

In relation to research question two, the findings revealed that Billboards/posters, Facebook and WhatsApp were the major media platforms utilised by politicians in disseminating political information during campaigns in Kano State, Nigeria. This signifies that the combination of these platforms allowed politicians in Kano State to reach diverse segments of the population, blending traditional and digital strategies to maximise their outreach and engagement during campaigns.

These findings are in alignment with those of Carlos (2022) investigated the effects of social media on political communication. The results revealed that social media platforms and devices mostly used was Facebook (71.44%) and their mobile phones (68.88%) on connecting to the Internet and accessing news regarding politics. 70% of the respondents spend 3 hours and below using social media.

The above observation is corroborated with findings of Omotayo and Folorunso (2020) who investigated the use of social media for political participation among youths in Oyo state, Nigeria. Findings reveal that social media was highly used by the youths for political participation. Facebook (98.8%) was found to be the most used, followed by Whatsapp (93.8%), Instagram (60.2%), X (55.3%), and Yahoo Messenger (50.9%) respectively.

The above findings deviate the finding of Oluwatosin *et al*. (2020) investigated the influence of the media on political knowledge among undergraduate students. Findings identified social media as the most frequently use media, followed by radio, television and newspaper.31% of the respondents had very high political knowledge while 3% had no political knowledge. Access to radio is the only significant correlate ($r = 0.42$, $p<0.05$) and independent predictor ($\beta= 0.43$, $t=-3.98$, $p<0.05$) of political knowledge although access to radio, television, newspaper and social media are significant joint predictors of political knowledge ($R2= .18$, $F (4, 241) = 4.32$).

Recommendations

Based on the findings of this research, the following recommendations are put forwards to improve to improve emerging media use for information dissemination on political campaigns by politicians in Kano State Nigeria:

1. Aspirants should provide training to their campaign team on best practices for engaging with critics and opponent on media platforms. Thus, well-trained media team can handled opposition more effective without escalating conflicts.
2. Politicians should develop a cohesive communication strategy that integrates newspapers and television to reinforce campaign messages across all platforms. This strategy should ensure that the same core messages and visuals are consistently used across these platforms to maximise reach and impact.

Conclusion

Based on the results of the findings, the study indicates that the utilisation of media is very high extent for information dissemination on political campaigns by politicians in Kano State. It was also concluded that, radio stations, Facebook, WhatsApp and Twitter are the types of media used by politicians for information dissemination on political campaign in Kano State.

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THE IMPACT OF EMERGING TECHNOLOGIES ON LIBRARY ADMINISTRATION: OPPORTUNITIES, CHALLENGES AND FUTURE PROSPECTS

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Abstract
The contemporary landscape of library administration is being significantly influenced by technological advancements such as artificial intelligence (AI), Intelligent Library Search and Federated Search, Internet of Things, Cloud Computing, Academic Integrity and Plagiarism, big data analytics, blockchain technology (BT), virtual reality (VR) and augmented reality (AR). These technologies offer novel prospects for augmenting services, managing resources, and fostering user engagement. Nonetheless, they also pose challenges related to financial constraints, the need for specialized technical knowledge, resistance to change, and security considerations. This paper delves into examining the influence of technology on library administration, emphasizing the opportunities it offers, the challenges encountered during implementation, and the potential future for libraries that effectively embrace these technologies. The study concludes by providing strategic recommendations for libraries to adeptly navigate these technological advancements. The paper investigates the varied impact of technology on library administration. It not only underscores the wide-ranging opportunities that technology offers but also delves into the challenges often encountered during its implementation. Moreover, the paper discusses the potential future for libraries that successfully adopt these technologies, taking into consideration factors such as user engagement, resource management, and information accessibility. Finally, the study concludes by offering a set of strategic recommendations designed to help libraries effectively navigate the challenges and opportunities in the ever-evolving digital landscape.

Keywords: Library Administration, Emerging Technologies, Opportunities, Challenges and Future Prospects

Introduction
The rapid advancement of technology has dramatically changed how libraries operate. From managing physical collections to providing access to digital resources, libraries have continuously adapted to meet the needs of their users. The emergence of technologies such as artificial intelligence (AI), Intelligent Library and Federated Search, Internet of Things, Cloud Computing, Academic Integrity and Plagiarism, big data analytics, Blockchain Technology, virtual reality (VR) and augmented reality (AR) has introduced new ways to enhance library administration and services, transforming how libraries interact with their users and manage their resources. The modern library is changing dramatically; it is no longer just a static collection of printed materials but rather a dynamic knowledge center powered by new

technologies (Ganesamoorthy & Selvakamal, 2024). The fifth law of library science (Ranganathan, 1931) states that 'he library is a growing organism.' Many libraries now adopt and use computers and other technologies in their operations and services to meet the needs of their users. The above factors led to the change of name of the department from library science to library and information science and more recently to library and information technology (Bharathi & Sudhier 2024)

Problem Statement

Incorporating emerging technologies into library management presents a set of complex challenges despite their significant advantages. The constraints included poor library leadership, inadequate technological infrastructure and a lack of financial prowess to sustain emerging technologies in an e-learning environment (Mitha & Omarsaib, 2024). Financial limitations, the demand for specialized technical competencies, employee reluctance towards change, and apprehensions concerning data security and privacy are among the foremost obstacles that libraries must address. Effectively navigating these challenges to leverage the potential of these technologies while mitigating associated complexities is imperative for the advancement of library administration.

Literature Review

Overview of Emerging Technologies in Library Administration

In 2024, a profound transformation is underway at many libraries, driven by a surge in technological integration and the need to stay relevant and redefine their role in their communities. This wave of innovation encompasses a comprehensive approach to improving user experiences and expanding the library's impact (Pressreader, 2024). Libraries are embracing the use of cutting-edge technologies such as artificial intelligence, virtual reality, and digital resources to enhance the overall quality and effectiveness of their services and operations. By leveraging these emerging technologies, libraries are aiming to provide more personalized experiences, streamline processes, and offer innovative resources to their patrons. These technologies include:

Artificial Intelligence (AI): Is transforming library administration by enhancing the efficiency, accuracy, and user experience across various library functions. AI is revolutionizing how libraries operate, offering new opportunities for efficiency, personalization, and innovation. As AI technologies continue to evolve, their role in enhancing library services and supporting academic research will only become more significant. These tools can help researchers identify relevant literature, analyze data, and generate insights, reducing the time and effort required for research and enabling more comprehensive and impactful studies. AI technologies are employed to generate and enrich metadata for digital and physical resources. By analyzing the text, images, and other content, AI can create detailed and accurate metadata, including abstracts, keywords, and descriptive tags. This improves the discoverability of resources and enhances search engine performance within library systems. Due to their ease of use, generative AI tools like ChatGPT have become extremely popular. With the growing popularity of these tools among students, faculty are increasingly turning to librarians to help cultivate AI literacy, discussing AI and its impact on literature searching and citations with their classes (Quigley, 2024)

Intelligent Library Search and Federated Search: Intelligent library search systems use AI and natural language processing (NLP) to improve search accuracy and relevance. These systems understand context, semantics, and user intent, enabling them to deliver more precise search results. They can also personalize searches based on a user's history, preferences, and

academic focus, making it easier for users to find the most relevant materials quickly. While **federated search** allows users to search multiple databases and information sources simultaneously through a single search interface. Instead of searching each database separately, federated search aggregates results from various sources, providing a comprehensive view of available resources. This technology is particularly useful in academic libraries, where users need access to a wide range of scholarly databases and journals. Libraries used this technology for descriptive cataloguing, subject indexing, database searching, and collection development (Gautam, 2024).

Internet of Things (IoT): IoT devices in libraries enable real-time monitoring and management of assets such as books, computers, and environmental conditions. For instance, RFID tags on books allow for automatic check-ins and check-outs, reducing manual workload. Its the best-integrated **library software** started using the Internet of Things (IoT) to transfer data without human intervention. Libraries use IoT to control smart circulation and check-out, managing inventory, ecological monitoring, energy efficiency, space utilization, user experience growth, security and access control, analytics for data, collection creation, augmented and virtual reality and smart shelves, ecological sustainability, monitoring remotely and maintenance planning, learning and collaboration spaces, personalized services, innovative technology, digital advertising, and wearable tees are just a few of the key IoT opportunities (Sanjiv, *et al.* 2024).

Cloud Computing: Cloud-based solutions provide scalable storage and access to digital resources, allowing libraries to manage vast amounts of data efficiently. Cloud computing also facilitates collaboration across institutions by enabling shared access to resources and tools. Libraries across the world are adopting cloud computing to make library services more streamlined and cost-efficient. It also improved file security, streamlined access with reduced security risks, an efficient virtual workspace, and enhanced information storage and retrieval capabilities (Isiaka, 2024).

Academic Integrity and Plagiarism: Academic integrity tools are essential in libraries to ensure the originality of academic work. Plagiarism detection software like Turnitin or Grammarly uses algorithms to compare texts against a vast database of published works, detecting similarities and potential plagiarism. These tools are integrated into library systems to help students and researchers maintain academic honesty by checking their work before submission. copying others' work damages, the intellectual integrity of their academic experience. Therefore, avoiding plagiarism has become the need of the hour (Gautam, 2024).

Big Data Analytics: Libraries utilize big data analytics to gain insights into user behavior, resource usage, and operational efficiency. By analyzing large datasets, libraries can optimize their services, tailor collections to user needs, and improve decision-making processes. It allows libraries to make informed decisions and optimize their services. By deciphering patterns from vast information pools, it empowers libraries to tailor offerings, anticipate needs, and optimize services, fostering an environment where user experiences are not just improved but intuitively aligned with evolving preferences and demands (Fatouh, 2024).

Blockchain Technology: Blockchain technology is quickly gaining interest in the library sector as it offers a strong way to improve data security, validate provenance, and guarantee the accuracy of information. Protecting sensitive data and ensuring the authenticity of digital information become increasingly important as the digital ecosystem develops and grows. It

also provides a decentralized, tamper-proof ledger that ensures transparency and trust in transactions like interlibrary loans. This unchangeable record is a potent weapon against data manipulation, guaranteeing that the historical and cultural value of digital archives endures and is reliable. With blockchain technology, library services could be transformed as it offers improved security, transparency, and effectiveness (Fasola, *et al.* 2024)

Virtual Reality (VR) and Augmented Reality (AR): VR and AR are used to create immersive learning experiences, such as virtual tours of the library or interactive exhibits. They can also enhance the user experience by overlaying digital information onto physical spaces, aiding in navigation and resource discovery. It enhances user engagement and provides new ways to explore library resources. Through VR headsets, patrons can embark on virtual tours of historical sites, wander through ancient libraries, or explore distant galaxies. Furthermore, libraries are utilizing VR to digitize their collections and create virtual libraries and archives. By digitizing rare manuscripts, historical documents, and artifacts, libraries can preserve cultural heritage and make it accessible to a global audience. Users can navigate through these digital archives in a 3D environment, interacting with objects and documents in ways that were previously impossible (Weiss, 2024)

Opportunities Presented by Emerging Technologies

1. **Automation and Efficiency:** Artificial Intelligence (AI) is transforming library administration by automating routine tasks such as cataloging, classification, and information retrieval. AI-driven chatbots and virtual assistants can handle user queries, freeing librarians to focus on more complex tasks. This automation enhances operational efficiency and reduces the likelihood of human error.

2. **Enhanced User Experience**: The integration of AI and machine learning allows libraries to offer personalized services. Recommender systems, for instance, analyze user behavior to suggest relevant resources, improving user engagement and satisfaction. Additionally, augmented reality (AR) and virtual reality (VR) technologies can create immersive learning environments, providing users with interactive experiences that extend beyond traditional library services.

3. **Improved Resource Management**: The Internet of Things (IoT) facilitates better inventory management by enabling real-time tracking of library materials. IoT devices can monitor environmental conditions, ensuring the preservation of delicate materials. Furthermore, blockchain technology can enhance the security and transparency of library transactions, such as the lending and returning of materials, by creating tamper-proof records.

4. **Scalable Storage Solutions**: Cloud computing offers libraries scalable and cost-effective storage solutions, enabling them to manage vast amounts of digital resources. Cloud-based platforms also support collaborative work, allowing libraries to share resources and expertise across institutions. This accessibility ensures that users can access information anytime and anywhere, fostering a more inclusive knowledge environment.

Challenges in Adopting Emerging Technologies

1. **Financial Constraints**: One of the primary challenges in adopting emerging technologies is the high cost of implementation. Many libraries, particularly those in developing regions, lack the financial resources to invest in advanced technologies. The

cost of purchasing, maintaining, and upgrading these systems can be prohibitive, limiting their adoption.

2. **Skill Gaps and Training Needs**: The integration of emerging technologies requires specialized skills that many library staff may not possess. Continuous training and professional development are essential to equip librarians with the necessary technical expertise. However, the rapid pace of technological change can make it difficult for staff to keep up, leading to skill gaps that hinder effective implementation.

3. **Data Privacy and Security Concerns**: As libraries increasingly rely on digital platforms, concerns about data privacy and security become more pronounced. The use of AI, IoT, and blockchain involves the collection and processing of vast amounts of data, raising questions about how this data is stored, shared, and protected. Libraries must navigate these issues carefully to maintain user trust and comply with regulatory requirements.

4. **Resistance to Change**: The introduction of new technologies can be met with resistance from both staff and users who are accustomed to traditional methods of library administration. This resistance can stem from a fear of obsolescence, a lack of understanding of the new technologies, or a reluctance to change established practices. Overcoming this resistance requires effective change management strategies and clear communication about the benefits of the new technologies.

Future Prospects for Library Administration

1. **Personalization and Customization**: The future of library administration lies in the ability to offer personalized and customized services. AI and machine learning will play a crucial role in analyzing user data to provide tailored recommendations and services. This shift towards personalization will enhance user engagement and ensure that libraries remain relevant in a digital age where information is abundant but often overwhelming.

2. **Collaborative and Open Platforms**: As cloud computing and blockchain technologies continue to evolve, libraries will increasingly collaborate on a global scale. Open-access platforms and shared databases will allow libraries to pool resources and provide users with access to a wider range of materials. This collaborative approach will also facilitate the sharing of best practices and innovations, driving continuous improvement in library services.

3. **Integration of Emerging Technologies**: Libraries will continue to integrate emerging technologies, such as AI, IoT, and blockchain, into their operations. This integration will not only improve efficiency and security but also enable libraries to offer innovative services that meet the evolving needs of their users. For instance, AI-driven predictive analytics could be used to anticipate user needs and provide proactive support, while IoT devices could create smart environments that enhance the user experience.

Conclusion

The paper has examined the impact of emerging technologies on library administration, highlighting the opportunities for improvement, difficulties encountered, and future prospects. Emerging technologies offer significant benefits, including enhanced efficiency, personalized

user experiences, and data-driven decision-making. However, libraries face challenges related to financial constraints, technical expertise, resistance to change, and security concerns.

Recommendations for Effective Technology Integration

1. **Strategic Planning for Technology Integration**: Libraries should develop comprehensive strategic plans that outline the integration of emerging technologies into their operations. These plans should include clear objectives, timelines, and resource allocation strategies to ensure a smooth and effective implementation.
2. **Investment in Staff Training, Development and adoption to new technologies**: To overcome the technical challenges associated with emerging technologies, libraries should invest in continuous training and development programs for their staff. This will ensure that library personnel have the necessary skills and knowledge to manage, maintain and adopt new technologies effectively.
3. **Securing Adequate Funding**: Libraries should actively seek out funding opportunities, including grants and partnerships with technology providers, to support the financial investment required for technology adoption. Budgeting for ongoing maintenance and upgrades is also essential to keep technologies up-to-date and functional.

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EXPLORING THE POTENTIALS IN AUTOMOBILE TECHNOLOGY CAREER PROSPECTS FOR SUSTAINABLE DEVELOPMENT AND NATIONAL SECURITY IN NIGERIA

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Abstract
Education is a vital instrument for national development. Advancement of a nation – technologically, economically and in the area of security is hinged on the educational philosophy been practiced in such a nation. The function of education is to impact knowledge and requisite skills to live as a productive citizen in the society, hence, the need for an education such as Automobile Technology that prepares individuals with the skills needed to live, learn and earn a decent living. The paper explored career prospects in automobile technology trade that can offer individuals with the saleable skills needed for job creation, and also for effective employment in the world of work. When people are gainfully employed, their quality of lives will be enhanced, security challenges will reduced, and overall country's economy will improve. All these positive indices lead to national development. The paper also pointed out barriers for effective implementation of automobile technology policies, such as faulty curriculum, underestimation of practical teaching, shortage of infrastructure, among others. The paper conclude and recommended that Security of lives and properties should be handled with utmost seriousness by both individuals and government since industrialization, economic growth and national development can only come to fruition in a secure environment, also, there should be a paradigm shift of our education curriculum from a provider – driven training model to demand- driven training model where the training provided by educational institutions is aligned to an identified gap in the labour market, among others.

Keywords: Automobile technology, Automobile Technology career prospects, Sustainable development and National Security.

Introduction
Education is adjudged as a crucial tool for national development. For education to yield the needed development, it has to be functional, adequate and responsive to the needs, yarning and aspirations of the society. Ogunyemi and Olaniyan, (2023) defined education as a vital instrument for national development, aiming to foster skills, knowledge, and values that contribute to individual growth and societal advancement.

However, Automobile technology is one of the Technical and Vocational Education and Training (TVET) programmes that boarder on the techniques of maintenance, repair and operation of vehicles. According to Ojo and Lampo, (2019) Automobile technology involves

the acquisition of scientific knowledge in design, selection of materials, construction, operation and maintenance of motor vehicles. Automobile technology is one of the trades offered in secondary schools, technical colleges and other post – secondary schools education (Federal Republic of Nigeria, 2015). Automobile technology is a form of education and training that prepares individuals with the skills needed to live, learn and earn a decent living. Therefore, exploring the occupational prospects and opportunities in Automobile technology trade can provide veritable grounds for individuals to set – up his/her own workshop, even employs others and thus contributes to national development by reducing unemployment which is one of the causative factors of security challenges.

Security had taking a center stage in the public discuss both locally and international. Security implies the protection of individuals, organizations, and nations from threats and risks that could cause harm or disruption (Brown & Smith, 2024). Nigeria, no doubt had witnessed a host of security challenges in different dimensions, ranging from the activities of Herdsmen, Boko - haram insurgencies, Armed robber attacks, Kidnapping for ransom, Banditry, and a host of other crimes. Security challenges impede a country's development inform of diverting resources, discouraging investment, disrupting economic growth and destabilize social stability, and hindering progress and prosperity. Since no meaningful development can take place in an unsecure environment; hence, security is crucial to sustainable development.

Sustainable development implies the development that meets the needs of the present generation without preventing the ability of future generations to meet their own needs. According to United Nations, (2023) sustainable development is a process of growth that meets the needs of the present without compromising the ability of future generations to meet their own needs. The author stressed that sustainable development involves balancing economic growth, environmental protection, and social inclusion to ensure long-term viability and equity. However, development is a phenomenon or process that brings about growth, progress, and positive change to state or individual's physical wellbeing, economic, environmental, social, and all other positive indices of human sustenance. Development connotes absence of security challenges; hence security is very essential to national coexistence and national survival.

Therefore, there is need for an educational philosophy such as that of Automobile Technology that encourages skill acquisition and job – creation via the occupational prospects available in the trade area. Evidences from literatures revealed that breakdown of security is being perpetrated by youth due to idleness, so, Automobile technology is capable of providing the youth with the skills, techniques, knowledge and attitude needed for effective employment in the world of work. When people are gainfully employed, their standards of living will improve, the rate of insecurity will reduce, and the overall country's economy will be enhanced. All these are the ingredients of sustainable national development.

Conceptual Clarifications

Automobile Technology Education

Automobile Technology Education refers to the process of acquiring knowledge and skills related to the design, manufacturing, maintenance and repair and operation of vehicles. According to Oke and Bello, (2024) automobile technology involves the study and application of vehicle systems and repair techniques tailored to local conditions. It focuses on improving vehicle performance, maintenance practices, and adaptation of automotive technologies to suit Nigeria's diverse road environments and economic need. The National Policy on Education Revised edition (2015) describes Automobile Technology Education as that aspect of Technology education that is intended to provide among other things opportunities for

immediate employment for the youths in the area of skill acquisition in vehicle repair and maintenance.

Furthermore, The Minimum Standard for Nigeria Certificate in Education, N.C.E. (Technical) by the National Commission for Colleges of Education (N.C.C.E.) revised edition (2020) describes the philosophy of Automobile Technology Education (A.T.E.) as a programme that boarders on improving the lives of the individuals and the society in general. However, some of the objectives of Automobile Technology Education adapted from general TVET objectives include:

a. to give training and impart necessary skills leading to the production of craftsmen, technicians and other skilled personnel who will be enterprising and self-reliant.
b. to provide trained manpower in the applied science, technology and commerce particularly at sub-professional grade.
c. to enable young men and women to have an intelligent understanding of the increasing complexity of technology.

A careful look at the objectives of Automobile Technology as expatiated above revealed that the programme is based on skills and competencies for job creation. Idle hands they say is devils' play grounds. Automobile technology skills can assist individuals to earn a decent living by creating a means of livelihood that will improve individuals' standard of living, curbs security challenges and thereby contributing to national development.

National Security

Security means different things to different people and in different places – at home it could means domestic security, in the place of work, it is referred to as job security and at national level when it has to do with protection and preservation of nation's sovereignty, territorial integrity and the citizen's well – being, it could be called national security. Security, according to Adeyemi and Bello, (2024) refers to the measures and strategies implemented to protect individuals, communities, and national assets from threats such as terrorism, crime, and civil unrest. Gubak and Bulus, (2018) maintained that security is related to the presence of peace, safety, happiness and the protection of lives and property or the absence of crisis, threats to human survival, among others. Security is one of the important indicators for national coexistence and national survival hence, the need for Automobile technology education that encourages skill acquisition for productivity and self-reliance. When people are gainfully employed, their standards of living will improve, the rate of insecurity will reduce, and the overall country's economy will be enhanced.

National Development

National development is a very controversial concept that had suffered definition pluralism. According to United Nations Development Programme (2021), national development implies the sustained, concerted actions of policy- makers and communities that promote the standard of living and economic health of a specific area with the ultimate goal of improving the overall quality of life of its residents. Lasisi, *et al.* (2022) opined that national development is any positive change which brings about desirable benefits to the individual and society. Perhaps, at the individual level, development may means growth in knowledge, skills, attitudes and enhanced ability to survive. At the society level, development is associated with modernization, material advancement, industrialization, scientific and industrial progress, new knowledge about man and the universal improvement in standard of living, decrease in loss of lives and social security management towards racial, tribal and gender equality, decrease in unemployment and availability of job opportunities. Therefore, to enhance national development, career opportunities in Automobile technology has enormous potentials for job

creation, improving quality of life, reduce poverty and limiting the incidence of security challenges due to joblessness.

Automobile Technology Career Prospects for National Development

Automobile is a composite of many complex systems. According to Valasek, (2018), Automobile technology is a multidisciplinary field of study that impacts knowledge about the design, operation and maintenance of automobiles, including the integration of cutting-edge technologies such as electric and hybrid propulsion and autonomous systems. Automotive field offers almost unlimited career opportunities for individuals to engage themselves, earn a living, be useful to themselves and people around them, and the society at large. In fact, many service managers, dealers and independents garage owners were once automotive mechanics. Valasek, (2018) observed that the renowned names (Henry Ford, Walter Chrysler, Ransom Olds, among others) in automotive industries all began as automotive mechanics. However, some of the automotive career options include:

a. **Automotive Repair Shop**: Automotive repair shops are independent garages. Some are one person specialty, while others may be general repairs shops that employ many master automotive technicians. Automotive Service Excellence (ASE) (2023) recognizes the following services specialties: Engine Repair, Automatic Transmission/Transaxle, Manual Drive Train and Axles, Electrical/Electronic System, Suspension and Steering system specialist, Braking system, Heating and Air conditioning, Engine performance and Light vehicles/Diesel engines. According to ASE, (2023), other automotive specialty include:

i. Wheel balancing and alignment.
ii. Tire vulcanizing and repairs.
iii. Battery charging.
iv. Clutch and gearbox repairs.
v. Carwash and engine servicing.

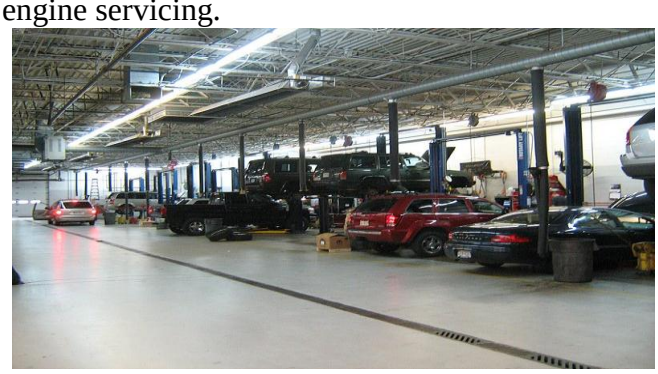

Plate i: Auto dealer's service and repair facility, Rockville, Maryland, USA, - internet sourced data (2023)

Plate ii : Auto repair service garage, Ukraine – internet sourced data (2023)

Plate iii: **Wheel balancing and alignment shop – Internet sourced data (2023)**

b. **Auto Parts Store:** This is another automotive career option. An automotive parts store may operate both as a wholesaler and as a retailer. As a wholesaler, the store sells auto parts and related accessories at a discount to other automotive service businesses, while a retailer part store sells parts at non-discounted rate to people who service their own vehicle.

Plate iv: Interior of an Advance Auto Parts store in Virginia, United States - Internet sourced data (2023)

c. **Service Station:** Automotive career also include the service station operation. The function of service station is to carry-out vehicles repair and maintenance job, and also to sell automotive fuels. Although, today, most service stations sells only fuel, oil and other automotive fluids without engaging in any repair and maintenance work.

Plate v: Samimootor, a car repair shop and filling station in Nuorgam, Utsjoki, Finland – Internet source data (2023)

d. **Fleet shop**: An automotive fleet shop refers to a repair shop that is dedicated to repairing and maintaining a collection of vehicles often owned by a single organization or company. Examples of this include; FUTMIN vehicles, Chanchaga red bricks vehicle, logistics and delivery vehicles, among others, and collection of other vehicles that belong to a single establishment.

e. **Engine machine shop:** This is an engine machine shop that is dedicated to the repair, modification, and rebuilding of internal combustion engine parts. These workshops utilize large electromechanical machines that are not found in the average automotive repair shops. The tasks performed by engine machine shop include: engine block machining, crankshaft grinding, cylinder head work, balancing of engine parts, among others.

f. **Auto Service Adviser:** The job of an auto service advisor is to welcome the customers and writes repair orders based on symptoms described by the car owner. Auto Service/repair writers often generally have a sound background in troubleshooting and diagnosis.

Apart from the auto occupational careers mentioned thereof, National Automotive Technician Education Foundation (NATEF), (2019) also pointed-out other career opportunities in automobile technology field, include:

i. Automotive technology instructors
ii. Curriculum developers
iii. Technical trainer educators
iv. On – line course instructors
v. Programme coordinators/managers, among others.

Therefore, exploring any of the career prospects highlighted and discussed above is capable of enhancing an individual's standard of living; tackles security challenges and encourages the national development campaign agenda by the government.

Barriers to Effective Implementation of Automobile Technology Education Policies in Nigeria

Despite the significant role of TVET in the areas of human resource development for productivity in Nigeria, little progress had been made due to a number of problems which have continued to bedeviling the programme. Uwaifo, (2015) identified the following among others as some of the challenges of Automotive technology policy implementation in Nigeria. These challenges are as follows:

a. **Under - estimation of practical teaching**

Technical and Vocational Education and Training programme of which Automobile technology is an aspect is targeted at cultivating the habit of practical application of skills by students. Technical and Vocational Education and Training (TVET) schools should therefore place extra emphasis on basic competences and skills required for practice in TVET fields as their major focus. However due to influence of traditional education for quite a long time, TVET schools still followed the traditional education mode which at times de-emphasis experiment and practice. For instance, experiment and practical courses are not qualitatively distinguished from courses of knowledge impartation, teachers just echo what the books say, students copy notes, and experiments and practical courses become courses of an armchair strategist. In terms of teaching content, theory is overemphasized, while practical training is down – played.

b. **Lack of regular training and re-training opportunities for the teachers**
Teachers remain the most important resource in any educational enterprise; therefore, they need to continue to update their knowledge since the world is dynamic. Many TVET teachers still practice the traditional chalk and board method of delivering instruction in the class. Regular training will therefore keep teachers updated with the latest educational practices, teaching pedagogies and advancements in automotive trade. All these will assist them (teachers) to stay current and relevant in their field.

c. **Financial constraints**
While general education programmes, for instance, humanity, may only require buildings for lecture halls, Automobile technology programme require in addition, the buildings and equipment for special laboratories and workshops. All these cost a large sum of money of which the Federal and State governments appear unable to meet adequately in view of other pressing national and economic priorities.

d. **Poor electricity supply**
Epileptic power generation and supply is another factor that has hindered the implementation of Automobile technology education policies in Nigeria. Most schools find it difficult to conduct practical as most machines are electrically operated. Most companies and industries had folded up due to incessant power failure. With the current removal of fuel subsidy, private firms that provide schools- industries linkages to our students have gradually shifted their production-base to other West African countries. All these have led to production of unskilled graduates, job- losses and reduction in the quality of lives of the citizens and as such cannot contribute to national development.

e. **Faulty Curriculum**: A close examination of the current Automobile technology curriculum generally reveals a lot of inadequacies, such as mismatched course contents, obsolete teaching methods and materials, outdated textbooks, grossly insufficient practical time, to mention but a few. There seems to be no emphasis anymore on the inculcation of job skills and competencies in line with the philosophy of the programme. Therefore, our education curriculum needs a paradigm shift from a provider – driven training model, where the training provided by the schools is not aligned to any identified need in the labour market, to a demand - driven training model where the learning experiences provided by the schools is tied to identified skill gaps in the labour market.

Conclusion

A country's progress and development is a function of the nature of the education model being practiced in that country because, school is seen as the mirror to the society. A country's education is dependent on the needs and aspiration of the country, therefore, for national coexistence and national survival, there is need for an educational philosophy such as that of Automobile technology that encourages skill acquisition for productivity, economic growth and self-reliance. However, the goals of Automobile technology education as enshrined in the national policy have been very difficult to achieve due to a number of challenges such as under – estimation of practical teaching, lack of regular training and retraining of technology teachers, financial constraints, among others.

Therefore, by addressing the challenges enunciated thereof, Automobile technology career prospects can offer individuals with the saleable skills, techniques, knowledge and attitude needed for effective employment in the world of work. When people are gainfully employed,

their quality of lives will be enhanced, security challenges will be ameliorated, the overall country's economy will be transformed, all these are elements of national development which can only be achieved in a secured environment.

Recommendations

In the light of the issues discussed in the paper, the following recommendations are drawn:

a. Security of lives and properties should be handled with utmost seriousness by both individuals and government since industrialization, economic growth and national development can only come to fruition in a secured environment.
b. There is need for regular training and retraining of TVET teachers as this will keep them updated with the latest educational practices, teaching pedagogies and advancements in their trade areas.
c. Automobile technology programme, being an aspect of TVET programmes is capital intensive hence; more funding should be allocated to ensure a smooth running of the programme.
d. Automobile technology programme courses should be designed to have enough practical relevancies that are required to set-up one's workshop or to secure a paid job in the industry.
e. There should be a paradigm shift of our Technology education curriculum from a provider -driven training model to demand - driven training model where the training provided by educational institutions is aligned to identified gaps in the labour market.

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INFORMATION SERVICE DELIVERY IN UNIVERSITY LIBRARIES: THE ROLE OF CLOUD COMPUTING APPLICATIONS

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Abstract
The advent of cloud computing has revolutionised information service delivery in university libraries thereby offering unprecedented scalability, flexibility, and cost-effectiveness. This paper explores the concept of and types of information services delivery in university libraries, the concept of cloud computing applications, and cloud computing service models such as software-as-a-service (SaaS), platform-as-a-service (PaaS), and infrastructure-as-a-service (IaaS) models. In addition, its benefits such as scalability and cost efficiency, data management and preservation, collaborative tools and resource sharing, as well as digital preservation and archiving, were highlighted. By analyzing existing literature and empirical studies, the research identified significant benefits, including reduced financial wastage on IT investments and improved user experiences. However, challenges such as security, privacy, and limited accessibility remain prevalent. This study aims to bridge the knowledge gap regarding the integration of cloud computing in university libraries, where traditional practices often hinder effective information service delivery. The findings underscore the necessity for strategic implementation of cloud technologies to optimize resource utilisation and enhance user satisfaction. Ultimately, this paper contributes to the ongoing discourse on technological integration in academic libraries by providing insights that can inform future research and development initiatives.

Keywords: Information, information service delivery, University libraries, and cloud computing application.

Introduction
Information service delivery encompasses the process of distributing targeted content or applications to users through a range of systems or devices. Information service delivery is central to library operations and services. Therefore, it involves the processes and activities libraries use to provide users with information services and resources, ultimately aiming to support and improve their activities and productivity (Haruna, 2022). This process ensures that users receive relevant information in an accessible and efficient manner. Information itself can be understood as processed data that offers meaning and context, guiding actions and decisions (Abduldayan, 2021). Within the context of university libraries, information includes a wide range of resources such as books, journals, databases, and multimedia materials. As user needs

evolve and technological advancements progress, university libraries face the challenge of adapting their information services to remain relevant and effective.

A significant advancement in this realm is the integration of cloud computing. Modern university libraries are increasingly leveraging cloud computing to enhance their information services by offering improved scalability, flexibility, and cost-effectiveness. Cloud solutions streamline operations, reduce IT costs, and facilitate remote access to resources, addressing issues like system crashes and data loss (Okwoli *et-al.*, 2016). However, challenges such as security, privacy concerns, and limited accessibility remain significant barriers. This paper explores how cloud computing applications are transforming information service delivery in university libraries by highlighting both the potential benefits and ongoing challenges.

Problem Statement

The rapid evolution of technology has fundamentally altered the landscape of information acquisition, processing, access, utilization, and dissemination within library settings. In university libraries, the efficacy of information service delivery hinges upon the seamless integration of technology and the availability of diverse resources tailored to meet users' information needs. While the potential of cloud computing applications in enhancing information service delivery is recognized, there exists a notable gap in understanding how these technologies can be effectively implemented to address existing challenges.

This research aims to investigate the role of cloud computing applications in improving information service delivery in university libraries, by identifying both the benefits and challenges associated with their implementation.

Literature Review

Information service delivery is multifaceted, encompassing various strategies, technologies, and resources to address the diverse information needs of their users. Traditionally, services such as reference assistance, circulation, and interlibrary loan have been foundational components, with reference librarians providing expert guidance in information retrieval and research. These services are outlined by Dalia (2018); Adamu, Babalola, and Saka (2019); Alabi and Sani, (2021) also include circulation services, interlibrary loan services, and others like Current Awareness Services (CAS) and Selective Dissemination of Information (SDI). According to Ranjan (2023), information services encompass a broad scope with a central focus on delivering information to users. The author categorizes these services into two main types. Responsive information services include reference services, which help users locate and utilize information sources; referral services, which direct users to additional resources or experts; and literature search services, which involve systematic searches for relevant literature. Anticipatory information services, on the other hand, comprise current awareness services, which keep users updated on recent developments; document delivery services, which provide access to specific documents upon request; and selective dissemination of information, which delivers tailored content based on users' predefined interests.

With technological advancements, these services have transitioned into digital formats, leveraging electronic databases, e-journals, and integrated library systems (ILS) to enhance accessibility and discoverability. Furthermore, online reference services have emerged and are facilitating remote access to reference assistance, while instruction and information literacy programme empower users with critical research skills.

Cloud computing is the latest revolution in the field of information and communication technology (ICT) which brings some unimaginable services that ease people's transactions and extremely enhance information services delivery. Cloud computing is defined as the provision of various services over the Internet, including servers, storage, databases, networking, software, and analytics (Microsoft Azure, 2019). Swapna and Biradar (2017) breaks down the elements of cloud computing as follow: C for cloud computing resources for information service delivery, L for location independence, O for online accessibility, U for utility usage, and D for on-demand availability. Pillai and Seena (2018) emphasized the necessity for cloud computing services to be massively scalable to qualify as true cloud computing. The authors further expressed the view with regard to how cloud computing is different from other computing and its advantages to libraries. Academic libraries are using many cloud computing technologies in its day to day operations. Web cataloguing tools offered by OCLC is the utmost bulging example where many library uploads their cataloguing records under shared resources service of OCLC under the web. Google Apps, OCLC Servies, Ex-Libris, OSS Labs, LibLime, Polaris, Dropbox and Dura space are the major examples of cloud service in academic libraries (Hosburgh, 2016; & Adegbilero-Iwari, 2017). Librarians find cloud computing as helpful enough in protecting and preserving their data and privacy thereby improving information service delivery. Libraries adopt cloud technology for easy access to e journals by hosting sister digital libraries tracking statistical data among others (Suman and Parminder, 2016). In cloud computing, shared resources, software, and information are provided to remote clients over a network.

Cloud Computing Services Models

Cloud computing services in academic libraries are broadly categorized into "Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS), and Infrastructure-as-a-Service (IaaS) models" (Makori, 2016 and Suman *et al.*, 2023).

Software-as-a-Service (SaaS) - delivers software applications and associated services to users over the internet eliminate the need for local installation and maintenance. Examples include, web-based applications like Hotmail, Google Apps, and Skype, as well as Web 2.0 solutions like Facebook, Twitter, and Flickr (Chudasma *et al.,* 2019). Moreover, Microsoft Office365 and Salesforce are also part of the example (Patel & Kansara, 2021). In the context of libraries and information centres, SaaS facilitates accessibility and usage of various software tools and platforms. Characteristics outlined by Mohammed and Zeebareec (2021) include continuous access to services, hosting applications in third-party premises, and availability of services through web interfaces. SaaS prioritizes end-user convenience, while PaaS suits application development needs.

In the vast landscape of software as a service (SaaS), Facebook, Twitter, Instagram, YouTube, and WhatsApp emerges as a fascinating examples, not only as a messaging apps but as a paradigm of cloud-based service delivery. The integration of cloud-based applications like Facebook, Twitter, Instagram, YouTube, and WhatsApp into university libraries exemplifies the transformative impact of cloud computing on information service delivery. Cloud-based social apps can be applied to university libraries in three ways which include, "Information distribution, Knowledge organization and Information communication" for effective service delivery (Agu, *et al*. 2022). These platforms, operating under the SaaS model, facilitate a range of activities from real-time communication to multimedia content sharing thereby enhancing the library's ability to engage with its community and deliver effective support.

Platform-as-a-Service (PaaS) - Provides a comprehensive suite of services for the development, testing, deployment, and maintenance of software and web-based applications. Notable examples include Amazon's Elastic Compute Cloud (EC2), which allows clients to lease computing resources and Google Apps, which offer a range of productivity tools such as Gmail and Google Docs. PaaS offerings support academic libraries by furnishing cost-effective solutions for information management and collaboration. Platform as a Service (PaaS) provides all the resources necessary for building applications and services over the internet without requiring users to download or install software. PaaS services encompass application design, development, hosting, collaboration, web service integration, database integration, security, and scaling (Okike and Omali, 2023). Users manage applications and data, while the vendor manages runtime, middleware, operating system, virtualization, servers, storage, and networking (Nazir *et- al*., 2020). PaaS offers advantages such as flexibility in software installation and scalability. However, interoperability and portability among providers are limitations of PaaS.

Infrastructure-as-a-Service (IaaS) - furnishes scalable and flexible computing resources, including storage and processing power, on a pay-per-use basis sometimes referred to as hardware-as-a-Service or utility computing. IaaS enables organizations to outsource their infrastructure needs to third-party providers. Notable examples of IaaS providers include Google and IBM cloud, DSpace and Fedora, whose offerings empower academic institutions with the necessary computational resources for research and educational endeavours. According to Okike and Omali (2023) infrastructure as a Service (IaaS) is a cloud computing model that provides virtualized computing and network resources to users. In this model, users construct their own virtual clusters and are responsible for managing and executing their own software stack. However, users may have control over some selected network components while not having control over the entire cloud infrastructure.

Benefits of cloud computing associated with information service delivery

The following are benefits offered by cloud computing application in university libraries

1. Scalability
2. Cost Efficiency
3. Flexibility
4. Interoperability
5. Collaboration
6. Data Management
7. Data Preservation
8. Resource Sharing
9. Digital Archiving and
10. Digital Preservation of information resources

The adoption of cloud computing in university libraries not only streamlines operations and reduces costs but also promotes a more collaborative, flexible, and sustainable approach to information service delivery

Role of Cloud Computing Application on Information Service Delivery

Cloud computing has emerged as a transformative technology offering scalability, flexibility, and cost-effectiveness to various sectors, including academic institutions. University libraries, serving as pivotal information hubs, are increasingly adopting cloud computing applications to enhance their services, streamline operations, and improve accessibility to resources thereby making information dissemination easier. Cloud computing offers a range of services,

including data storage, resource sharing, and collaborative tools, which can significantly improve information services in university libraries. According to Ekhaguosa *et al*. (2022), the utilization of cloud computing applications among university librarians in the Niger Delta region of Nigeria has been widespread, indicating a growing awareness of its benefits. The study found that librarians frequently use cloud applications for accessing, storing, and sharing electronic resources, underscoring the importance of adequate internet infrastructure to facilitate these services. Furthermore, research by Chudasma *et al.* (2019) assessed the awareness and utilization of cloud computing services among library personnel and users in selected university libraries in Gujarat, India. The findings revealed that a significant majority of library users and staff were aware of cloud technology, with laptops being the predominant device used for accessing cloud services. This suggests a positive trend towards the adoption of cloud computing in academic libraries, although challenges related to user training and infrastructure remain.

According to Okwoli *et-al.,* (2016), with cloud computing in libraries, all sorts of financial wastages on IT investment, careless attitudes of users and technological headaches such as computer virus, system crashes and loss of data will be drastically monitored and avoided. There will likely be a significant improvement when cloud computing is adopted in delivering information services.

Conclusion

The integration of cloud computing applications in university libraries represents a transformative opportunity to enhance information service delivery. By facilitating remote access to resources, reducing financial wastage, and promoting collaboration among library staff and users, cloud computing can significantly improve the overall academic experience. However, the successful implementation of these technologies requires addressing critical challenges related to security, infrastructure, and staff training. As university libraries continue to evolve in response to technological advancements, the strategic adoption of cloud computing will be essential for optimizing resource utilization and enhancing information service delivery.

Recommendations

To maximize the benefits of cloud computing in university libraries, the following recommendations are proposed:

1. Invest in Infrastructure: Libraries should prioritize investments in reliable internet connectivity and IT support to facilitate seamless access to cloud-based resources.
2. Enhance Training Programmes: Comprehensive training initiatives should be implemented to improve the technological competencies of library staff by ensuring that they are equipped to support users effectively.
3. Develop Security Protocols: Libraries must establish robust security protocols to protect user data and address privacy concerns associated with cloud computing.
4. Foster Collaboration: Fostering collaboration among library staff and users can enhance information service delivery and improve the overall academic experience.
5. Establish Feedback Mechanisms: Libraries should create platforms for user feedback to continuously improve service delivery and address any challenges faced by users.
6. Promote Awareness Campaigns: Promoting awareness among library users about the available cloud services can enhance utilization and engagement.

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FUNCTIONALITY OF 21st CENTURY INSTRUCTIONAL FACILITIES FOR TEACHING AND LEARNING ELECTRICAL/ELECTRONIC COURSES IN TERTIARY INSTITUTION IN NIGER STATE

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Abstract
The research assessed the functionality of 21st century instructional facilities in teaching and learning electrical/electronic courses in tertiary institutions in Niger State. The study adopted descriptive survey research design. The population of the study was 710 lectures and students of electrical/electronic technology in five tertiary institutions in Niger State. The sampling techniques used for this study was purposive sampling technique. The sampling size was 75 electrical/electronic lecturers and 200 electrical/electronic students in five tertiary institutions in Niger State. Two research questions formulated and guided the study. Mean and standard deviation were used to answer the research questions while z-test was used to test the null hypotheses at 0.05 level of significance. The findings revealed that most of the instructional facilities for teaching and learning electrical /electronic courses are available, while some are not available. Most of the instructional facilities for teaching and learning electrical /electronic courses are functioning, while some are not functioning. It was recommended that Government should adequately equip the tertiary institutions that offer electrical/electronic technology with modern equipment and facilities for the training of electrical/electronic technologists.

Keywards: Functionality, Instructional Facilities, Electrical/Electronic Courses and Tertiary Institution.

Introduction

Background to the study

The current state of education in Nigeria even in this 21st century leaves much to be desired. This is due to the development in technology, revolution in all areas of our day to day activities. The rate at which technology is advancing in all sectors has called for more concern in the education sector in Nigeria. The current development in the world of work especially the automation of industries shows that some of the facilities for teaching and learning in our education sector in Nigeria are outdated and called for a rapid and total intervention. There is a general neglect and decay of educational facilities at all levels of education in Nigeria occasioned by the long-standing culture of poor funding of education by successive governments in Nigeria. This situation prompted the comment in the editorial in the guardian newspaper by Oni (2019) that there must be something anti-intellectual about the policies and allocation of resources in our country especially under past military governments, sadly, the civilian administrations have not fared any better. Still commenting on the same issue especially in the face of the proposal of the Federal Government to establish six more Federal Universities in Nigeria, according to Oni (2019) in the guardian newspaper observed that: "From the 1990s to date funding of tertiary education has been problematic as successive governments showed marked preference for other priorities and corruption became endemic. Budgetary allocation has declined to the extent that universities and other tertiary institutions are barely able to pay the salaries and allowances of personnel, libraries, laboratories and engineering workshops have long been in decay with the result that most products of the

nation's tertiary institutions lack the intellectual preparation and critical skills required to drive the development process in any sphere of national life".

The Nigerian tertiary institutions of learning are far too ill-equipped to train and develop new graduates suitable for the 21st century; their products are mediocre (Ezeji, 2019). Analysis of the situation point to the extreme level of infrastructural as well as pedagogical deficiency in Nigerian Universities, this being the result of underfunding of public universities (Nwakanma,2020). Sanni (2021) while commenting on the Nigerian content Act passed in 2010 to regulate the activities of the Nigerian content division of the Nigerian National Petroleum Corporation (NNPC) lamented that so far, the effect of the law is not yet felt in Nigeria. This is because the International Oil Companies (IOCs) are reluctant to comply with it. They complain that Nigerian graduate engineers required in the industry do not have the basic engineering knowledge and skills largely due to inadequate training in the universities. While decrying the poor state of education in Nigeria and the resultant effect on Nigeria, Ibrahim (2019) lamented that Nigeria was losing quite a huge sum of foreign exchange because of applicants seeking foreign university education. He hereby gave a comparison of universities in Nigeria and Britain, noting that in an average British university, all facilities are available for research with libraries having the latest books on different subjects unlike in Nigeria. (Oni, 2019).

Tertiary Education, as adopted in the Federal Republic of Nigeria (2014) means Universities, Polytechnics, and Colleges of Education. By design, tertiary education is supposed to promote knowledge, provide solutions to national problems, and ultimately assist the society to achieve its aim of human and socio-economic development in all sectors (Oluwatoyin, 2020). To achieve these ideals, tertiary education must operate a semblance of symbiosis with other sectors, and institutions in the nation (Nwakanma, 2020). That is, it is important that policies are made, and that these policies are considerate of the current socio-economic realities of the society, Nation and the world at large to facilitate successful execution. Governments increasingly understand that the entire educational system from early childhood through tertiary education must reflect the new social and economic needs of the global knowledge economy, which increasingly demands a better-trained, more skilled, and adaptable workforce (Oranu, 2021). One of the best education systems to fulfilled the aim, goal and objective of Federal Republic of Nigeria as stated in the National policy of education is the technical/technology education. Tertiary institution where technical and vocational education and training (TVET) can provide an effective and efficient complement to traditional university studies in providing students with skills and knowledge relevant to the labour market (Olalekan, 2018). Tertiary institutions offering technical and vocational education and training (TVET) programs provide courses in electrical and electronic engineering.

The teaching and learning of electrical/electronic courses involve imparting information to the learner and the acquisition of scientific knowledge, ideas, facts, skills and other relevant data arranged in the technical information for the electrical/electronic learner's academic and mental development. Teaching is the science and art of helping a person to learn. Technically, teaching involves assisting the learner to develop insight into a problem or to form an association between a response and a stimulus. According to Ogwo and Oranu (2019) teaching is a partnership enterprise between the teacher and the students which ultimately leads to permanent changes in the behaviour of the students. The teaching and learning of electrical/electronic courses to a great extent depends on the adequate provision and utilization of instructional facilities in the teaching of the subject. Instructional facilities are the essential concrete features that enable the electrical/electronic lecturers/instructors teach effectively in the electrical/electronic workshop and lecture theatre (Okoro, 2021; Oranu, 2021).

Instructional facilities which include; buildings, machines, workbenches, equipment, tools and materials for a major place and resources which electrical/electronic lecturers manipulate in other to cause learning to occur. This implies that instructional facilities are those items which the electrical/electronic lecturer turns to for help in his goal of seeking activities that would help him perform the job of instruction.

According to Larson, (2022) whatever the lecturer uses as aid in order to teach a lesson could be referred to as instructional facility. Instructional facilities in teaching of electrical/electronic courses help the lecturers to convey intended messages effectively so that learner receives, understands, retains and applies experience gained to reach overall educational goals. Facilities could also be described as tools. In Nigeria, tools in industrial technical education are grouped together, and they include; saws, pliers, files, chisel, screws drivers, among others, which are also classified as hand tools. The lathe, pillar drills, grinders, power saw, combination plier, rolling, shaping and milling machines are classified under machine tools, while some other materials include; steel rods, wires, wood and cement. These facilities help actualize instructions in electrical/electronic lecture theatre and workshop (Ibrahim, 2019). The realization of the objectives of and the ability to improve student achievement depend on a number of factors. These include the availability of equipment, tools, and materials, and adequate supply of lectures, the proper implementation and often utilization of instructional facilities (Umunadi, 2020). Awobodu, (2020) has noted that lecturer's utilization of relevant facilities, material and tools in teaching electrical/electronic courses facilitates learning and enhances students' achievement. The provision and availability of instructional facilities could be accomplished through compliance to various recommendations by organizations, bodies and commissions that create standards. The National University Commission (NUC 2017) recommended a specified number of each of the facilities, tools, equipment and machinery for a specified number of students intended for admission in academic year for electrical/electronic in tertiary institutions. This recommendation by NUC means that facilities should be given consideration in the initial planning of the course programme. The NUC also emphasized that a provision of these instructional facilities less than the number specified in the tertiary institutions would be classified as inadequate and the provision of instructional facilities that matches with the number specified in the tertiary institution would be classified as adequate. According to Asilokun (2022), the availability of adequate electrical/electronic facilities enhances students' learning by allowing them to be involved in demonstrations, and practice will continue to build their skills.

For effective instructions and attainment of skills, the instructional facilities should be modern and functional, so that the lecturer and learner could benefit from it (Ololube, 2018). Also, according to Ajayi (2020), for electrical/electronic graduates to be effective and gainfully employed, there must be available and functional tools and equipment (facilities) to offer electrical/electronic trade in tertiary institution. The author further stressed that, courses lacking facilities or tools for proper teaching and learning should not be offered at all in tertiary institutions, therefore, the saying half bread is better than none, does not work in acquisition of skill and knowledge. This means that there is need for functional facilities that should be a replica of what is obtainable and relevant to the occupation/trade, which the student should appreciate their importance.

Functionality is concerned with making instructional facilities to serve educational purposes in the school for teaching and learning under the best condition and effectively utilized. Utilization of available and functional instructional facilities in teaching electrical/electronic courses promotes meaningful communication enhances effective teaching, increases the

interest of learners and motivate individualized instruction in which learning is assured. This implies that, the ultimate goal of utilizing instructional facilities is to facilitate teaching and learning (Okoye, 2018).

To achieve self-reliant and gainful employment, serious attention should be given to the availability and functionality of instructional facilities. Hence, the assessment of availability and functionality of instructional facilities in teaching and learning electrical/electronic courses in tertiary institutions in Niger State, Nigeria become imperative in this 21st century.

The 21st Century is best described as the age of science and technology, exploration, experimentation and development. This has resulted to innovations in all fields of human endeavour with its attendant socio-economic consequences. Thus, every nation must be abreast with such innovations to be economically viable. In view of this, Oranu, (2021) opined that Nigeria needs to grow and compete favorably with other nations in business and industry, in new methods and new techniques. This requires not only capital investment, but also a workforce that is knowledgeable and has the flexibility to acquire new skills for new jobs as the structures of the economy and occupations change. The search therefore, is for skilled workers and specialists in new and growing fields such as Technical Education. Training in vocational and technical education is primarily meant to equip the trainee with skills, knowledge and attitude to become self-reliant, enterprising and ready to create environment for self and societal empowerment. The flexibility and productivity of any workforce largely depends on the availability of skilled workers especially technologist, technicians and artisans.

Statement of the Research Problem

The goal of electrical/electronic programmes in Nigerian tertiary institution is to produce qualified electrical/electronic manpower with sound theoretical and practical knowledge that can perform all kinds of electrical/electronic works and diagnose, on electrical devices to the manufacturer's specification in the 21st century. The electrical/electronic graduates in tertiary institution in Niger State, Nigeria have the prospect of either being employed in industries, or setting-up their own business, becoming self-employed or furthering their education to post graduate level. The above can also be fusible when the facilities in tertiary institutions are available, adequate, functional and utilized. The government at different level had made several attempts and contributions towards the provision of facilities in electrical and electronics in tertiary institution. Also, research has being conducted by different researchers on the availability and functionality of facilities and strategies for improving electrical and electronic facilities for teaching and learning.

Okoye (2018) stated that the functionality of instructional facilities in tertiary institutions refers to their effectiveness and suitability for supporting teaching, learning, research, and other academic activities in tertiary institutions. Here are some key aspects of their functionality: Supporting Teaching and Learning: Instructional facilities should provide appropriate spaces and resources for lectures, seminars, workshops, and other forms of instruction. This includes well-equipped classrooms, lecture halls, and specialized facilities for hands-on training in disciplines like laboratories, studios, and workshops; Enabling Research: Tertiary institutions often engage in research activities. Adequate facilities such as research laboratories, libraries with comprehensive collections, and access to digital resources are essential to facilitate research endeavours; Promoting Practical Application: Facilities should allow for the application of theoretical knowledge through hands-on experiences. This could involve specialized equipment, simulated environments, or spaces for conducting experiments and projects; Facilitating Collaborative Learning: Spaces for group discussions, study rooms, and

project work areas encourage collaborative learning, fostering teamwork and problem-solving skills among students; Accommodating Technological Needs: Given the increasing reliance on technology, instructional facilities should be equipped with up-to-date computer labs, audio-visual equipment, and internet connectivity to facilitate modern teaching methods and research; Ensuring Safety and Accessibility: Facilities should be designed with safety measures in place and be accessible to all, including individuals with disabilities. This includes ramps, elevators, and other accommodations. The functionality of instructional facilities is crucial for providing a high-quality education and fostering a stimulating learning environment in tertiary institutions. Regular assessment, maintenance, and investment in these facilities are necessary to meet the changing demands of education.

However, these graduates of electrical/electronic technology prove to be ill equipped as most companies and industries spend money in training and retraining the graduates of electrical/electronic in tertiary institutions in Niger State, Nigeria in other to meet the standard required by the companies and industries, instead of starting work immediately (Adesina, 2018).
Niger State is also characterized with high level of unemployment, making majority of graduates including graduates of electrical/electronic technology to roam about and get involved in various criminal activities. According to Olalekan (2018) unemployment among electrical/electronic graduates can be attributed to several factors: Skill Mismatch; Lack of Experience; Economic Downturn and industrial revolution, most of the unemployed graduates are idle and restive. Consequently, these idle graduates devise alternative means to earn a living. Most graduate of electrical/electronic are still unemployed especially in this 21st century, therefore there is need to carry out research on the functionality of those equipment and the level at which the equipment have being used if they are available. The instructional materials should be updated to meet up with the current state of technology revolution and innovation.

The graduates from tertiary institutions offering electrical/electronics should be equipped with necessary and right instructional materials. They should be equipped with modern electronic components, testing equipment, and tools (Awobodu, 2020). According to Okoye (2018) computer Labs are important for software simulations, programming, and design work related to electrical and electronic systems, workshop space are essential for practical skills development, including wiring, soldering, and assembly of electronic circuits, a comprehensive collection of textbooks, journals, and electronic resources specific to electrical and electronic engineering should be made available. It's important for institutions to regularly update and maintain these facilities to keep up with technological advancements and industry standards. Additionally, faculty expertise and ongoing professional development play a critical role in ensuring effective utilization of these resources. Government has been spending money to ensure that these facilities are available base on the researches carried out and the effort of the government still. Most of the graduate of electrical/electronic cannot be self-employed in this 21st century skills, therefore there is need to carryout functionality on these facilities and the level if at all they are available. It is therefore base on this ground that the researcher intends to evaluate the availability, functionality and utilization of instructional facilities for teaching and learning electrical/electronic courses in tertiary institutions in Niger state. This intends to investigate the functionality and utilization of instructional facilities in teaching and learning of electrical/electronic courses in tertiary institution in Niger State, Nigeria.

Purpose of the Study

The purpose of this study was to evaluate the functionality and utilization of instructional facilities in teaching and learning of electrical/electronic courses in tertiary institution in Niger State, Nigeria. The specific purpose of the study was to:

1. Determine the availability of the 21st century instructional facilities for teaching and learning electrical/electronic courses in tertiary institution in Niger State, Nigeria.
2. Determine the functionality of the available 21st century instructional facilities in teaching and learning electrical/electronic courses in tertiary institution in Niger State, Nigeria.

Research Questions

The following research questions guided the study.

1. What are the available instructional facilities for teaching and learning electrical/electronic courses in tertiary institutions in Niger State?
2. What are the adequacies of instructional facilities for teaching and learning electrical/electronic courses in tertiary institutions in Niger State?

Research Methodology

The descriptive survey research method with the use of a structured questionnaire was used to collect the required information from the respondents. The survey research was adopted because survey design generally can be used to effectively investigate problems in realistic settings. Nworgu (2018) described survey research as that which a group of people or items is studied by collecting and analyzing data from only a few people or items considered to be representative of the entire group.

The study was carried out in Niger State, a state in central Nigeria and the largest state in the country which shares boundaries with Kaduna State (North-East), Federal Capital Territory (South-East), Kebbi State (North-West), and Kwara State (South-West). This study covers five tertiary institutions offering electrical/electronics in Niger State. The following are the tertiary institutions: Federal University of Technology Minna; Niger State College of Education Minna; Federal polytechnic Bida; Institute of technology and Innovation Minna; Niger State Polytechnic Zungeru.

The targeted population for this study comprises of 710 lecturers and students of electrical/electronic technology in 5 tertiary institutions in Niger state. Total sampled for the study is 275, consisting of 75 electrical/electronic lecturers and 200 electrical/electronic students. Simple random techniques were used to select 200 level students from 5 tertiary institutions and all electrical/electronic lecturers were used from all the 5 tertiary institutions, purposive sampling technique was used to select 40 students in each institution among 200 level students. This was carried out to enable the researcher select experienced and active lecturers and students for the study.

The instrument used for data collection is questionnaire. The questionnaire is to determine the opinion of the respondents that comprises of electrical/electronic lecturers and electrical/electronic students in tertiary institutions in Niger Stata. technical colleges in Niger State. The questionnaire is divided into two parts (i and ii). Part i consist of respondents "personal data", containing information about gender, age, categories, qualification and part ii is grouped into (A and B) where section A consist of 16 items which sought to elicit information on the available instructional facilities for teaching and learning electrical/electronic courses in tertiary institutions in Niger State, section B consist of 16 items which sought to elicit

information on the functionality of instructional facilities for teaching and learning electrical/electronic courses in tertiary institutions in Niger State.

The instrument use for data collection was administered to all the five tertiary institutions offering electrical/electronic programme. The instrument was retrieved immediately for computation. The instrument for data collection was administered by the researcher and research assistance. The data collected by the researcher was analyzed using mean, standard deviation as statistical tools. A four-point rating scale was employed with the following response: Highly Available (HA), Available (A), Moderately Available (MA) and Not Available (NA) and Highly Function (HF), Function (F), Moderately Function (MF) and Not Function (NF). The data collected for the study was organized and analyzed on the basis of the research question SPSS version 27 was used for the analysis. Decisions on the research questions were based on the resulting means score interpreted. Any item that its mean is 2.50 and above will be regarded available or functioning while, any items that its mean is less than 2.50 will be regarded as not available or not functioning. The standard deviation was used to decide on the closeness or otherwise of the respondents to the mean in their responses. Any item with standard deviation of less than 1.96 indicated that the respondents were too far from the mean. Independent sample z-test was used to analyzed hypothesis to determine the no significant at ($P^{<}.05$) level of significance on the functionality of electrical/electronic instructional facilities used for teaching in tertiary institutions in Niger State.

Presentation and Data Analysis

This chapter deals with the presentation and analysis of data with respect to the research questions formulated for this study, the result of this data analysis for the research questions are presented.

What are the available 21st century instructional facilities for teaching and learning electrical/electronic courses in tertiary institutions in Niger State?

Table 4.1: mean response of electrical/electronic lecturers and electrical/electronic students on the available instructional facilities for teaching and learning electrical/electronic courses in tertiary institutions in Niger State. N_1=75, N_2=200.

4.1 Research Question 1

SN	ITEMS	$\overline{X}_1$	SD_1	$\overline{X}_2$	SD_2	$\overline{X}_t$	R
1	Laboratories	2.21	0.81	2.53	0.68	2.37	NA
2	Computer Labs	3.53	0.72	3.76	0.52	3.65	A
3	Workshops	3.53	0.72	3.76	0.52	3.65	A
4	e-library	3.54	0.67	2.83	0.47	3.19	A
5	Specialized software	2.05	0.53	2.43	0.51	2.24	NA
6	Tools and equipment	3.50	0.64	3.9	0.40	3.75	A
7	Lecture theatre and classrooms	3.48	0.71	3.17	0.30	3.33	A
8	Safety equipment	3.22	0.91	3.05	0.51	3.14	A
9	Internet connectivity	2.19	0.64	2.42	0.68	2.30	NA
10	Prototyping Facilities	2.37	1.10	2.59	0.69	2.48	NA
11	Access to industrial partnership	2.72	0.79	2.35	0.40	2.54	A
12	Test and measuring instrument	2.70	0.81	2.51	0.68	2.61	A
13	Power supply	2.98	0.51	2.72	0.53	2.85	A
14	Audio-visual aids	3.28	0.47	2.94	0.67	3.11	A
15	Electronics labs	3.38	0.64	3.02	0.40	3.20	A
16	Argumentation/visual reality	2.57	0.53	2.31	0.47	2.44	NA

KEY: $\overline{X}1$= mean of lecturers, $\overline{X}2$= mean of students, N_1= number of lecturers, N_2= number of students, SD1= Standard Deviation of lecturers, SD2= Standard Deviation for students, $\overline{X}t$= Average mean of both lecturers and students, R= Remark, NA= Not Available, A= Available.

Table 4.1 reviewed that the respondents agreed with item 2, 3, 4 6, 7, 8, 11, 12, 13, 14, and 15 with the mean ranges between 2.54 to 3.75 which is above 2.50. this indicated that the respondents agreed that the listed instructional facilities ae available in tertiary institutions in Niger State. While items 1, 5 9, 10, and 16 with the means ranges between 2.24 to 2.48 which is less than 2.50 this indicated not available. This means that the responses of the respondent show that the instructional facilities are not available for teaching electrical and electronics programme in tertiary institutions in Niger State. The standard deviation is between 0.40 to 1.10 which is below 1.96 indicating that the responds are not too far from each other.

Research Question 2

Are instructional facilities for teaching and learning electrical/electronic courses in tertiary institutions in Niger State functioning?

Table 4.3 Mean responses of electrical/electronic lecturers and electrical/electronic students on the functionality of instructional facilities for teaching and learning electrical/electronic courses in tertiary institutions in Niger State. N1= 75, N2=200

SN	ITEMS	$\overline{X}_1$	SD_1	$\overline{X}_2$	SD_2	$\overline{X}_t$	R
1	Laboratories	2.62	0.38	1.89	0.82	2.26	N F
2	Computer Labs	2.69	0.44	3.41	0.93	3.05	F
3	Workshops	3.52	0.58	3.04	0.64	3.28	F
4	e-library	2.43	0.93	2.19	0.90	.2.31	N F
5	Specialized software	2.21	0.50	2.11	0.67	2.16	N F
6	Tools and equipment	3.17	0.62	2.74	0.80	2.96	F
7	Lecture theatre and classrooms	2.86	1.05	3.02	0.87	2.93	F
8	Safety equipment	2.59	0.93	2.72	0.98	2.66	F
9	Internet connectivity	2.36	0.75	1.98	0.99	2.17	N F
10	Prototyping Facilities	2.21	0.93	1.89	0.99	2.05	N F
11	Access to industrial partnership	2.47	0.50	2.74	0.67	2.61	F
12	Test and measuring instrument	2.88	0.85	3.21	0.92	3.05	F
13	Power supply	2.56	0.57	3.11	1.72	2.84	F
14	Audio-visual aids	2.92	0.75	2.58	0.99	2.75	F
15	Electronics labs	2.65	0.57	3.05	0.99	2.85	F
16	Argumentation/visual reality	1.88	0.85	2.62	0.92	2.25	N F

KEY: $\overline{X}1$= mean responses of lecturers, $\overline{X}2$= mean responses of students, N1= number of lecturers, N2= number of students, SD1= Standard Deviation for lecturers, SD2= Standard Deviation for students, $\overline{X}t$= Average mean of lecturers and students, R= Remark, F= Functional, NF= Not Functional.

Table 4.2 reviewed that the respondents agreed with item 2, 3, 6, 7, 8, 11, 12, 13, 14, and 15 with the mean ranges between 2.61 to 3.28 which is above 2.50 indication that the instructional facilities for teaching and learning electrical/electronics courses are functioning. While items 1, 4, 5, 9, 10, and 16 with the mean ranges between 2.05 to 2.31 which is less than 2.50 indicating that the respondent revealed that the instructional facilities for teaching and learning electrical/electronics courses are not functioning in tertiary institutions in Niger State not

functioning. The standard deviation is between 0.38 to 1.72 which is below 1.96 indicating that the responds are not too far from each other.

Findings of the study

The following are the principle findings of the study; they are organized based on the research questions and hypothesis.

4. Eleven (11) of the listed instructional facilities are available in teaching and learning electrical/electronic courses in tertiary institutions in Niger State. While, five (5) of the instructional facilities are not available for teaching and learning electrical/electronic courses in tertiary institutions in Niger State
5. Ten (10) of the listed instructional facilities are functional in teaching and learning electrical/electronic courses in tertiary institution in Niger State. While, six (6) of the instructional facilities are not functional in teaching and learning electrical/electronic courses in tertiary institution in Niger State.

Discussion of the Findings

The discussion of findings is based on the research questions posed for the study. The findings in research question 1shows that majority of the instructional facilities listed for teaching and learning electrical/electronic courses in tertiary institutions in Niger State are available. The responses of the electrical and electronics lecturers and students regarding the availability of instructional facilities for teaching and learning electrical/electronic courses in tertiary institutions are: Computer Labs, Workshops, e-library, Tools and equipment, Safety equipment, Lecture theatre and classrooms, Access to industrial partnership, Electronics labs among others. Teaching and learning of electrical and electronics courses at every levels of education require several instructional facilities if the aims and objectives of electrical and electronics programme should be achieved. The findings is in line with the work of Tom (2017) who agree that Safety equipment, Internet access, Access to industry partnership are some of the available instructional facilities in teaching and learning electrical/electronic courses in tertiary institutions. Also, the study of Chuwumezie (2018) concord that availability of instrument for test and measuring various electrical parameters, audio-visual aids, power supply and electronic labs are also the available instructional facilities in teaching and learning electrical/electronic facilities in tertiary institutions. The study is in line with the study of Yisa, et al, (2022) who revealed that workshop, equipment and tools are available and adequate for teaching and learning. The above available instructional facilities show that the government and the school management are committed, but the question remains are the above-mentioned instructional facilities meet up with the current development in terms of technology revolution? The study also, revealed that some of the instructional facilities for teaching and learning electrical courses in tertiary institutions in Niger State are not available. The respondent noted that the following instructional facilities are not available: Specialized software, Internet connectivity, Prototyping Facilities, Argumentation/visual reality. The above instructional facilities are mostly related to the 21st century facilities. unfortunately, they are not available in our tertiary institutions for teaching and learning electrical and electronics courses in Niger State. This agrees with the study of Yisa, et, al, (2022) who in their study revealed that the ICT materials resources are not available and not adequate at technical colleges in Niger State. This is an indication that the tertiary institution in Niger State has a long way to go. Because, unavailable instructional facilities are mostly needed in this era of technology development and advancement, electrical and electronics students needs to learned the current and needed skills to met up with the global standard. Yisa, et al, noted further that devices that are commonly used today, such as augmented reality (AR) and virtual reality (VR) headsets are the fresh and new IT innovation. By making these instructional facilities readily available, tertiary

institutions can create a robust infrastructure for teaching electrical and electronics that prepares students for real-world challenges and opportunities in the 21st century.

In respect to the research question two, electrical and electronics lecturers and students agreed that most of the instructional facilities for teaching and learning electrical and electronics course in tertiary institutions in Niger Stata are functioning. The following are some of the instructional facilities that the respondents agreed with that are functioning: Computer Labs, Workshops, Tools and equipment, Lecture theatre and classrooms, Access to industrial partnership, Electronics labs, Power supply. This study is supported by the study of Usman et al, (2021) who revealed that hand tools in electrical/electronics option are functioning.

Moreover, the study revealed that some of the instructional facilities are not functioning, such as: Laboratories, e-library, Specialized software, internet connectivity, Prototyping Facilities, Argumentation/visual reality. It is evident that the non-functional instructional facilities are the most needed and necessary for this 21st era of technology and digital transformation. When we talk about technology development, digitalization, robotic automation and innovation in the world of work and educational system internet connectivity, argumentation or visual reality, specialized software are needed for effective teaching and learning in order to prepare the learners towards the future. The study is in line with the study Usman et al, (2021) who revealed that some of the workshop facilities for teaching industrial and technology education are not functioning electrical/electronics programme inclusive. According to Trumper (2017), Modern instructional facilities, equipped with advanced technology and interactive tools, create dynamic learning environments that engage students and facilitate active learning, fostering deeper understanding and retention of course material. Umunadi (2020), agrees that Instructional facilities offer diverse learning spaces tailored to different learning styles and preferences, accommodating both traditional classroom instruction and alternative teaching methods such as experiential learning, project-based learning, and flipped classrooms.

Conclusion and Recommendations

Conclusion

As a result of the findings of the study, the desire to produce competent graduates of electrical/electronic technology can be achieved when the instructional facilities in each tertiary institution are relevant, and functioning for the programme as demanded by the curriculum. It is revealed that some of the instructional facilities that are mostly needed and necessary for the 21st century is not available and not functioning for teaching and learning in tertiary institutions in Niger State. Hence, the call for immediate provision of functioning instructional facilities and training and retraining of electrical/electronic lecturers on the utilization of instructional facilities in order to meet the goal of electrical/electronic technology

Recommendations

Based on the findings of the study the following recommendations are made:

1. National University Commission and other bodies regulating the activities of the tertiary institutions should make sure that instructional facilities are made available before accredited to offer electrical/electronic courses.
2. Obsolete and faulty instructional facilities should be replaced or repaired as the case may be.

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EFFECTS OF INDUCTIVE AND DEDUCTIVE INQUIRY INSTRUCTIONAL APPROACHES ON STUDENTS' LEARNING OUTCOMES IN MOTOR VEHICLE MACHANICS WORK IN TECHNICAL COLLEGES IN NIGERIA

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Abstract
The study investigated the effects of Inductive and Deductive inquiry instructional approacheson students' learning outcomes in motor vehicle mechanics work in technical colleges in Nigeria. Two research questions and two null hypotheses guided the study. The study adopted the pre-test non-equivalent control group design of quasi-experimental study. The study was conducted in four technical colleges in Benue State. A purposive sampling technique was usedto drawn four technical colleges for the study. A total of 196 NTC 11 comprised of 162 males and 34 females students from four technical colleges was used as a sampled population for thestudy. The instruments used for data collection were; Motor Vehicle Mechanics Work Achievement Test (MVMWAT) and Motor Vehicle Mechanics Work Interest Inventory (MVMWII). The MVMWAT and MVMWII were subjected to face and content validation by three experts. The reliability coefficient of MVMWAT was found to be 0.79 through Kuder-Richardson 21 (K-R 21), while that of MVMWII was 0.83 through Cronbach Alpha Statistics. Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The findings of the study revealed among others that; Both Inductive and Deductive inquiry instructional approaches significantly enhanced students' academic achievement as well as aroused students' interest in Motor Vehicle Mechanics Work.Based on the findings, it was recommended that; teachers should adopt inductive and deductive inquiryinstructional approaches in teaching and learning as this would enhance students' learning outcomes in Motor Vehicle Mechanics Work.

Keywords: Inductive deductive, achievement, interest, motor vehicle mechanic work.

Introduction
Technical colleges are vocational training institutions set up and charged with the responsibilityof training individuals to acquire knowledge, attitudes and skills needed for either paid employment or self-reliant. The aim of technical colleges in Nigeria in the words of Akanbi (2017) is to offer training and impart the necessary skills leading to the production of craftsmenin different occupations who will be further enterprising and productive in the automobile world of work. Varieties of vocational and technical trade courses offer in technical colleges according to Federal Republic of Nigeria (FRN) (2013) that lead to award of National Technical Certificate (NTC) and Advance National Technical Certificate (ANTC) include: airconditioning and refrigeration, blocklaying, bricklaying and concreting, electrical installation and maintenance work, carpentry and joinery, furniture making and upholstery, painting and decorating, mechanical engineering craft practice, fabrication and welding, vehicle bodybuilding and motor vehicle mechanics work.

Motor Vehicle Mechanics' Work (MVMW) is a trade in Nigerian technical colleges that equipped students with skills needed for the maintenance and repairs of motor vehicles.

National Board for Technical Education (NBTE) (2016) stated that MVMW is one of the tradesprogramme obtainable in technical colleges in Nigeria designed to produce competent skilled craftsmen with quality knowledge of the working principles of motor vehicles, the techniquesand safety practices involved in the maintenance and repairs of motor vehicles. Unfortunately,the attainment of these objectives appears to be far-fetched from the reality as most graduates of this programme cannot undertake the expected practical tasks upon graduation. This may further be evident from their poor performance in the national examinations such as National Business and Technical Examination Board (NABTEB). Defective teaching method according to Maina (2022) is one of the factors for poor performance of students in MVMW in NABTEBexaminations. It is important, therefore, to engage students' creative thinking in order to develop their problem-solving skills by adopting student-centred methods like inquiry instructional approaches. Inquiry implies involvement that leads to understanding. Inquiry in the context of this study refers to a way of questioning, seeking knowledge or information or finding out about phenomena (Panjaitan & Siagian, 2020). In other words, inquiry-based learning is a constructivist approach, in which students have ownership of their learning. One of the inquiry teaching approaches is inductive inquiry. Inductive instructional approach is an approach where students are allowed to discover concepts or principles before the teacher willthen engage them in one or more inquiry activities like exploration to help understand the concept or principle. Inductive inquiry teaching approach is based on the claim that knowledgeis built primarily from a learner's experiences and interaction with phenomena (Wardani & Kusuma, 2020). Another form of inquiry teaching approach is the deductive inquiry.

Deductive inquiry is also an inquiry teaching approach. It is based on the idea that a highly structured presentation of content creates optimal learning for students (Ju & Choi, 2018). Therefore, the deductive inquiry teaching approach is an instructional approach where the teacher presents a generalization, principle or concept, and then engages students in one or more inquiry activities to help understand the concept. This means that there is need for MVMW teachers to adopt proper teaching strategies to teach MVMW that will lead to effectivelearning outcomes.

Learning outcomes are statements that describe the knowledge or skills students should acquireby the end of a particular assignment, class, course, or program, and help students understand why that knowledge. Akir *et al*. (2012) explained that learning outcomes is the measurable skills, abilities, knowledge or values that students should be able to demonstrate as a result of a completing a course. Learning outcomes in this study measure the potential applications of knowledge and skills acquire by students MVMW. However, it is not yet established whether inductive inquiry instructional approach or deductive inquiry instructional approach is better in improving students' learning outcomes such as achievement in MVMW.

Academic achievement connotes performance in school subject as symbolized by a score on an achievement test. Achievement is the outcome of education which involves the determination of the degree of attainment of the learner in tasks, courses or programmes to which the learner is sufficiently exposed (Atsumbe *et al*., 2018). Kenni (2020) posited that Academic achievement of students may partly depend on the kind of attitude they put towardsschool and the level of success they wish to attain. Thus, the use of effective instructional approach, may enhance better students' achievement and interest.

Interest is a powerful motivational process that energizes learning, and is essential to academicsuccess. Ige and Hlalele (2017) defined interest as a social construct developing

within the dynamic relationship between the individual and the situation. Zumyil (2019) pointed out thatthe type of interest a student brings into the classroom is an important factor for his/her achievement or otherwise in a subject. Based on the foregoing therefore there is need to investigate the effects of inductive and deductive inquiry instructional approaches on technicalcollege students' learning outcomes in motor vehicle mechanic work trade.

Statement of the Problem

Despite these Government efforts for establishing and equipping technical colleges, the graduates of MVMW find it difficult to display the skill proficiency in the automobile world of work after graduation. Adamu *et al.* (2022) attributed lack of skills among these graduates to ineffective instructional approaches amongst MVMW teachers. The ineffective instructional approaches in terms of knowledge, skills and attitudes amongst MVMW teachers has so manynegative effects that may hinder the realization of the programme objective. Mamman and Oyinloye (2016) explained that ineffective instructional approaches in Information and Communication Technology (ICT), subject matter, and pedagogy among technical college teachers in Nigeria is responsible for the manifested ineffective and inefficient instructional delivery and shortage of skilled craftsmen. It is so disheartening to note that technical college graduates of motor vehicle mechanics works are finding it difficult to achieve the aims and objectives as stipulated in the National Policy on Education.These low achievement in motor vehicle mechanics work in NABTEB examinations may be attributed to poor delivery approaches adopted by teachers, students' interest, and teachers' laxity towards teaching, concentration on few topics for examination purposes, and students' inability to recall previously learned materials (Umoru & Onoja, 2017). This makes the realization of the goal for technical colleges in most states in the country including Benue Stateto be far below expectation. Therefore, the problem of this study posed as a question; what is the effects of inductive and deductive inquiry instructional approaches on students' learning outcomes in motor vehicle mechanics work in technical colleges in Nigeria?

Purpose of the Study

1. Effect of inductive and deductive inquiry instructional approaches on students' achievement in Motor Vehicle Mechanics work.
2. Effect of inductive and deductive inquiry instructional approaches on students' interestin Motor Vehicle Mechanics work.

Research Questions

1. What is the effect of inductive and deductive inquiry instructional approaches onstudent's achievement in Motor Vehicle Mechanics Work?
2. What is the effect of inductive and deductive inquiry instructional approaches onstudent's interest in Motor Vehicle Mechanics Work?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance to guidethe study.

H_{O1}: There is no significant difference between the mean achievement scores of students taught Motor vehicle mechanics works using inductive inquiry instruction and those taught using deductive inquiry instructional approaches.

H_{O2}: There is no significant difference between the mean interest scores of students taught Motor vehicle mechanic work using inductive inquiry instructional approach and those

taught using deductive inquiry instructional approaches.

Methodology

Quasi-experimental research design was employed for the study. The study was conducted in all the Technical Colleges in Benue State. The targeted population of the study was 401 NationalTechnical Certificate II (NTC II) students comprising of 367 Male and 34 Female MVMW for 2023/2024 academic session in all the Technical Colleges in Benue State, Nigeria. Multi-stagesampling techniques were adopted for the study. A purposive sampling technique was employed to drawn four technical colleges for the study. The four technical colleges were selected for the study because they comprised of both male and female students. Thus, the sampled population for the study was 196 NTC II MVMW students comprising of 162 Male and 34 Female from the four technical colleges in Benue State. The instruments used for the data collection for the study were. Motor Vehicle Mechanics Work Achievement Test (MVMWAT) and Motor Vehicle Mechanics Work Interest Inventory (MVMWII). The instruments, MVMWAT and MVMWII were subjected to face and content validation by three experts in the Department of Industrial and Technology Education, Federal University of Technology Minna, Niger State. A trial testing exercises of MVMWAT and MVMWII were carried out to determine their internal consistency. This was conducted using 20 randomly selected NTC II students from Government Technical College, Minna, Niger State. The choiceof Government Technical College, Minna, Niger State for the trial testing exercise was based on the fact thatthe GTC, Minna did not formed part of the study area. Kuder Richardson 21 (K-R21) was used to determine the internal consistency of Motor Vehicle Mechanic Work Achievement Test (MVMWAT) which was found to be 0.79 and the Cronbach Alpha reliability technique was used to ascertained the internal consistency of the MVMWII to be 0.83.

The regular MVMW teachers administered the pre-test on their students in the two groups. After the pre-test, treatment was administered to the subjects by their regular teachers. At the end of the six weeks of teaching, a post-test was administered to both experimental groups. The post-test was administered, supervised, and graded by the teachers that teaches the groups using the scoring guides developed by the researcher. The scores of the experimental groups inboth pre-test and post-test were recorded and compared to check if there would be a significantdifference in the achievement of the groups. Data collected for the study, was analysed using Statistical Package for Social Science (SPSS) version 23.0. Descriptive and inferential statistics were used to analyse the data. The Descriptive statistics used to answer theresearch questions are mean and standard deviation. While the inferential statistic that was usedfor testing the Null hypotheses is Analysis of Covariance (ANCOVA).

Results

Research Question One

What is the effect of inductive and deductive inquiry instructional approaches on the students' achievement in motor vehicle mechanics' work?

Table 1: Mean of Pre-test and Post-test Achievement Scores of Students taught Motor Vehicle Mechanics Work using Inductive and Deductive Inquiry Instructional approaches

Groups	N	Pre-test Mean	Post-test Mean	Mean Gain
Experimental Group I (IIIA)	107	36.59	67.43	30.84
Experimental Group II (DIIA)	89	33.03	63.67	30.64

The data presented in Table 1 shows that the experimental group I taught with Inductive InquiryInstructional Approach (IIIA) had a mean score of 36.59 in the pretest and a mean score of 67.43 in the posttest making a pretest, posttest mean gain in experimental group I to be 30.84. the experimental group Il taught with Deductive Inquiry Instructional Approach (DIIA) had a mean scoreof 33.03 in the pretest and a mean score of 63.67 in the posttest making a pretest, posttest meangain in experimental group II to be 30.64. With this result, the students in the experimental group I taught with Inductive Inquiry Instructional Approach performed better in the achievement test than the students in the experimental group II taught with Deductive InquiryInstructional Approach. Hence, Inductive Inquiry approach is slightly effective than theDeductive Inquiry approach on students' achievement in Motor Vehicle Mechanics Work.

Research Question Two

What is the effect of inductive and deductive inquiry instructional approaches on the student's interest in Motor vehicle mechanics work?

Table 2: Mean of Pre-test and Post-test Interest Scores of Students taught Motor Vehicle Mechanics Work using Inductive and Deductive Inquiry Instructional approaches

Groups	N	Pre-test Mean	Post-test Mean	Mean Gain
Experimental Group I (IIIA)	107	32.62	68.09	35.47
Experimental Group II (DIIA)	89	30.96	63.77	32.81

Table 2 shows that, the experiment group 1 had a mean score of 32.62 in the pretest and a meanscore of 68.09 in the posttest making a pretest, posttest mean gain in experimental group 1 to be 35.47. The experimental group II had a mean score of 30.96 in the pretest and posttest meanof 63.77 with a pretest, posttest mean gain of 32.81. With this result, the experimental group Iinterest is higher than the interest of the students in experimental group II. Therefore, inductive inquiry instructional approach is more effective than the deductive inquiry instructionalapproach in stimulating student's interest in Motor vehicle mechanic's work.

Hypothesis One

There is no significant difference between the mean achievement scores of students taught Motor vehicle mechanics work using inductive inquiry instructional approach and those taughtusing deductive inquiry instructional approaches.

Table 3: Analysis of Covariance for the Test of Significance Difference between the Achievement Scores of Students taught Motor Vehicle Mechanics Work using Inductive and Deductive Inquiry Instructional approaches

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5863.468[a]	2	2931.734	410.225	.000
Intercept	8183.906	1	8183.906	1145.138	.000
Pretest	5180.078	1	5180.078	724.826	.000
Group	29.806	1	29.806	4.171	0.43
Error	1365.011	191	7.147		
Total	839275.000	194			

Corrected Total	7228.479	193

a. R Squared = .811 (Adjusted R Squared = .809)

The data presented in Table 3 shows F-calculated value for testing the significance differencebetween the achievement scores of students taught Motor vehicle mechanics work using IIIAand those taught with DIIA .The F- calculated value of 4.171 was obtained with associated exact probability value of .043 Since the associated probability of 0.043 was less than 0.05 setas a level of significance, the null hypothesis which stated that there is no significance difference between the mean achievement scores of students taught Motor Vehicle MechanicsWork using inductive inquiry instruction and those taught using deductive inquiry instructionalapproaches is rejected. Hence, there is significant difference between the mean achievement scores of students taught Motor vehicle mechanics work using inductive inquiry instruction and those taught using deductive inquiry instructional approach.

Hypothesis Two

There is no significant difference between the mean interest scores of students taught Motor vehicle mechanics work using inductive inquiry instruction and those taught using deductive inquiry instructional approaches.

Table 4: Analysis of Covariance for the Test of Significance Difference Between the Mean Interest Scores of Students Taught Motor Vehicle Mechanics Work Using Inductive Inquiry Instruction and those Taught using Deductive Inquiry Instructional Approaches

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5703.365[a]	2	2851.683	341.027	.000
Intercept	4844.402	1	4844.402	579.332	.000
Pretest	4796.698	1	4796.698	573.628	.000
Group	323.471	1	323.471	38.683	.000
Error	1597.150	191	8.362		
Total	848936.000	194			
Corrected Total	7003.515	193			

a. R Squared = .781 (Adjusted R Squared = .779)

Table 4 shows the F-calculated value for testing the significance difference between the interestscores of students taught Motor vehicle mechanics work using IIIA and those taught with DIIA.The F-calculated value of 38.683 was obtained with associated exact probability value of .000.Since the associated probability of 0.000 was less than 0.05 set as a level of significance, the null hypothesis which stated that there is no significance difference between the mean interestscores of students taught Motor vehicle mechanics work using IIIA and those taught using DIIA is rejected. Hence, there is significant difference between the mean interest scores of students taught Motor vehicle mechanics work using inductive inquiry instruction and those taught using deductive inquiry instructional approach.

Discussion of Findings

The findings in table 1 on the effects of Inductive and deductive inquiry instructional approacheson students' achievement in motor vehicle mechanics work in technical colleges

in Benue StateNigeria revealed that, III and DII approaches are effective for improving students' academic achievement. However, the III approach was more effective than the DII approach. Analysis of covariance was used to test hypothesis one Table 3 this indicated that there was a significantdifference between the mean achievement scores of students taught Motor vehicle mechanics work using IIIA and those taught with the DII approach, in favour of the IIIA. This confirmedthat the difference between the IIIA and the DIIA was statistically significant.

The findings in Table 2 on the effects of inductive and deductive inquiry instructional approaches on students' interest in motor vehicle mechanics work in technical colleges in Benue State Nigeria revealed that, III and DII approaches are effective for improving students'interest inventory. However, the IIIA was more effective than the DIIA. Analysis of covariancewas used to test hypothesis two Table 4. This indicated that students taught motor vehicle mechanics work using IIIA obtained higher interest mean scores than the students taught withDIIA in the motor vehicle mechanics work interest inventory. The finding is in conformity with that of Akanwa and Ovute (2014) who observed that, the constructivist group indicated ahigher positive mean interest scores in their favour. Furthermore, Uroko (2010) holds a similarview concerning the finding, confirmed that students taught using IIIA strategy had a higher mean interest rating than those in the conventional teaching method. Since Inquiry instructional approaches are highly learners-centered learning strategy on the problem solving, and places the learners the responsibility of learning directly on the students, it potentially enhance and stimulate students' interest and motivation.

Conclusion

Based on the findings of the study, it was concluded that both inductive and deductive inquiryinstructional approaches are effective for improving students' academic achievement and interest in motor vehicle mechanics work in technical colleges but inductive instructional approach is more effective for enhancing students' academic achievement and interest level of technical college students in motor vehicle mechanics' work. The implication, of the findings isthat, the adoption of inquiry instructional approaches holds the potential to enhance students' academic achievements and interests in Motor vehicle mechanics work, Nevertheless, thefindings are limited to the contents of motor vehicle mechanics work at technical colleges in Nigeria. Therefore, it is concluded that, inductive inquiry instructional approach had positive effects on students' academic achievement and interest in motor vehicle mechanic's work.

Recommendations

Based on the findings of the study, the following recommendations were made:

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EFFECT OF BLENDED LERARNING STRATEGY ON STUDENS' ATITTUDE TO LEARNING GEOGRAPHY AND ACADEMIC PERFORMANCE AMONG SECONDARY IN DUTSIN-MA EDUCATIONAL QUALITY ASSURANCE ZONE, KATSINA STATE.

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Abstract

This study was designed and conducted to investigate the effect of blended learning strategy on students' attitude change to learning Geography and academic performance in secondary school. The study employed a quasi-experimental design adopting pre-test and post-test control group. The sample for this study comprised of three hundred and sixty five SSII Geography Students. The study was conducted in two public schools in Dutsin-Ma Quality Educational Zone. The schools were selected using purposive sampling technique, one of which was randomly assigned as experimental group while the other one was randomly assigned as control group. The instruments used were Geography Achievement Test (GAT) and Attitude to Learning Geography Questionnaire (ALGQ) with the reliability of 0.724 and internal consistency of 0.751 respectively. The research questions were answered using mean and standard deviation while the hypotheses were tested at (P<0.05) using t-test independent sample. The result revealed that the computer-based instructional strategy is superior to the teacher-centered method in enhancing both academic performance and attitude to learning geography among the students. Based on these, some recommendations were made which include; teachers of senior secondary schools should expose Geography students to blended learning strategy, so as to promote their academic performance, it should be incorporated in the curriculum of teacher training institutions to raise the attitude to learning geography.

Keywords: Blended learning, Academic Performance, Geography, Students' Attitudes

Introduction

Geography as a school subject is one of the most important subjects in senior secondary school education and it's relevant for students in their pursue of tertiary education cannot be over emphasizes. Geography equips with the understanding of its environment, because geography teaches man how to interact with his physical environment, so it therefore helps students to appreciate their environment better and the usefulness of the abundant resources in their environment. However, teaching of Geography as science or social science subject in senior secondary schools is confronted with some problems which include poor academic performance of students in Geography which has been documented by many researchers. This has also been corroborated by high failure in public examinations in the country such as the West African Examination Council (WAEC) and National Examination Council (NECO). Studies have shown decline in students performance in geography and this has been attributed to the fact that strategies used in our classrooms are not very effective (Adewumi, 2008). Students' academic performance is being used as one of the predictors of overall quality of education system.

However, student's low performance in geography is caused by many factors such as internal and external factors from the students (Carbone, Hurst &Gunstone, 2009). The internal factors may be the attitude, motivation, interest, knowledge, skills, hope, assumption, and goals (Carbone, *et al*, 2009). The instructional strategies employed by the teachers are essential in

the implementation of the curriculum contents. A strategy is a predetermine way or manner used by teacher to promote learning among students. The difficulties experienced by some science teachers in putting their lessons across to learners could be traceable to the fact that they are not properly informed of recent development and equipment, nor equipped with relevant skills of new methods that showcase best practices (Olorundare, 2011). Shifting and going beyond the conventional teaching approaches according to Nnaka (2006) implies adopting the innovative technological approaches such as computer based learning, guided discovery method, cooperative instructional strategy, problem solving method, among others to teaching and learning situation.

Although technology provides a wide variety of educational solutions and serves effective learning, many doubt the beliefs towards its practicality in the educational environment. They think it forms a distraction and needs a lot of skill to master. Blended learning on other hand allows learners to visualize, listen, feel, and interact with the learning topics. It moves them from theory into practice. They can gain deeper understanding for all the theories that they taught. They can learn according to their rapidity, which creates the opportunity for more individualized education (Fakhir 2015). Those who learn faster can expand their learning and learn extra things that are not included in the school syllabus. However, the slow learners can easily revise their notes and give response to their teachers to overcome challenges they face (Bailey and Martin, 2013). According to Jackson, (2014) Educators should take strong and reliable steps towards applying technology in their classes and learning environments as it forms the link between the students' inner world and the outside world. However it has been observed by the researcher that most of secondary schools in Dutsin-Ma Zone have well equipped computer laboratories with network connections, and also students on their sides most of them have smart phones know how to browse but using the experience for social media only. However it has been observed by the researcher that most of secondary schools in Dutsin-Ma Zone have well equipped computer laboratories with network connections, and also students on their sides most of them have smart phones know how to browse but using the experience for social media only. If the teachers can use that opportunity in teaching and learning situation this may make learning sound, easier and enhance student's academic performance and attitude. According to Ahmed, Ahmad &Abdelzahir, (2018) the best learning environment has emerged with the combination of the strongest aspect of web- based learning and traditional learning.

Based on these the researcher sought to investigate the Effect of Blended Learning Strategy on students' attitude to learning Geography and academic performance in senior secondary school in Dutsin-Ma educational quality assuarance zone.

Objectives of the study

Based on the above background of the study and statement of problem, this study seeks to accomplish the following objectives:

1. To determine the effect of Blended Learning strategy on geography student's academic performance in senior secondary school in Dutsin-Ma educational zone.
2. To find out the effect of Blended Learning strategy on geography student's attitude in senior secondary school in Dutsin-Ma educational zone

Research questions

The following research questions will be answered in this study:

1. What is the difference in mean performance of geography students taught using Blended Learning and those taught using conventional teaching method?

2. What is the difference in mean attitude change of students taught geography using Blended Learning and those that taught using conventional teaching method

Research Hypotheses

To guide the research, the following null hypotheses are formulated:

Ho_1: There is no significant difference between the mean academic performance score of geography students taught using Blended Learning and those that taught using conventional teaching method.

Ho_2: There is no significant difference between the student's attitude change geography students taught using Blended Learning and those that taught using conventional teaching.

Significance of the Study

The findings of the study would hopefully be significant to senior secondary school student more especially those with low academic performance and with negative attitude to geography. It would also be beneficial to parent and student's guidance, Curriculum implementers (teachers) curriculum planners and professional bodies like Science Teachers Association of Nigeria (STAN).

Methodology

The design for this study was a quasi-experimental design, adopting pre-test and post-test control group. The population of the study comprises 1493 SS2 Geography students in public co-educational Senior Secondary Schools in Dutsin–Ma Educational Zone. This is made up of 957 males and 536 females with an average age of 17 years. Two (2) co-educational schools were selected using purposive sampling techniques out of the eleven (11) co-educational schools in Dutsin-Ma Educational Zone. Both of the schools have computer laboratories with internet access. The schools selected were G.S.S.S karofi and G.S.S.S Birchi. G.S.S.S Birchi was assigned as experimental sample while G.S.S.S karofi was assigned as the control sample, in each of the school SS 2 science intact class was used for the study. The sample consists of one hundred and four (365) SS 2 students, 213 for experimental group and 152 for control group. There were 202 males and 163 females in the two sampled schools.

The instruments used were: Geography Achievement Test (GAT) and Attitude to Learning Geography Questionnaire (ALGQ). Both the instruments were validated by two experts from Science education department and one from department of educational foundation both in Federal university Dutsin-Ma.

A pilot test was conducted to establish the reliability of the instruments on a group of twenty (20) SS 2 students of Government Pilot Secondary School Safana which is outside the area of the study. The reliability index obtained using Pearson Product Moment Correlation (PPMC) of GAT was 0.72 and internal consistency of ALGQ was 0.751 respectively which indicates a high reliability index of both the s. This indicates that the instruments GAT and ALGQ are reliable.

The collected data was analyzed using descriptive statistics in terms of mean and standard deviation to answer the three (3) research questions. While t-test independent sample (inferential statistics) was used to test all the three (3) hypotheses formulated for the study at 0.05 level of significance. The Statistical Package for Social Science (SPSS) version 23 was used to process the data.

Result and Discussion

The result of the study was presented for both pre-test and post-test scores in the experimental and control group and that of male and female students of experimental group which were subjected to descriptive statistics and inferential statistics in form of Means, Standard and t-test independent sample in order to answer the research to test the hypotheses.

Hypothesis one

Ho_1: There is no significant difference between the mean academic performance score of geography students taught using Blended Learning and those that taught using conventional teaching method.

In order to test hypotheses one the pre-test scores in the experimental and the control groups for GAT were subjected to T-test of independent sample statistics. Summary of the analysis was presented in table 1

Table 1: T-test analysis of the Pre-Test Mean Scores for GAT of the Experimental and Control Groups

Groups	N	Mean	SD	Df	**T-value**	**P-value**
Experimental	213	17.21	1.187	363	18.189	0.000
Control	152	14.58	1.572			

Table 1 revealed that the t-value computed was 18.189 and the p-value of 0.000 is less than the alpha value of 0.05, Based on the decision rule, this study rejected the null hypothesis two (1) that says there is no significant difference between the mean academic performance score of geography students taught using Blended Learning and those that taught using conventional teaching method. The decision implies that, there is a significant difference in the mean score of geography students taught using Blended Learning and those that taught using conventional teaching method. This indicates that the students of experimental group performed significantly in mean academic performance of geography better than those in control group, this is as result of Blended Learning strategy.

Hypothesis two

Ho_2: There is no significant difference between the student's attitude change geography students taught using Blended Learning and those that taught using conventional teaching.

In order to test hypotheses three, the post-test scores in the experimental and the control groups for ALGQ were subjected to T-test of independent sample statistics. Summary of the analysis was presented in table 2

Table 2: T-test analysis of the Post-Test Mean Scores for ALGQ of the Experimental and Control Groups

Groups	N	Mean	SD	Df	T-value	P-value
Experimental	213	65.14	6.064	363	14.082	0.000
Control	152	55.08	7.566			

Table 2 revealed that the t-value computed was 14.082 and the p-value of 0.000 is observed. Since the obtained p-value of 0.000 is less than the alpha value of 0.05, Based on the decision rule, this study rejected the null hypothesis two (2) that says There is no significant difference between the student's attitude change geography students taught using Blended Learning and those that taught using conventional teaching. The decision implies that, there is a significant difference in the mean score of attitude to learning geography between those using Blended Learning and those that taught using conventional teaching. This indicates that the students of experimental group performed significantly better than those in control group in the score of attitude to learning geography, this is as result of Blended Learning strategy

Conclusion and Recommendations

Based on the findings of this research, the following conclusions were drawn:

1. Blended Learning strategy enhances the student's academic performance among senior secondary school students under study.
2. Blended Learning strategy improves attitude to learning of geography among senior secondary school students under study.

Based on the findings of this study, the following recommendations were made:

1. Teachers of senior secondary schools should expose geography students to Blended Learning so as to promote their academic performance.
2. Blended Learning should be incorporated in the curriculum of teacher training institutions to enhance attitude to learning geography.

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EFFECT OF USING CHARTS AS INSTRUCTIONAL MATERIALS ON SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN CHEMISTRY IN KATSINA ZONAL EDUCATION QUALITY ASSURANCE, KATSINA STATE

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Abstract
This study investigated the effect of using charts as instructional materials on secondary school students' achievement in chemistry in Katsina zonal education quality assurance. The study has two research objectives, answered two research questions and tested two null hypotheses at 0.05 level of significance. The research design adopted for the study was a pretest posttest control group quasi-experimental design. The experimental group was subjected to treatment using charts as instructional materials while the control group was taught using lecture method. The population of the study consisted of 6328 SS11 Students from twenty five schools in Katsina zonal education quality assurance. Two co-educational public senior secondary schools were selected using random sampling technique. A total number of (158) Students' from the sample of the study. Intact classes of SS11 were used for the study. The instrument, chemistry achievement test (CAT) was used to collect data validated by experts in chemistry department of Umaru Musa Yar'adua university Katsina the reliability coefficient was established at r = 0.91. Research questions were analyzed using mean and standard deviation while null hypotheses were tested using t-test independent sampled were to test the hypotheses at 0.05 level of significance. The result revealed that, there is a significance difference between students using charts as instructional material and those using lecture method and there is no significance difference among male and female students using charts instructional material and those lecture method. Based on the findings of this study, it was concluded that, the use of charts as instructional materials is effective in enhancing students' academic achievement in chemistry. It was also recommended that, the Federal and state ministry of education should not only be encouraged teacher to use charts in teaching chemistry concepts, but they should be supervised to ensure they frequently use them in their day to day teaching exercise.

Keyword: Charts, Academic Achievement and Gender

Introduction
Science teaching in schools should be such that it enables young people to have access to new knowledge to expect change, and to have rationale and be creative toward the problems generated by change, this is because to ensure change will mean progress (Afangideh, 2019). Science education is considered as the most effectual instrument for the augmentation and expansion of a person as well as a nation (Sabiru, 2022). The quality of education depends upon the facilitation modalities followed by the teachers and instructional practices adopted by the instructional system at concerned level of education (Sabiru, 2022). The pressing need of the using instructional materials at all levels of educational system (Mamu, 2022). In this fast moving technological society, the explosion of knowledge and information around us is a stark reality, in order to cope with this situation, educational curricula and teaching materials are changing with a focus of using instructional materials to take Students on an active role in the acquisition of knowledge, creative and thus take more ownership (Mamu, 2022). A child

constructs his knowledge while engaged in the process of learning; "intelligent guessing" must be encouraged as a valid instructional material (NCF, 2020).
Instructional materials are materials or resources employed by the teacher to make teaching and learning effective and productive and they are sometimes called instructional resources. Agwagor (2022) defined instructional materials as things or materials that can be seen or touched, places or persons that established conditions which enable learners to acquire knowledge, skills and attitude. They make lessons clearer and more meaningful to the learners (Agwagor, 2022). Ali (2021) stated that instructional materials are sources from which a learner may turn and secure help and information for the attainment of instructional objectives (Ali, 2021).

Ikwumelu (2021) defined instructional materials "as any material which the Chemistry teachers and the students utilize for the purpose of making teaching and learning more effective". The term is often used interchangeably with 'teaching aid' or 'instructional resources' (Ikwumelu, 2021). Adeya (2021) stated that some of the instructional materials used for the teaching of Chemistry in senior secondary schools are discussed below:

Radio is a major audio –aid to learning. It is used mainly for basic instructional experiences for pupils in primary and secondary schools in collaboration with the ministry of education, and the broadcasting corporation in disseminating the education programmers to the learners. As one of the instructional materials with the audio form of media, it can be regarded as one of the most popular mass media because it uses both electricity and batteries. It is used to relate lectures prepared by experts to a vast number of people at the same time. The only problem it has is that it does not allow the students the opportunity to ask questions during educational broadcast.

Model is a representation of a phenomenon, an object, or idea. In science, a model is the outcome of representing an object, phenomenon or idea with a more familiar one. For example, one model of the structure of an atom is the arrangement of planets orbiting the Sun. The model can only relate to some properties of the target. A model refers to an individual system, though that individual may be an exemplar for a whole class of similar things.

Film strip is a roll of film usually 16mm or 35m in size containing images designed to be viewed frame by frame with film strip projector.

Map is a scaled-down drawing of the portions of the earth surface. In maps several colours and symbols are used to represent boundaries and physical features such as rivers, mountains, forests and rock formations. Cultural groups, races, economic or political bloc can also be represented with colours and symbols. In social studies and civic education, maps help students to have a closer study of any given location on the earth plane.

Movable chalkboard: these are made of plywood which stands on wooden poles and is painted black to serve as supplementary board.

Wall chalkboard: This is a common type of concrete walls that is painted in black or any other colours in the classroom.

Ezegbe (2021) classified instructional materials into two as visual materials, made up of reading and non-reading materials and audio-visual materials, comprising of electrically operated and non-electrically operated materials.

These include chalk board, posters, bulletin board, displayed models, motion pictures, slides, projected transparences, and flip chart and flannel boards. In fact they represent all the materials

the eyes can focus and is used by the teacher or instructor in delivering the lesson to the pupils, it makes visual impression.

These include record players, tape recorders and language laboratory and all that appeals to the sense of hearing.

These include aids that make use of both sight and hearing such as sound motion, pictures, slide on sound and television.

These include devices built to stimulate the action or function of the real thing. The essence of this type of aid is to develop feeling sensation and correct habits. Any subject can be taught more effectively through the appropriate use of teaching materials or aids, charts.

Okocha (2019) opined that charts are used as instructional materials in teaching situation. Some of the charts that are being employed in the classroom situation are line charts, wall chart, bar chart, floor chart, flip charts. For the presentation of materials to teach the pupils in the classroom situation, they help to sense the vision and association (Okocha, 2019). Charts are defined as materials which communicate facts and ideas clearly and succinctly through a combination of drawing, words and pictures (Okocha, 2019). The instructional values of chart materials lie generally in their capacity to focus attention, to convey certain types of information in condensed and summarized form, these materials teach facts and also relate ideas (Okocha, 2019). Charts are easily obtained, attract attention, and aid the understanding of concepts (Dale, 2020). It is the excellent means for condensing different kinds of information in a striking and easily remembered form (Dale, 2020). It also helps to clarify functions and relationships that are difficult to explain in words. But if the representation is not bold enough, a conventional class size may find it difficult to see it (Dale, 2020).

Dale (2020) chart is a combination of pictorial, graphic, numerical materials which presents a clear visual summary and are used to present idea and concept which may be difficult to understand if presented using the verbal code only. Waiter (2019) added to that the use of chart as instructional material in teaching improves the student writing skills and stimulates creativity in the learners. Charts present an abstract rendition of reality because what is presented is shown as effective in the cognitive domain of learning. The important of using charts as instructional materials (Waiter, 2019).

1. Motivates the student
2. Shown continuity in the process
3. Shown relationships by means of facts, figures and statistics
4. Encourages utilization of other media of communication
5. Presents abstract ideas in visual form
6. Summarizes information
7. Shows the development of structure
8. Creates problems and stimulates thinking
9. Presents matter symbolically (especially in chemistry lab or class)

Chemistry is the subject that deals with the study of matter, structures, compounds, patters, numbers, figures and relationship (functions) which aid in solving real life situation or problems in our daily activities, as an individual, organization or government (Ekuene, 2020). This implies that Chemistry is a very vital subject which traverses every sphere of life (Ekuene, 2020).Chemistry occupies a unique position among various science subject offered at the senior secondary school level. The study of chemistry involves the pursuit of truth a process that instills diligence, patience, and objectivity in learners (Ahmad 2021).

In spite of the importance and compulsory nature of chemistry students still fails in this subject during examinations. According to West African Examination Council (WEAC) chief examiner's report regarding the May/June 2022 WAEC majority of the candidates could not correctly write the first twenty elements with symbols nor were they able to differentiate between groups and period in the periodic tables (WAEC chief examiner's reports, 2022). Students' general achievement as reported by WAEC chief examiner's reports on students' performance in the 2019, 2020, 2021 and 2022 examination indicate poor achievement in chemistry. Table below shows the statistics of Katsina State Secondary School Students' achievement chemistry.

Table 1. Summary of WAEC SSCE Chemistry result from 2019-2022

Year	No of Student Enrolled	A1	B2	B3	C4	C5	C6	D7	E8	F9
2019	33,720	80	81	98	3,800	3,907	5,607	16,800	1,022	2, 329
2020	37,223	60	92	108	2,950	3,201	4,771	13,401	7,502	5, 130
2021	39,577	50	68	71	3,107	3,480	5,102	17,807	3,508	6, 381
2022	14,513	78	94	107	1,801	2,907	3,101	2,650	1,630	2, 140

Source: Department of planning, Research and statistics, Katsina State Ministry of Education (2022).

Academic achievement is the knowledge attained or skills developed in the school subjects, usually designed by test and examination score or by marks assigned by the teacher or both, and the amount of knowledge derived from learning in the school and it is the product and out-come of instruction in gender (Nwagbo, 2019). Gender refers to the amount of masculinity and feminists found in human beings, the normal man has preponderance of feminist. (Onah & onwubuarairi,2019). Gender is a social term that is set to differentiate male and females in terms of their different roles and responsibilities. Igwe (2018). Opinion that gender issue is a pertinent factor in educational setting in Nigeria and could be a factor that leads to low achievement of learners in chemistry as a science subject. In recent years several researches have been conducted on gender related issues. Such studies suggested that by the age of eleven, many young stars produce instructional materials in difference ways (Igwe, 2018).).

Statement of the Problem

There has been a drastic reduction in the standard of academic achievement by students at all level of education in Nigeria in the past and presents decade (sabiru, 2022). Teachers, parents and other stakeholders in science education have been worried about the poor achievement of student in both internal and external examinations (sabiru, 2022). In spite of the important position of chemistry among other science related disciplines, literature has revealed that students achievement in chemistry at senior secondary school certificate examination (SSCE) has been consistently poor (Njoku, 2021). It has been observed that students purposively develop phobia any time chemistry is mentioned because they see chemistry as a difficult subject to learn (mamu, 2022). The using of charts as instructional materials especially in a chemistry class may play a vital role in increasing chemistry students' academic achievement in senior secondary school. Therefore, this study will seek to find out the: effect of using charts as instructional materials on secondary students' achievement in Chemistry.

Objectives of the Study

Specifically, the study determined:

1: The effect of charts as instructional materials on chemistry students' academic achievement in Katsina zonal Education Quality Assurance.

2: The effect of charts as instructional materials among male and female chemistry students' academic achievement in Katsina zonal Education Quality Assurance.

Research Question

1: What is the effect of charts as instructional materials on chemistry students' academic achievement in Katsina zonal Education Quality Assurance?

2: What are the effects of charts as instructional materials among male and female chemistry students' academic achievement in Katsina zonal Education Quality Assurance?

Hypotheses

The following null hypotheses were tested at 0.05 level of Significance.

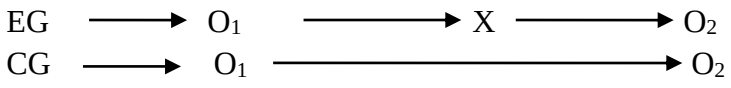
H_{01}: There is no significance difference between students taught using charts as instructional materials and those using lecture method.

H_{02}: There is no significance difference between among male and female students taught using charts and those using lecture method.

Methodology, Design and Procedure

The study adopted pre-test post-test quasi experimental design. The study has two groups; experimental group (EG) was exposed to experimental treatment (X_1) involving the use of using charts while the control group (CG) was treated using lecture method. The two groups were taught periodic table concept for the period of six weeks. Pre-test (O_1) were administered before treatment to both experimental and control groups. Intact classes were used in both the sample schools. Post-test (O_2) was administered on the six weeks after treatment. The research design of the study is represented.

Fig 1: Diagrammatic Representation of the Research Design



Where: EG = Experimental group

CG = Control group

X = treatment (charts)

O_1 = Pre-test

O_2 = Post test

The population of the study consisted of 6,328 Senior Secondary year (SSII) Students in 25 public Senior Secondary Schools in Katsina Zonal Education Quality Assurance. The zone comprises of three Local Governments. Two schools were randomly selected for the study through balloting. In each school, an intact class comprising of both male and female students were selected. The study subjects in each group are as summarized in Table 1 below;

Table 2: Distribution of the Sample and Sample Size of the Study

			Samples		
SN	**Groups**	**Schools**	**Male**	**Female**	**Total**
1	Experiment Group	Katsina College Katsina	44	33	78
2	Control Group	Government Senior Secondary School MagamaJibia	42	30	80
	Total				**158**

Chemistry Achievement Test (CAT) was used as data collection tool. CAT is a 30-item, multiple choice questions adopted from previous West African Examination Council (WAEC) and National Examination Council (NECO) SSCE questions papers.

To ascertain the validity of the test, the thirty items on CAT was submitted to the experts in the department of science education federal university dutsinma Katsina for content as well as face validities. The items contained in was CAT also given to three lecturers in the Chemistry Department of federal university dutsinma Katsina; in which they examine whether the items are suitable for the selected chemistry concepts in terms of item clarity and cognitive demand. After the validation the observations made by experts were effected. The final draft was pilot tested in order to determine the reliability index.

The reliability coefficient of the instrument was determined using Cronbach Alpha method with the aid of Statistical package for social science (SPSS). From the result obtained, reliability of the instrument was found to be 0.64. Hence the instrument is significantly reliable. The data collected were analyzed using t- test independent sample.

Result

Research Question One: What is the effect of charts as instructional materials on chemistry students' academic achievement in katsina zonal Education Quality Assurance?

To answer research question one, the post-test scores of students for CAT in the experimental and control groups were subjected to descriptive statistics in form of Means and Standard Deviations. This is presented in Table 3.

Table 3 Analysis of Post-Test Means and Standard Deviations Scores for CAT of the Experimental and Control Groups

	GROUP	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference
Experimental and control	Experimental	78	16.67	1.703	.193	4.60
	Control	80	12.06	1.817	.203	

Table 4.1 Indicated experimental Group were 16.67 and 1.703 and that of control group were 12.06 and 1.817. The post-test mean difference was 4.60 in favour of experimental group

Research Question Two: What are the effects of charts as instructional materials among male and female chemistry students' academic achievement in katsina zonal Education Quality Assurance?

To answer research question two, the post-test scores of students for CAT in the experimental of male and female students were subjected to descriptive statistics in form of Means and Standard Deviations. This is presented in Table 4.2

Table 4 Analysis of Post-Test Means and Standard Deviations Scores for CAT in the Experimental 1 Group of Male and Female Students

	GROUPG1	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference
Gender	**Male**	**42**	**16.83**	**1.710**	**.264**	**0.361**
	Female	**36**	**16.47**	**1.699**	**.283**	

Table 4 revealed that the post -test means and standard deviations of students for CAT in the experimental Group male students were 16.83 and 1.710 and that of female students were 16.47 and 1.699. The post-test mean difference was 0.361

Testing of Hypotheses analyzed data using statistical tools to test the two (2) null hypothesis formulated for the study, the inferential statistics of t-test Independent sample was used to test the hypotheses at 0.05 level of significance.

Ho_1: There is no significance difference between students taught using charts as instructional material and those using lecture method

In order to test hypotheses one, the post-test scores in the experimental and the control groups for CAT were subjected to t-test of independent sample statistics. Summary of the analysis was presented in table 5.

Table 5 t-test analysis of the Post-Test Mean Scores for CAT of the Experimental and Control Groups of

Groups	N	Mean	SD	Df	t-value	P-value	Decision
Experimental	78	16.67	1.703				
				156	16.427	0.000	Significant
Control	80	12.06	1.817				

Table 5 revealed that the t-value computed was 16.427 and the p-value of 0.000 was observed. Since the obtained p-value of 0.000 is less than the alpha value of 0.05, based on the decision rule the study rejected the null hypothesis one (1) that says there is no significance difference between students taught using charts as instructional material and those using lecture method. The decision implies that there is a significance difference between students taught using charts as instructional material and those without instructional materials. This indicated that the students of experimental performed significantly better than control group after treatment with charts as instructional material.

Ho_2: There is no significance difference among male and female students taught using charts as instructional material and those using lecture method.

In order to test hypotheses two, the post-test scores in the experimental groups of male female students for CAT were subjected to t-test of independent sample statistics. Summary of the analysis was presented in table 6.

Table 6 t-test analysis of the Post-Test Mean Scores for CAT of the Experimental Groups of Male and Female Students

Groups	N	Mean	SD	Df	t-value	P-value	Decision
Male	42	16.83	1.710	76	0.933	0.354	Not sig.
Female	36	16.47	1.699				

Table 6 revealed that the t-value computed was 0.933 and the p-value of 0.354 was observed. Since the obtained p-value of 0.354 is greater than the alpha value of 0.05, based on the decision rule, this study retained the null hypothesis two (2) that says there is no significance difference among male and female students taught using charts as instructional material and those using lecture method. This indicates that the male and female students of experimental performed significantly similar when taught using charts as instructional materials.

Discussion of the Findings

The result indicated that there is a significance difference between students using charts as instructional material and those using lecture method. This indicated that students taught using charts as instructional materials in teaching chemistry enhances students' academic achievement in chemistry and performed significantly better than those that taught using lecture method. The result agreed with that of Onah and Onwubuarri (2019) carried out a study on the effect of using standard instructional materials and improvised instructional materials on Secondary School Students 'Academic Performance in Physics in Ilorin, Nigeria. The sample consisted of selected Secondary Schools in Ilorin Metropolis of Kwara State. The research employed a quasi-experimental design of the pretest posttest non-randomized control group design. the following findings were made there was significantly difference between the students taught with standard instructional materials and those thought with improvised instructional materials, i.e., mean scores on the posttest ($t = 4.09$, $df\ 14$, $p = 0.05$)

The finding also indicated that there is no significance difference among male and female students taught using charts instructional material and those using lecture method. This indicated that male and female students performed significantly similar after treatment with charts as instructional material. The result is line with that of Muhammad (2019), on the effects of charts instructional material on academic achievement, retention and attitudes towards chemistry among diploma students of Kano State polytechnic. Analysis of data using t-test statistic and weight average revealed that inquiry method of instruction was gender-friendly and that is enhances retention.

Conclusion

The use of charts as instructional materials to teach scientific concepts in Schools have been emphasized over the years. Many empirical research carried out on this area tends to prove the significance of concrete teaching materials in enhancing students learning. This study proves that, charts do not only elevate students learning and achievements in schools, but also have equal potential to make learning retentive in students. Disparity in male and female students' academic achievements in schools subjects can be annulled when charts are used.

Recommendations

Based on the findings of this study, the following recommendations were made:

- Federal and state ministry of education should not only be encouraged teacher to use charts in teaching chemistry concepts, but they should be supervised to ensure they frequently use them in their day to day teaching exercise.
- Government should give additional orientation to both teachers and Students on charts as instructional materials utilization and production so as to enhance their academic achievement both in teaching and learning.

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ASSESSMENT OF STUDENT'S KNOWLEDGE AND ATTITUDE TOWARD CLIMATE CHANGE: A REVIEW

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Abstract
Climate change is a universal phenomenon and it is a great concern to all countries. Every part of the world is suffering from one form of the devastating impacts of climate change or the other. Nigeria, like other countries, is severely affected by climate change. Although attempts are increasingly made to increase knowledge and attitude of climate change, secondary school students still have low knowledge and attitude of climate change especially in Nigeria. This study, therefore, sought to review literature related to student's climate change knowledge and attitude and to identify the strategies to improve student's knowledge and attitude towards climate change. The study adopted an integrative literature review approach and a comprehensive electronic search for relevant literatures were done using Google Scholar and Research gate which led to the discovery of research articles suitable for the study. South Africa, Malawi and Nigeria were selected as case studies. The literature revealed that knowledge and attitude of secondary school students towards climate change among students in South Africa was high, while in Nigeria and Malawi it was low. The study recommended that the curriculum should be revised to include Climate Change content and activities that promote learning through practice and that teacher education institutions should introduce climate change learning and teaching strategies and modules for all pre-service teachers. Additionally, teachers should employ strategies that can enhance learners' knowledge and help them change their attitudes towards climate change.

Keywords: Climate Change, knowledge, Attitude, students, strategies

Introduction
There is evidence that climate change is already having an impact on student learning outcomes and one sector that is particularly vulnerable to the effects of climate change is education (Al Hussain and Khan 2023). The Intergovernmental Panel on Climate Change (IPCC 2021) articulates that "Climate change refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties (e.g. temperature, precipitation, humidity, incident radiation, wind patterns), and that persists for an extended period, typically decades or longer. Climate change can be caused by a number of natural mechanisms such as; volcanic eruption, ocean current, the earth's orbital changes and solar variations (Udegbunam, 2020). Ugwu et. al (2021) stated that although there are natural causes of Climate Change, the current trend has been largely attributed to anthropogenic activities mainly the burning of fossil fuels, industrial pollution, deforestation, land use changes, gas flaring, energy production, transportation, housing, Agricultural activities, unsustainable consumption patterns and population growth which leads to the emission of Greenhouse Gases. These gases trap the heat in the atmosphere and raise temperature of the Earth steadily above the natural levels. The main Green House Gases are Carbon dioxide (CO_2), Methane (CH_4),

Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF_6).

According to Sulistyawati *et al.,* (2018) Climate Change will continue to increase in its intensity, and there is a great risk to public health, global food security, economic development, and to the natural world on which much of humans' prosperity depends. Rahman *et al.,* (2021) Stated that dimensions of natural disasters due to climate change such as flood, wildfires, excessive sunlight, heavy rains, heatwaves, clean water crises, earthquake, excessive wind, rising sea levels, drought, thunderstorms, melting of ice caps, tsunamis and so on are fast occurring and are placing citizens of various countries in serious danger.

Mitigation and adaptation are the primary responses of the human community to Climate Change in order to reduce its incidence and minimize its negative impacts on humans and the ecosystems. According to Schwirplies (2018), climate change mitigation encircles all the measures that help in reducing greenhouse gas emissions like the use of energy-efficient equipment, devices, and vehicles; and the use of alternative fuels, e.g., solar energy, biofuel or biodiesel and wind energy, tree planting, Afforestation, Reforestation and Agroforestry. Wadson *et al.,* (2023) stated that adaptation dimension relates to building resilience and reducing vulnerability in the face of Climate Change impacts that are already happening or are soon to happen. Examples of adaptation include construction of flood walls to protect property from stronger storms and heavier precipitation, or the planting of agricultural crops and trees more suited to warmer temperatures and drier soil conditions.

The prominent setback in the fight against climate change is that majority of people (including students) across the world are still not knowledgeable of what climate change is all about (Benedikter & Tsedze, 2019). Education serves as one of the social pillars that raise the younger generation's climate change knowledge and contributes to bridging gaps in scientific and social comprehension of climate change (García *et al.,* 2022). Considering the youthful exuberance, inquisitiveness, enthusiasm in students, the information passed on to them should be looked upon as knowledge delivered. As a result, the purpose of this study was to examine the literature on the knowledge and attitude of students towards climate change. A literature evaluation of knowledge and attitude of students towards climate change in three countries, including Nigeria, was conducted.

Methodology

Integrative literature review approach was followed by the paper to investigate knowledge and attitude of secondary school students towards climate change. According to Snyder (2019), an integrative literature review is a noncontact method that involves reading and analyzing the existing literature about the topic. The authors conducted a comprehensive electronic search using Google Scholar and Research Gate which led to the discovery of various research articles. These articles scattered in different journals and were reviewed. A total of 35 articles were reviewed by the authors. These articles were published between 2016-2024.

Literature review

Students' Knowledge and Attitude Toward Climate Change

Students have the potential to drive climate change mitigation and adaptation, but their ability to implement solutions depends on enhancing their knowledge and attitude towards climate change. Knowledge has been defined as the state of being aware of and understanding reality. Climate change knowledge therefore is a person's awareness and understanding of the fact and realities of climate change. knowledge of climate change could help students become

scientifically and ecologically literate citizens, who can describe, explain and predict natural phenomena using sound ecological thinking, capable of full participation in a democratic sustainable society. The level of knowledge on the impact of climate change could lead students to engage in activities that contribute to climate change solutions. Oruonye (2011) stated that Adequate knowledge of the effects of climate change will help make students to join forces in reducing the vulnerability of societies to climate related risks both now and in the future. Rahman et. al (2019) explained that knowledge of Climate Change may help learners develop a sense of responsibility in managing the environment.

A person's attitude expresses one's thoughts and feelings about a specific object (Deshiana et. al, 2022). Attitude means the way an individual think or acts towards a given subject or issue. Attitude can guide experiences and decide the effects of experience on our behaviours. Students' attitudes to climate change guides how and the manner they respond to challenges as a result of climate change. Yadav et. al (2023) describes attitude as persons' enduring favorable or unfavorable cognitive evaluations, feelings, and action tendencies toward some object or idea. It is actually an acquired feeling. Attitude is the mixture of beliefs and feelings that people have about situations, specific ideas or other people.

Climate change knowledge and positive attitude are key for successful adaptation and mitigation. Karpudewan *et al.,* (2015) stated School-based education specifically plays an important role in improving students' attitude and knowledge and it was indicated that potential effectiveness of education is higher when students possess knowledge and positive attitude towards a specific issues particularly issues concerning global warming.

Trends in Knowledge and Attitude of Secondary School Students Towards Climate Change

In South Africa, a collaborative effort between the Department of Education and the Department of Environmental Affairs and Tourism (DEA&T) led to the integration of environmental education and sustainable development into various school subjects, promoting a more wholistic approach to learning climate change knowledge and attitude. According to the Curriculum and Assessment Policy Statements (CAPS, 2011) learners should know and be able to explain: the difference between weather and climate; the different climates in South Africa; the climate of their area; and the factors that influence both of these systems, such as temperature, wind, air pressure, and precipitation by the end of grade 5. Learners in grade 10 learn about the greenhouse effect's impact on people and the environment, global warming's evidence, causes, and consequences in Africa, impact of climate change on Africa's environment and people, including deserts, droughts, floods, and rising sea levels. Learners in grade 11 learn about the function of oceans in climate management in Africa; the El Nino and La Nina processes and their influence on Africa's climate; and reading and understanding synoptic weather maps.

The inclusion of climate change into the curriculum yielded the needed result as study conducted by kutwayo et. al. (2022) revealed that students had high knowledge of climate change. The study titled "climate change knowledge, concerns and experiences in secondary school learners" was conducted using a cross sectional survey design. Questionnaire was used to collect data among 924 secondary school learners in 14 public schools in low-income western cape areas. Descriptive and inferential (chi-square) was used to analyzed the data. The result revealed that 72% of the respondent knew that climate change leads to higher temperatures, 60% agreed that human activity is responsible for climate change, and 58%

believed that climate change affects human health. Two third (69%) said that climate change is a serious issue and 66% indicated that action is needed for prevention.

In Malawi, the government developed a National Climate Change Learning Strategy (NCCLS, 2013) with the aim of addressing knowledge gaps that are key for formulating informed policies and climate change interventions. In 2020, the National Climate Change Learning Strategy was revised in order to address gaps noted in the 2013 Strategy and to take on board emerging issues in the climate change arena. Through three main pillars, each with their own set of goals, the country has set a clear pathway to mainstreaming climate change learning throughout the country. The pillars are: Individual learning and skills development, Institutional capacity building and Resource mobilization. In schools, there has been a lot of effort directed towards Climate change education in the country. For instance, the Malawi Institute of Education (2015) developed a Climate Change sourcebook to help in equipping learners with the acquisition of knowledge, attitudes and practices about Climate Change adaptation, mitigation and resilience. The book was developed with support from UNFCC and the United Nations Development Programme (UNDP).

Despite all these efforts, study conducted by Wadson et. al (2023) titled "Climate Change Education in Malawi: Examining Learners' Knowledge, Attitudes and Practices Towards Learning Climate Change Education Content in Senior Secondary Schools" shows that students in secondary school had low knowledge of climate change. The researchers employed mixed method convergent parallel design in order to carry out the research. Data was collected from 8 secondary schools in two education divisions. Questionnaires and focus group discussions were used to collect data. Quantitative data was analysed using SPSS, while qualitative data was analysed thematically. Results indicate that 56.9 per cent of learners had little knowledge of CC. In terms of attitudes, 73.4 per cent agreed that learning Climate Change content makes them worried about the environment. It was found that an average of 66.9 per cent of the learners did not have a variety of Climate Change practices for mitigating and adapting to Climate Change.

In Nigeria, the curriculum produced by Nigeria educational research and development council (NERDC, 2013) were infused with topics that are related to climate and general environmental contents like our environment, physical environment, sanitation, pollution, natural and manmade environmental hazards, deforestation, population, effects of industrial concentration, composition of atmospheric gases, weather and climate, classification of climate and major climate types of the world in most secondary school subjects like Biology, Geography, Chemistry, Physics, Agriculture, and Social Studies. These contents and subjects are veritable means of promoting climate change knowledge and attitude of secondary school students in Nigeria.

However, Studies conducted in Nigeria to assess the knowledge and attitude of students towards climate change revealed that it is low (Falaye & Okwilagwe 2016, Ezeudu *et al.,* 2016 Udegbunam & Onyegegbu 2021, Odekeye *et al.*, 2024,). Falaye & Okwilagwe (2016) conducted a study titled "Assessing the Senior School Students' Knowledge, Attitude and Practices Related to Climate Change: Implications for Curriculum Review and Teacher Preparation". The study adopted survey research. The research participants were 1,103 senior secondary school (SSII) students from Ibadan Metropolis. A questionnaire was employed to collect data; descriptive and inferential statistics were used for data analyses. Findings indicated that knowledge of climatic change issues is low among students, while their attitude

is slightly favourable. They engage in practices that do not entirely predispose the environment to devastating effects, especially flooding.

Ezeudu et. al. (2016) conducted a research titled "Climate Change Awareness and Attitude of Senior Secondary Students in Umuahia Education Zone of Abia State". Six research questions and four hypotheses guided the study. The study adopted descriptive survey research design. Purposive sampling technique was used to sample sixteen (16) schools out of the thirty-four (34) secondary schools and six hundred and forty students (640) out of the two thousand and twelve students. Two instruments were used for data collection, Awareness Scale for Climate Change (ASCC) and Climate Change Attitude Scale (CCAS). The instruments were developed by the researcher and validated by three experts in the University of Nigeria, Nsukka. The data collected were analyzed using mean score and standard deviation to answer the research questions while t-test was used to test the hypotheses formulated for the study. The major findings of the study based on the analyzed data were that the senior secondary school students have low climate change awareness and attitude, that there is no significant different between the male and female students mean score on climate change awareness and attitude.

Udegbunam and Onyegegbu (2021) conducted a study titled "Awareness and Attitude of Secondary School Biology Teachers and Students on Climate Change Adaptation in Awka Education Zone of Anambra State". Descriptive survey research design was employed. The sample consisted of 464 respondents (68 Biology teachers and 396 SSII Biology students) drawn from six (6) public secondary schools using simple random sampling technique. Two instruments were used for data collection namely: Climate Change Adaptation Awareness Questionnaire (CCAAQ), and Attitude to Climate Change Adaptation Questionnaire (ACCQ). The instruments were trial tested and using Cronbach Alpha Formula yielded internal consistency reliability index of .96 and .97 respectively. The data collected were analysed using mean and standard deviation for research questions while the null hypotheses were analysed using t-test. Findings showed that biology teachers and students' awareness and attitude level on climate change adaptation were low. There was no significant difference in biology teachers and students' awareness and attitude towards climate change adaptation by school location.

Odekeye *et al.,* (2024) Conducted a Study Titled "Assessment of Climate Change Awareness Among Secondary School Students in Osun State, Nigeria". A descriptive survey research design was adopted for the study. The population for the study comprised secondary school students in Osun State. A simple random sampling technique was used to select 220 students as the respondents. A self-developed questionnaire with a reliability coefficient of 0.82 using Cronbach 's Alpha was obtained from the result of the pilot study conducted on the instrument. Data was analyzed using percentages, mean, standard deviation, t-test and ANOVA. The results revealed that 37.3% of the respondents have no knowledge of climate change; 53.2% of the respondents have poor knowledge of climate change while 9.5% have a good Knowledge of climate change. It further showed that there was no significant difference in the climate change awareness of students based on their gender but there was a significant difference based on school types with Private schools having higher mean score than public school.

The literature reviewed reveal that knowledge and attitude of secondary school students towards climate change among students in South Africa was high while in Nigeria and Malawi it was low. This finding shows that the curriculum has not been effectively used to promote knowledge and attitude of students. Findings by Ayanlade & Jegede (2016) in Nigeria revealed that although teachers are aware of climate change, there seem to be different interpretations

of climate change education. The teacher education institutions themselves seem to be varying in terms of training pre-service teachers on climate change and in some institutions climate change education is not emphasized. This kind of situation will not assist in enhancing climate change education in schools.

Strategies to Improve Student's Knowledge and Attitude Towards Climate Change

In the quest of searching for appropriate strategies to improve climate change knowledge and attitude among students, Odoom (2020) citing Pruneau *et al.,* (2003) identifies three pedagogical processes for learning climate change which are; local observation of phenomenon, conceptual change theory and experiential learning. The local observation of phenomenon concerns with creating appropriate platforms for the learners to observe a phenomenon in order to construct or shape their ideas. The conceptual change theory involves conceptual development where initial ideas held by students are shaped into more scientific notion. During this process, the initial idea or conceptions are enriched and restructured and therefore strengthened or replaced. Experiential learning involves learning by interacting with the environment. It is defined as the process by which the learner constructs knowledge through affective and cognitive interactions with the Biophysical and the built environment.

Monroe et. al. (2019) suggested some strategies to improve teaching and learning of climate change knowledge and attitude to include transdisciplinary, project-based learning and critical thinking. Transdisciplinary approaches include means to embed multiple inputs, development requirements, and expectations from a variety of actors, many of whom are located outside of learning centers, in the curriculum. It involves integrating multiple discipline and perspective to address complex issues surrounding climate change education. Critical-thinking strategy would enable students to understand what is going on in society, ask critical questions, and be determined and spur on action. Project-based learning is a form of learning that is oriented on learning in the real world and allows learners to actively participate in gaining topic knowledge and expertise.

It is also encouraged by Field *et al.,* (2019) and Beach *et al.,* (2019) that graphical representations and videos, stories, field trips, observation, project, and enquiry-based teaching coupled with discussion and creating a platform for learners to engage in democratic process of thinking, agreeing, implementing, and evaluating concrete changes individually and in a group through debates be used in teaching and learning of climate change.

Conclusion and Recommendation

It can be concluded from the above literature review that Despite the infusion of climate change contents in some secondary school subjects in Nigeria, it was revealed that knowledge and attitude of students towards climate change was low. It is therefore recommended that the senior secondary school curriculum should be revised to include Climate Change content and activities that are likely to promote learning through practice. It is also recommended that teacher education institutions should introduce climate change learning and teaching strategies and modules for all pre-service teachers so that the integration of climate change education could be achieved at all levels of the schooling system. Additionally, teachers should employ strategies such as experiential learning, project-based learning, local observation of phenomenon and others in the teaching of Climate Change content. This can enhance learners' knowledge and help them change their attitudes towards climate change.

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IMPACT OF VIRTUAL LEARNING PLATFORM IN ADDRESSING LARGE CLASS ISSUE AS PERCEIVED BY BIOLOGY EDUCATION STUDENTS IN FEDERAL UNIVERSITY DUTSIN-MA, KATSINA STATE, NIGERIA

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Abstract
The study assessed the Impact of Virtual Learning Platform in Addressing Large Class Issue as Perceived by Biology Education Students in Federal University Dutsin-Ma, Katsina State, Nigeria. The study set four objectives with corresponding research questions and null hypothesis. The study adopted a descriptive survey research design. The population of the study comprised of all Biology students in Federal University Dutsinma, Katsina state with total number of three hundred and seventy three students (373). 100 Biology education students were randomly selected for the study Forty item self-structured questionnaire tagged questionnaire for Virtual learning was used as instrument for collection of data using likert rating scale of strongly agree (SA), agree (A), Disagree (D), and Strongly Disagree (SD). The instrument was validated by expert from science education department, Federal University Dutsin-Ma. Finding shows that Virtual learning have significant impact on the reducing the effect of class size in Federal University Dutsin-Ma, there is no significant difference in the opinions of male and female respondents on the effect of class size on academic performance of biology students of Federal University Dutsin-Ma and there is a significant gender differences in the academic performance of Biology education students when exposed to small class size in favour of male students. Based on the findings, recommendations were made which include: there is need for a reform in laws discouraging to reconsider building more classes to avoid large population of Students in class, ICT facilities and training should be available to both lecturers and students in order to benefit from virtual learning, Universities management should organize workshops, seminars or conference where the both students and lecturers can be enlightened on the relevance of entering into virtual learning.

Keywords: Virtual Learning Platform, Large Class Issue, Biology Education Students and Federal University Dutsin-Ma

Introduction
The population of students applying to tertiary institutions in every country particularly in Nigeria is on the increase as observed by the researchers. This is because education is the best legacy that every parent or every nation of the world can give to her citizen. Access to education may likely make individual within the society to be useful to themselves and to the society at large. In the same vein, access to quality and productive education may be hindered by overcrowded students in the class if not properly controlled. Contemporary educators need to integrate information and communication technology to solve some challenges confronting education. Part of these technologies that could be adopted is 'Virtual Learning Technology'.
Learning is acquisition of knowledge, skills and experience that may lead to change in behavior. Learning as defined by Bello, (2020). Is a process that leads to change, which occurs as a result of experience and increases the potential for improved performance and future

learning. The importance of learning is that it helps the individual to acquire the necessary skills and knowledge so that one can achieve the set objective. An important fact about learning is that it is a means to improve knowledge and gain skills that will help in reaching specific goals. Learning is the process of acquiring new understanding, knowledge, behaviors, skills, values, attitudes, and preferences that lead to change in behavior Richard, (2015). Virtual Learning is defined as the learning acquired through interaction with computer and other information and communication technology hardware and software that are relatively based on open systems. This type of learning allows interactions and encounters with other participants and providing access to a wide range of resources Pelet & Lacarte, (2012).Virtual learning by Abdullah, et al, (2013). Referred to an online classroom and a social space in schools that contains a calendar, social networks, shared workspace and online assessment. Virtual learning is a software tool that supports the management of education and teaching by using the internet Trafford & Shirota, (2011). The virtual learning platform is more comprehensive compared to computer-aided instructions (CAI) as it contains the communication dimension as well as interaction and discussions between teachers and students or among students Piccoli et al., (2001). Virtual learning has been used synonymously with the concept such as e-learning, online learning, distance learning or web-based learning (Omiola, & Ojeleye, 2020). Virtual learning expands the possibility of using internet facilities, platforms, satellite links, and related system to access, analyze, create, exchange, use data, get information, and knowledge in ways which until recently, were almost unimaginable. In fact, it involves learning acquired by students through the interaction of digitally delivered content. It involves network-based inputs and tutoring support obtained on online tool and media such as internet, intranets, extranets, simulations, games, virtual worlds, clouds, satellite broadcasts and web platforms (Jarmon, 2013).

Class size refers to the number of students in a given course or classroom, specifically either the number of students being taught by individual teachers in a course or classroom or the average number of students being taught by teachers in a school, district, or education system. The term may also extend to the number of students participating in learning experiences that may not take place in a traditional classroom setting, or it may also refer to the total number of students in a particular class in a school. It should be noted that schools, districts, state and federal education agencies commonly track and report "average class sizes." While average class sizes are commonly expressed as a ratio of students to teachers. A class above fifty students in the class may be termed as a 'large class' Kokkelenberg. (2008).

Fewer studies still have examined the impact of class size on student performance in higher education. Bandiera, (2009). Examines administrative records from a leading UK university and find a significant negative, but highly non-linear effect of class size on student tests results. They conclude that changes in class size have a significant impact on student performance but only at the very top and bottom of the class size distribution. Furthermore, it was reported that students at the top of the grade distribution are most negatively affected by class size, particularly in large class sections. Similarly, Kokkelenberg, (2008). Find that average grades decline significantly with class size at a public northeastern U.S. University. The finding reports that grades drop dramatically with class size up to twenty students.

The larger the class the greater the instructor effort devoted to class wide activities at the expense of individual attention. In this way, individual student learning and outcomes decline as class size increases. His model illustrates the importance of separating class size effects from total student responsibilities effects. Lazear, (2001). Outlines a theoretical model where class size itself is important due to the role that class size plays in setting the class room environment.

Large classes (more students) may allow students to be more disruptive, allow them to "hide" from participation, engagement, or even attendance, while small classes may more easily lend themselves to pedagogical activities that improve learning, such as hands on activities and student-faculty classroom interaction.

Based on the researchers' observation, there many courses in the tertiary institutions where lecturers and students experience challenge regarding the issue of large crowd. Most especially the general courses that are compulsory for all students. In the same vain, the interaction made with some tertiary institution students on the negative effect of overcrowded of students for lecture revealed that, it has a negative effect because it reduces the overall performance of the students while the students find it difficult to achieve the objective of the lessons. It is as a result of this, that the researchers seek to find out the impact of virtual learning platform in addressing class size issue as perceived by students of Federal University Dutsin-Ma. Katsina State, Nigeria.

Statement of the Problem

In recent years, the increasing enrollment of students in tertiary institutions, including Federal University Dutsin-Ma in Katsina State, Nigeria, has led to a rise in large class sizes. This phenomenon poses significant challenges, particularly in specialized fields such as Biology Education, where personalized instruction is crucial. The advent of virtual learning platforms offers a potential solution to address the issues associated with large class sizes. However, the effectiveness and impact of these platforms, specifically in the context of Biology education students at Federal University Dutsin-Ma, remain largely unexplored.

The persistent problem of large class sizes in Science education courses raises concerns about the quality of education and the ability of students to actively engage with course content. The problem statement, therefore, revolves around the lack of comprehensive insights into how virtual learning platforms can serve as a viable strategy to mitigate the challenges posed by large class sizes in Biology Education at Federal University Dutsin-Ma. It is imperative to explore the perceptions of Biology Education students regarding the impact of virtual learning platforms on their learning experiences within the context of large class settings. This includes understanding whether virtual platforms effectively address issues such as limited interaction with instructors, reduced opportunities for practical engagement, and the overall quality of education.

To bridge this knowledge gap, this study aims to investigate the impact of virtual learning platforms from the perspective of Biology education students at Federal University Dutsin-Ma, offering valuable insights that can inform educational strategies, policy development, and the enhancement of teaching and learning experiences in the face of growing class sizes.

Purpose of the Study

The main purpose of this study will be to determine the impact of virtual learning platform in addressing class size issue as perceived by students of Federal University Dutsin-Ma. Katsina State, Nigeria. Specifically, the study determines:

1. To determine the impact of virtual learning platform in addressing class size among biology students of Federal University Dutsin-Ma.
2. To examine the effect of class size on academic performance of biology education students of Federal University Dutsin-Ma.
3. To find out gender differences in the academic performance of senior secondary school students in biology when exposed to small class size.

Research Questions

The following questions are used to guide the conduct of this study:

1. What is the impact of virtual learning platform in addressing class size among biology students of Federal University Dutsin-Ma?
2. What is the effect of class size on academic performance of biology students of Federal University Dutsin-Ma?
3. What is the gender differences in the academic performance of senior secondary school students in biology when exposed to small class size?

Hypotheses

H_{O1}: There is no significant difference impact of virtual learning platform in addressing class size among biology students of Federal University Dutsin-Ma.

H_{O2}: There is no significant difference in the opinions of male and female respondents on the effect of class size on academic performance of biology students of Federal University Dutsin-Ma.

H_{O3} There is no significant gender differences in the academic performance of senior secondary school students in biology when exposed to small class size.

Methodology

The study employed descriptive survey design. The population of the study comprises all Biology students in Federal University Dutsinma, Katsina state. However, from the survey carried by researcher it was revealed that there are three hundred and seventy three students (373). A sample size of 100 students were selected using simple random sampling technique. a self- structured questionnaire were used as instrument for data collection, the questionnaire were consist of 35 - item instrument, tailored around the modified Likert scale thus for each item, respondents were Strongly Agree (SA), Agree (A), Disagree (D) or Strongly Disagree (SD). The questionnaire was made up of five Sections A, B, C, D and E. Section A were comprise items on the demographic data of respondents while section B, C, D and E were consist Research questions raise to guide the study. The instrument was validated by expert from science education department, Federal University Dutsin-Ma. Descriptive statistics in form of frequency and percentage was used describe the demographic data of the respondents and answer to the research questions while the inferential statistics of Chi-square and t-test independent sample to test the hypotheses at 0.005 level of significance.

Results

Demographic Data of the Respondents

Table 1: Gender of Respondents

Gender	Frequency	Percentage (%)
Male	50	50%
Female	50	50%
Total	100	100%

Source: Questionnaire Field Work, 2024

Table 1 above shows that (50%) of the respondents are male, while female respondents constituted 50%. This shows that respondents are equal.

Table 2: Ages of the Respondents

Age	Frequency	Percentage (%)
18-20 years	70	70%
20-30years	25	25%
40 years above	5	5%
Total	100	100%

Source: Questionnaire Field Work, 2024

Table 2 above shows that majority of the respondents are between the ages of 18-20 and they constitutes (70%), followed by those between the age of 20-30 who constituted (25%) of the respondents, while those that falls between 40-above years constitutes (5%) of the respondents. Therefore, the above shows that majority of the respondents are between 18-20 years. This indicated that majority of the respondents are young.

Table 3: Religion of Respondents

Religion	Frequency	Percentage (%)
Islam	50	50%
Christianity	45	45%
Others	5	5%
Total	100	100%

Source: Questionnaire Field Work, 2024

Table 3 above shows that majority (50%) of the respondents are Muslims, followed by Christians, who are (45%), while those who practice religion aside Islam and Christianity constitutes (5%) of the retrieved data. This shows that majority of the respondents are Muslims.

Table 4: Tribe of Respondents

Tribe	Frequency	Percentage (%)
Hausa	40	40%
Igbo	25	25%
Yoruba	30	30%
Others	5	5%
Total	100	100%

Source: Questionnaire Field Work, 2024

Table 4 above shows that majority (40%) of the respondents were Hausa by tribe, this is followed by those on the category of others which constituted (25%), while Igbo and Yoruba constituted (30%) and (5%) respectively.

Answering research Questions:

Research Questions 1: What is the impact of virtual learning platform in addressing class size among biology students of Federal University Dutsin-Ma?

Table 5: Virtual learning have significant impact on the reducing the effect of class size in Federal University Dutsin-Ma

S/N	ITEMS	FREQUENCY (NO)	PERCENTAGE (%)
1.	A	33	33
2.	SA	10	10
3.	D	17	17
4.	SD	40	40
Total		**100**	**100**

Source: Questionnaire Field Work, 2024

From the table 5 above shows that, 33 respondents representing 33% of the total respondents agreed with the statement, that Virtual learning have significant impact on the reducing the effect of class size in Federal University Dutsin-Ma, 10 respondent representing 10% strongly agreed with the statement while 17 respondents representing 17% of the total respondents disagreed with the statement that Virtual learning have significant impact on the reducing the effect of class size in Federal University Dutsin-Ma, and 40 respond for the option strongly disagree representing 40% respectively. This reveals that the majority of the respondents agreed with the statement that Virtual learning have significant impact on the reducing the effect of class size in Federal University Dutsin-Ma.

Table 6: Virtual learning contributed in reducing the damaged caused by class size and large population of students in Federal University Dutsin-Ma

S/N	RESPONSE	FREQUENCY (NO)	PERCENTAGE (%)
1.	A	30	30
2.	SA	30	30
3.	D	20	20
4.	SD	20	20
Total		**100**	**100**

Source: Questionnaire Field Work, 2024

From the table 6 above shows that, 30 respondents representing 30% of the total respondents agreed with the statement, Virtual learning contributed in reducing the damaged caused by class size and large population of students in Federal University Dutsin-Ma, 30 respondent representing 30% strongly agreed with the statement while 20 respondents representing 20% of the total respondents disagreed with Virtual learning contributed in reducing the damaged caused by class size and large population of students in Federal University Dutsin-Ma, and 20 respond for the option strongly disagree representing 20% respectively. This reveals that the majority of the respondents agree and strongly agree with the statement that Virtual learning contributed in reducing the damaged caused by class size and large population of students in Federal University Dutsin-Ma.

Table 7: Students in Federal University Dutsinma can attends lectures conveniently due to the introduction of virtual platform

S/N	RESPONSE	FREQUENCY (NO)	PERCENTAGE (%)
1.	A	45	45
2.	SA	25	25
3.	D	17	17
4.	SD	13	13
Total		**100**	**100**

Source: Questionnaire Field Work, 2024

From the table 7 above shows that, 45 respondents representing 45% of the total respondents agreed with the statement, Students in Federal University Dutsinma can attends lectures conveniently due to the introduction of virtual platform, 25 respondent representing 25% strongly agreed with the statement while 17 respondents representing 16% of the total respondents disagreed with Students in Federal University Dutsinma can attends lectures conveniently due to the introduction of virtual platform and 13 respond for the option strongly disagree representing 13% respectively. This reveals that the majority of the respondents agree and strongly agree with the statement Students in Federal University Dutsinma can attends lectures conveniently due to the introduction of virtual platform.

Table 8: Virtual learning have negative impact on the students' academic performance in Federal University Dutsin-Ma

S/N	RESPONSE	FREQUENCY (NO)	PERCENTAGE (%)
1.	A	30	30
2.	SA	50	50
3.	D	10	10
4.	SD	10	10
Total		**100**	**100**

Source: Questionnaire Field Work, 2024

From the table 8 above shows that, 30 respondents representing 30% of the total respondents agree with the statement Virtual learning have negative impact on the students' academic performance in Federal University Dutsin-Ma, 50 respondent representing 50% strongly agreed that Virtual learning have negative impact on the students' academic performance in Federal University Dutsin-Ma while 10 respondents representing 10% of the total respondents disagreed with Virtual learning have negative impact on the students' academic performance in Federal University Dutsin-Ma, and 10 respond for the option strongly disagree representing 11% respectively. This reveals that the majority of the respondents agreed and strongly agreed that Virtual learning have negative impact on the students' academic performance in Federal University Dutsin-Ma.

Research Questions 2: What is the effect of class size on academic performance of biology students of Federal University Dutsin-Ma?

Table 9: Class room size have negative effect on the students' academic performance in Federal University Dutsinma

S/N	RESPONSE	FREQUENCY (NO)	PERCENTAGE (%)
1.	A	28	28
2.	SA	12	12
3.	D	16	16
4.	SD	44	44
Total		**100**	**100**

Source: Questionnaire Field Work, 2024

From the table 9 above shows that, 28 respondents representing 28% of the total respondents agreed with the statement, Class room size have negative effect on the students' academic performance in Federal University Dutsinma, 12 respondent representing 12% strongly agreed with the statement while 16 respondents representing 16% of the total respondents disagreed with Class room size have negative effect on the students' academic performance in Federal University Dutsinma, and 44 respond for the option strongly disagree representing 11% respectively. This reveals that the majority of the respondents agreed and strongly agreed with the statement that, Class room size have negative effect on the students' academic performance in Federal University Dutsinma.

Table 10: Class room size have positive effect on the students' academic performance in Federal University Dutsinma

S/N	RESPONSE	FREQUENCY (NO)	PERCENTAGE (%)
1.	A	19	19
2.	SA	37	37
3.	D	25	25
4.	SD	19	19
Total		**100**	**100**

Source: Questionnaire Field Work, 2024

From the table 10 above shows that, 19 respondents representing 19% of the total respondents agreed with the statement, Class room size have positive effect on the students' academic performance in Federal University Dutsinma, 37 respondent representing 37% strongly agreed with the statement while 25 respondents representing 25% of the total respondents disagreed with Class room size have positive effect on the students' academic performance in Federal University Dutsinma, and 19 respond for the option strongly disagree representing 19% respectively. This reveals that the majority of the respondents agreed and strongly agreed with the statement that, Class room size have positive effect on the students' academic performance in Federal University Dutsinma.

Table 11: Students ability to understand in class room is reduced due to large population of students in Federal University Dutsinma

S/N	ITEMS	FREQUENCY (NO)	PERCENTAGE (%)
1.	A	28	28
2.	SA	12	12
3.	D	16	16
4.	SD	44	44
Total		**100**	**100**

Source: Questionnaire Field Work, 2024

From the table 11 above shows that, 28 respondents representing 28% of the total respondents agreed with the statement, Students ability to understand in class room is reduced due to large population of students in Federal University Dutsinma, 12 respondent representing 12% strongly agreed with the statement while 16 respondents representing 16% of the total respondents disagreed with Students ability to understand in class room is reduced due to large population of students in Federal University Dutsinma and 44 respond for the option strongly disagree representing 40% respectively. This reveals that the majority of the respondents strongly disagreed with the statement that, Students ability to understand in class room is reduced due to large population of students in Federal University Dutsinma.

Table 12: There is need to consider building more classes in Federal University Dutsinma because the poor performance of Biology students

S/N	RESPONSE	FREQUENCY (NO)	PERCENTAGE (%)
1.	A	30	30
2.	SA	50	50
3.	D	9	9
4.	SD	11	11
Total		**100**	**100**

Source: Questionnaire Field Work, 2024

From the table 12 above shows that, 30 respondents representing 30% of the total respondents agreed with the statement, There is need to consider building more classes in Federal University Dutsinma because the poor performance of Biology students, 50 respondent representing 50% strongly agreed with the statement while 9 respondents representing 9% of the total respondents disagreed There is need to consider building more classes in Federal University Dutsinma because the poor performance of Biology students, and 11 respond for the option strongly disagree representing 11% respectively. This reveals that the majority of the respondents agreed and strongly agreed with the statement that, There is need to consider building more classes in Federal University Dutsinma because the poor performance of Biology students.

Research Questions 3: What is the gender differences in the academic performance of senior secondary school students in biology when exposed to small class size?

Table 13: Male student's performance better than Female student in secondary school

S/N	RESPONSE	FREQUENCY (NO)	PERCENTAGE (%)
1.	A	50	60
2.	SA	35	35
3.	D	5	5
4.	SD	10	10
Total		**100**	**100**

Source: Questionnaire Field Work, 2024

From the table 13 above shows that, 50 respondents representing 50% of the total respondents agreed with the statement, Male students performance better than Female student in secondary school, 35 respondent representing 35% strongly agreed with the statement while 5 respondents representing 5% of the total respondents disagreed with Male students performance better than Female student in secondary school, and 10 respond for the option strongly disagree representing 10% respectively. This reveals that the majority of the respondents agreed and strongly agreed with the statement that, Male student's performance better than Female student in secondary school.

Table 14: Female students always tend to have poor academic performance than Male counter part

S/N	RESPONSE	FREQUENCY (NO)	PERCENTAGE (%)
1.	A	38	38
2.	SA	12	12
3.	D	16	16
4.	SD	34	34
Total		**100**	**100**

Source: Questionnaire Field Work, 2024

From the table 14 above shows that, 38 respondents representing 38% of the total respondents agreed with the statement, Female students always tend to have poor academic performance than Male counterpart, 12 respondent representing 12% strongly agreed with the statement while 16 respondents representing 16% of the total respondents disagreed with Female students always tend to have poor academic performance than Male counterpart, and 34 respond for the option strongly disagree representing 34% respectively. This reveals that the majority of the respondents agreed with the statement that, Female students always tend to have poor academic performance than Male counterpart.

Testing Hypotheses

H_{O1}: There is no significant impact of virtual learning platform in addressing class size among biology students of Federal University Dutsin-Ma.

Table 15: Chi- Square analysis on impact of virtual learning platform in addressing class size among biology students of Federal University Dutsin-Ma.

	Chi-square	Df	P- value	Decision
impact of virtual learning platform in addressing class size among biology students of Federal University Dutsin-Ma	1.00	3	0.801	**Significant**

Table 15 revealed that the Chi- Square value of 198.89 was computed and the p- value 0.000 was observed. Hence, the study rejected the hypothesis that say there is no impact of virtual learning platform in addressing class size among biology students of Federal University Dutsin-Ma. This implies that the virtual learning platform significantly has impact in addressing class size among biology students of Federal University Dutsin-Ma

H_{O2}: There is no significant difference in the opinions of male and female respondents on the effect of class size on academic performance of biology students of Federal University Dutsin-Ma.

Table 16: t-test analysis of the opinions of male and female respondents on the effect of class size on academic performance of biology students

Gender	N	Mean	SD	Df	t-value	P-value	Decision
Male	50	18.04	3.323	98	2.897	0.065	Not sign.
Female	50	19.97	1.979				

Table 16 revealed that the t-value computed was 0.917 and the p-value of 0.015 was observed. Since the obtained p-value of 0.065 is greater than the alpha value of 0.05, based on the decision rule, this study retained the says there is no significant difference in the opinions of male and female respondents on the effect of class size on academic performance of biology students of Federal University Dutsin-Ma. The decision implies that, of male and female respondents have the same opinions on the effect of class size on academic performance of biology students of Federal University Dutsin-Ma.

H_{O3}: There is no significant gender differences in the academic performance of Biology education students when exposed to small class size.

Table 17: t-test analysis of the gender differences in the academic performance of Biology education students when exposed to small class size

Gender	N	Mean	SD	df	t-value	P-value	Decision
Male	50	21.04	3.323	98	2.897	0.010	Significant
Female	50	19.97	1.979				

Table 16 revealed that the t-value computed was 2.897and the p-value of 0.015 was observed. Since the obtained p-value of 0.010 is less than the alpha value of 0.05, based on the decision rule, this study rejected the says there is no significant gender differences in the academic performance of Biology education students when exposed to small class size. The decision implies that, there is a significant gender differences in the academic performance of Biology

education students when exposed to small class size in favour of male students. This indicated that male students performed significantly better than male students when exposed to small class size.

Conclusion

Based on the finding from the study, it was concluded that Virtual learning have significant impact on the reducing the effect of class size in Federal University Dutsin-Ma, Virtual learning contributed in reducing the damaged caused by class size and large population of students in Federal University Dutsin-Ma and male students performed significantly better than male students when exposed to small class size.

Recommendations

Based on the findings of this study, the researcher recommended that;

1. There is need for a reform in laws discouraging to reconsider building more classes to avoid large population of Students in class.
2. ICT facilities and training should be available to both lecturers and students in order to benefit from virtual learning
3. Universities management should organize workshops, seminars or conference where the both students and lecturers can be enlightened on the relevance of entering into virtual learning.
5. Guidance Counsellors posted in schools should make their impact to be felt; especially in the provision of educational, vocational and personal social services to students,

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ENTREPRENEURSHIP IN THE 21ST CENTURY THROUGH THE LENS OF LANGUAGE AND CULTURE

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Abstract
Entrepreneurship in the 21st century is deeply intertwined with the dynamics of language and culture influencing how businesses are set up, communicated and executed. Primarily, language is the medium for communication, for shaping mental processes and enabling the exchange of ideas in business and entrepreneurship. In the global market place where multilingual abilities are becoming increasingly valuable, entrepreneurs have to navigate diverse cultural landscapes where language plays a critical role in bridging gaps and fostering relationships. This paper explores how linguistic diversity and cultural nuances influence entrepreneurial practices, decision making and innovation in today's economy. It highlights the importance of cultural competence in entrepreneurship where understanding local customs, values, and communication styles can be the difference between success and failure. It concludes that in the 21st century, successful entrepreneurship requires not only innovative ideas but also a deep appreciation of the cultural and linguistic contexts in which these ideas are deployed.

Keywords: Entrepreneurship, language, culture

Introduction
In the 21st century, entrepreneurship is shaped by rapid globalization, technological advancements and increased cultural exchanges. As businesses expand across borders, language and culture have become central to entrepreneurial success. This is because effective communication, cultural awareness and sensitivity to diverse markets have emerged as critical factors for thriving in a global economy. Therefore, entrepreneurs need to navigate different languages, adapt to different cultural norms and embrace diversity to foster innovation, build relationships and create products or services that resonate with various audiences.

The process of starting and running new businesses aimed at making a profit or creating value is usually referred to as entrepreneurship. Entrepreneurs identify opportunities where others see challenges and leverage resources to turn ideas into reality. **G**lobal entrepreneurship refers to the creation, development, and management of businesses on an international scale **(**De Mooij, 2019). In this domain, entrepreneurs identify opportunities that transcend national borders, leverage global resources, networks and markets to launch and grow businesses. This kind of entrepreneurship is central to modern economies, fostering economic growth, job creation and technological innovation. But while the ability to do this requires creativity, strategic thinking and risk-taking, the success of entrepreneurial ventures is significantly influenced by the language used to communicate and negotiate in business as well as cultural factors, including religious and ethical considerations, attitudes toward risk, as well as perceptions of achievement and failure. Hence, understanding how language, culture and business are linked is essential for entrepreneurs operating in a globalized economy where effective communication and cultural sensitivity can provide a competitive edge.

Edward T. Hall's Cross-Cultural Communication Theory (1976) which focuses on how people from different linguistic and cultural backgrounds communicate with each other is adopted as framework in the following discussion on how language diversity and cultural nuances influence entrepreneurial practices, decision making and innovation in today's economy**.** Also, closely tied to global entrepreneurship which depends on the ability to adapt to and function within diverse cultural and linguistic environments, is the role of multilingualism. Multilingualism can improve cross-cultural communication by allowing entrepreneurs to engage directly with various audiences and partners in their native languages, reducing misunderstandings and facilitating smoother, more efficient business negotiations. Entrepreneurs who grasp and utilize cross-cultural communication are in a stronger position to establish international networks, reach wider markets and enhance their global competitiveness.

Globalization and Multilingualism

Globalization in the 21st century has revolutionized the business landscape, enabling entrepreneurs to expand beyond local markets and reach a wider audience. But when conducting business across borders, cross-cultural communication is an essential requirement especially as language plays a vital role in shaping how people think, interact, and convey ideas. Effective communication can make a difference between success and failure in business as it can influence negotiations, marketing and customer relationships **(**Hurn & Tomalin**,** 2013**)**. Since languages embody cultural meanings, norms, and values that differ widely across regions and communities, entrepreneurs must navigate language barriers, diverse communication styles, cultural differences and potential misunderstandings to manage their businesses effectively (Lewis, 2006).

Multilingualism and entrepreneurship intersect in several dynamic ways enhancing the potential for business growth, innovation, and global reach. Demko (2021) notes that it is a valuable asset for entrepreneurs operating in today's globalized market because the ability to communicate in multiple languages enables entrepreneurs to engage with diverse customers, build international relationships and negotiate more effectively in ways that respect local customs. Multilingual entrepreneurs are better equipped to navigate different cultural contexts that are crucial for gaining a competitive edge in a globalized economy as language skills not only enhance communication but also contribute to the development of an entrepreneurial mind set which embraces risk-taking, being proactive and innovativeness (Demko,2021**;** Kamwangamalu**,** 2016)**.** This perspective is consistent with broader research on the role of culture and linguistic skills on entrepreneurial success, indicating that language proficiency is essential for overcoming the "liability of foreignness" and for facilitating smoother market entry strategies (Neeley, 2012).

In the emerging economies of Africa, entrepreneurship faces a range of challenges such as weak infrastructure, limited access to finance and policy constraints that hinder its full potential, but not least, is the multilingual character of the continent as the linguistic landscape is made up of people who often speak multiple languages due to the coexistence of indigenous, colonial, and international languages (Herrington, Kew, & Mwanga, 2017**;** Ahlstrom, & Ding, 2014).**).** With over 2000 distinct languages spoken, no other continent comes close to this linguistic diversity. Countries such as Nigeria and the Democratic Republic of Congo with hundreds of indigenous languages spoken within their borders are known for their linguistic diversity. Also, colonial languages like English, French,

Portuguese, and Spanish still serve as official languages in many African nations. Many Africans are known switch easily between languages depending on the context—using local languages in personal settings and colonial languages in formal situations. But this blending of languages reflects the fluidity and adaptability of African multilingualism that could be put to good use in entrepreneurship **(**Kamwangamalu, 2016).

In the 21st century digital age where online entrepreneurs use global e-commerce platforms, social media marketing and remote business operations to connect with customers and collaborators across language barriers**,** communicating in the same language as business partners and clients is widely recognized as a key factor in building trust, respect and facilitating the development of long-term relationships. Entrepreneurs that are proficient in multiple languages can confidently enter new markets, generate business messages that align with cultural and linguistic preferences of customers, create positive brand images and foster customer loyalty much more easily. Research indicates that companies, in particular, online platforms like Amazon and eBay demonstrate how entrepreneurs with multilingual skills can effectively access broader international markets and gain a competitive edge in global trade (Kamwangamalu, 2016).

These advantages are also highlighted in a report in the *Harvard Business Review* which avers that multilingual entrepreneurs are better positioned to navigate cultural nuances, negotiate business deals and collaborate with international teams (Neeley, 2012). The report notes that while English is increasingly becoming the lingua franca of global business because of technological and media advancements, this trend presents challenges for non-English speakers who must acquire functional English skills in order to participate in certain industries. Yet the advantages of non-English speaking entrepreneurs engaging in global business should not be discounted because their involvement brings diverse perspectives, innovation, and cultural insights that are valuable in today's interconnected markets. These entrepreneurs often possess deep understanding of local markets, customer behaviors, and regional trends, which can be leveraged to create products and services tailored to specific needs. Additionally, their participation fosters multilingual business environments, which can bridge communication gaps between different regions and open up opportunities in non-English-speaking markets. Moreover, by engaging globally, they contribute to greater cultural exchange and inclusivity, while also encouraging businesses to adopt more flexible and adaptable communication strategies, moving beyond reliance on English as the sole language of commerce. This can enhance creativity, lead to innovative problem-solving approaches, and promote cross-cultural collaboration (Branne &Mughan, 2016).

With multilingualism comes greater cultural awareness that boosts appeal in international markets and fosters innovation through exposure to diverse perspectives which can give birth to new business solutions and product development. Therefore, the ability to speak multiple languages is a significant advantage for entrepreneurs as shown by the crucial role multilingualism plays in large organizations such as IBM which invested in inclusive language strategies to accommodate its diverse workforce. Similarly, emphasizing the importance of language skills in entrepreneurship, a report by the European Commission found that 11% of small to medium-sized enterprises (SMEs) in the EU lost business due to language barriers (European Commission, *Effects on the European Economy of Shortages of Foreign Language Skills in Enterprise*, 2011).

Cross-Cultural Communication in Entrepreneurship

Understanding the complexities of cultural differences in communication enables entrepreneurs to build stronger relationships, navigate negotiations more successfully and competently market their products across borders. Effective cross-cultural communication is invaluable for entrepreneurs working in multilingual markets in a world that is increasingly interconnected as it fosters innovation and growth. However, they must strategically adapt their communication style to align with the specific cultural and linguistic contexts in which they operate particularly when it comes to cross-border negotiations or the establishment of international partnerships.

Addressing the evolving nature of entrepreneurship in the 21st century, Hisrich, Peters & Shepherd (2019) stress that entrepreneurs who demonstrate multilingual proficiency are better positioned to access a wider demographic and enhance their competitive advantage in both local and international markets. But effective communication between people from diverse backgrounds demands an understanding of cultural nuances because of potential challenges that can be posed by language barriers. Hence, the pertinence of Hall's Cross-Cultural Communication theory in this context as it elucidates how individuals from distinct cultural and linguistic environments encode, convey and interpret messages to facilitate more effective intercultural communication and collaborations.

Among the key concepts presented by Hall are the different approaches to time management, relationship-building and innovation across cultures. Of relevance here is Hall's concept of high-context and low-context communication which highlights critical factors entrepreneurs must consider when adapting the way they communicate in different cultural settings. In high-context cultures such as Japan, China, and many Arab countries, communication is often implicit with significant emphasis on non-verbal cues and the context of messages. Much of the information is conveyed indirectly and relies on shared cultural understanding. Conversely, low-context cultures, including the United States, Germany and Scandinavia, prioritize direct, explicit and unambiguous communication where clarity and precision are paramount. Business negotiations in these environments tend to emphasize facts, efficiency and formal contracts.

For entrepreneurs working in diverse cultural contexts, aligning their communication style with the norms of their target audience is crucial. Building on Hall's theory, Hofstede (2001) further explores power distance as a key dimension in understanding cultural differences that influence communication and business practices. In high power distance cultures, hierarchical communication prevails and subordinates expect clear, direct communication from leaders. In contrast, low power distance cultures favor egalitarian communication, with open dialogue and collaborative decision-making. Understanding these cultural variances in verbal and non-verbal communication is crucial to successful cross-cultural interactions.

Another notable aspect is the varying perceptions of time across different cultural settings, especially in relation to entrepreneurial activities. In entrepreneurship, time is often treated as a valuable resource whether in the context of structured business meetings or the development of goods and services. While most Western cultures are time-conscious and adhere to strict schedules, other cultures, such as those in Latin America, the Middle East, and Africa, adopt a more flexible approach to time, placing greater emphasis on building and maintaining relationships. So, to avoid misunderstandings and delays, entrepreneurs must align their time management strategies to the cultural expectations of their partners or clients.

Cultural Sensitivity and Market Strategy

At the core of these insights lies the importance of cultural sensitivity, a vital component in developing an effective market strategy for global entrepreneurship. Since consumer behavior is often influenced by local customs, values and beliefs, a thorough understanding of cultural nuances is crucial (De Mooij, 2019). Therefore, success in international markets requires careful attention to factors like language differences, regional dialects, idiomatic expressions, and body language. Businesses that align their strategies with these cultural elements are more likely to thrive as they are more open to adapting business practices, products, or services to fit specific cultural values, traditions and consumer behaviors of targeted markets.

To achieve this successfully, entrepreneurs must immerse themselves in the local culture taking into account alongside language, factors such as religion, social norms and purchasing habits. Such cultural adaptability enhances the ability of entrepreneurs to offer products or services that are relevant and appealing to local consumers and ultimately contribute to long-term business success. For example, rather than a "one-size-fits-all" approach, the language used in branding should resonate culturally with intended audience which signals a commitment to serving the unique needs of each market. International brands, KFC and Pizza Hut, both demonstrate a willingness to take into consideration local tastes when they offer jollof rice on their menus to customers in Nigeria.

However, it is worth noting that a marketing campaign that resonates in one country may require significant adjustments to avoid cultural misunderstandings in another because symbols, practices and gestures may carry different meanings across cultures. So, entrepreneurs must be cognizant of these differences to avoid potential missteps that could damage their brand image. This explains why entrepreneurs who successfully adapt to the context and cultural preferences of their target audience are more likely to foster stronger relationships, gain competitive advantage, and secure their positions in the global market place. In a similar vein, Ting-Toomey (2005) also stresses the crucial importance of maintaining “face” in intercultural communication so as not to cause offense. The way individuals manage face in communication reflects their cultural values and influences how they handle conflict and relationships. This involves actions taken to uphold one's desired social image or to avoid losing face (i.e., being embarrassed or disrespected) particularly in conflict situations. In many Asian and African cultures, maintaining face is crucial and it is common to avoid direct confrontation or disagreement. Deference is often shown to those in positions of higher authority. In contrast, Western cultures generally find directness and assertiveness more acceptable. Entrepreneurs must be mindful of these cultural differences to preserve relationships and encourage collaboration as this sensitivity can lead to smoother negotiations and long-term business success.

Cross-Cultural Collaborations and Innovation

Collaborations that integrate different cultural perspectives are major drivers of entrepreneurial activities because they bring several advantages. Diversity stimulates creativity and helps teams explore solutions that might not emerge in homogenous groups. Apart from opening up new markets with adaptable business models that are more responsive to global trends, the sharing of knowledge, skills and technological advancements are made easier. Importantly, knowledge of cultural differences can not only guide entrepreneurs on how to approach partnerships but also innovation. For instance, it is important to understand that cultures with low uncertainty avoidance (U.S., Singapore) are more likely to be more open to innovation and risk-taking in business decisions. On the other hand, cultures with high uncertainty avoidance (Japan, Greece) prefer clear rules, detailed contracts and structured business processes avoid

ventures that come with high risk as they prefer stable, long-term businesses. Many cultures in Africa are also averse to taking risks, often preferring stable, secure employment over the uncertainty of entrepreneurship. Yet, as in other places, young people appear to be driving innovation in Africa. Their footprints can be seen the rapid growth in tech start-ups, e-commerce (e.g. Flutterwave and Jumia) and mobile technology that are transforming traditional industries and bringing innovations.

Diverse entrepreneurial teams draw on a wider range of experiences and knowledge that foster innovation by integrating different cultural perspectives. Teams working across cultures must innovate how they share information, provide feedback, and make decisions. Such collaborations fuel creatively, offer a broader range of ideas and challenge established ways of thinking which often results in unique ideas and products. In the end, cross-cultural collaborations push businesses towards out-of-the-box thinking, promoting both creative and practical innovations that can enhance competitiveness in the global market.

Conclusion

The above emphasizes the vital role that linguistic diversity and cultural dynamics play in shaping entrepreneurial ventures in the 21st century. As businesses expand globally, understanding and integrating diverse cultural perspectives become crucial drivers of innovation, market penetration, and long-term success. Language not only facilitates communication but also influences business practices, negotiation strategies, and consumer preferences. Embracing multilingualism, refining communication, and adopting a collaborative stance can foster a mix of ideas and approaches that will empower entrepreneurs to develop more innovative solutions and products. Therefore, cultivating cultural awareness, linguistic proficiency, and leveraging cross-cultural collaboration are essential for entrepreneurs navigating the complexities of the global marketplace.

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LEVEL OF OCCUPATIONAL STRESS AND SELF-EFFICACY ON THE PRODUCTIVITY OF BLOCKLAYING, BRICKLAYING AND CONCRETING TEACHERS IN TECHNICAL COLLEGES IN NORTH CENTRAL, NIGERIA

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Abstract
The study investigates the Level of pressure of occupational stress and self-efficacy on Blocklaying, Bricklaying and Concreting teachers'(BBC) productivity in Technical Colleges in North Central, Nigeria. The study utilized quantitative method. The population of the study was 83 BBC teachers from Technical Colleges offering BBC subjects in the 6 North Central States and the Federal Capital Territory. Census sampling was carried out to select the entire 83 BBC teachers from the Technical Colleges in North Central States including the FCT. The study used a structured questionnaire of a 4-point Scale rating as the instrument of data collection validated by 3 research experts. Frequency distribution, mean and standard deviation were employed to analyze the individual responses of the respondents while regression analysis was used to determine the relationship between level of pressure of occupational stress and level of self-efficacy on teachers' productivity of BBC teachers in Technical Colleges. The findings of the study revealed a coefficient of -0.3.46 of occupational stress and 0.260 of self-efficacy respectively indicating an inverse relationship between occupational stress and BBC teachers' productivity and a positive relationship between self-efficacy and BBC teachers' productivity. In addition, the study revealed that both occupational stress and self-efficacy have significant relationship with teachers' productivity at 5% level of parenthesis. The study however recommends that technical colleges should focus on implementing strategies that will effectively manage and reduce stress levels among teachers and focus on building teachers' self-efficacy belief.

Keywords: Occupational Stress, Self-efficacy, BBC Teachers, Teachers' Productivity, Technical Colleges.

Introduction

Technical colleges, also known as vocational schools or trade schools, are educational institutions that provide specialized training and education in various technical and vocational fields. These colleges offer programs that focus on developing practical skills and knowledge required for specific trades or industries. Some of the common programs offered in technical colleges include engineering programs such as electrical and civil engineering, information and technology programs, metal, wood and automobile programs, and construction and building programs such as block, bricklaying and concreting amongst others (Isola, 2019).

Blocklaying, Bricklaying, and concreting (BBC) are fundamental trades within the construction industry. BBC involves the construction and maintenance of structures using bricks, blocks, and concrete. The skills taught in BBC courses include brick and block laying, mortar mixing, concrete pouring, and finishing techniques, which requires qualified teachers. A teacher of Block/Bricks Laying and Concreting in a technical college is someone who has received the necessary and required training in Building Technology (Block/Bricks Laying and Concreting) from accredited institutions and is responsible for effectively influencing such knowledge in Technical Colleges. The necessity for competency arises from the fact that block/brick laying and concrete teachers are responsible for teaching the course outline.

Competence is the capacity to perform a given task accurately and satisfactorily (Abusomwan & Osaigbovo, 2020). The productivity of BBC teachers is derived from their ability to accomplish academic related task. Haslam, *et al*. 2021 posited that the ability of BBC teacher to deliver effective instruction, preparing lesson plans and employing various teaching strategies to impart technical knowledge and skills to students effectively and efficiently, fostering engagement, creating an inclusive learning environment, managing classroom dynamics, supporting individual student needs and continuous improving instructional practices can be regarded as BBC teachers' productivity. However, Upadhyaya (2021) argued that the teachers' productivity, which entails their ability to perform at the optimal level, is challenged by the stress they faced during teaching.

Stress is a crucial and unavoidable part of life. Up to a certain level, stress is acceptable as it helps to support everyone in becoming stronger and developing their capacities (Haslam et al. 2021).The social, physical, and psychological background of individuals determines how they perceive stress and how they react to it (Civilotti et al. 2021). However, stress is taken and dealt with in different ways by different individuals (Nelson & Bergeman 2021). It is also posited that some events and situations cause people to feel pressure, rigidity, and destructive emotions, which adds apprehension and antagonism to stress (Skodol 2021). Occupational stress is a kind of stress that arises due to the increased workload and the expectations of the management. Most of the teachers especially those in primary and secondary schools experience occupational stress (Upadhyaya 2021). Occupational stress increases when management perception such as lack of organizational support, open communication, recognition of stress influence among others, frustration, and conflict accumulates. Stress absorption capacity differs from person to person and with their socioeconomic conditions (Li *et al*. 2022). Accordingly, evidence has shown that occupational stress adversely affects not only teachers' productivity it negatively affects teachers' self-efficacy.

In order to accomplish the goals of the school, teachers are encouraged by their sense of self-efficacy to work hard. Additionally, it boosts the teacher's confidence in their skills, which will promote collaboration between teachers at the same school, teachers from other regions of the nation, and the community at large (Babu, et al 2022). Numerous earlier research, such as those by Burley, et al (2021), Glickman, and Tamashiro (2022), claim that teachers' self-efficacy can help determine whether they will be negatively impacted by job stress and leave their jobs. According to a further study by Friedman and Farber (2019), revealed self-efficacy beliefs affect an individual self-regulation process.

Statement of the Problem

Teachers play a crucial role in delivering high-quality education, but their productivity is often affected by occupational stress and self-efficacy. In Nigeria, teachers face poor pay, less societal respect, and poor prospects compared to other professions. The country's rising unemployment rate could be attributed to the inability of teachers especially those in technical colleges to impart the required skills to students in the areas of Block/Bricks Laying and Concreting, automobile, woodwork craftwork amongst others, resulting in students lacking relevant skills for modern technologies, thus, it is in line with the above that the study seek to ascertain the influence of occupational stress and self-efficacy on productivity of Blocklaying, Bricklaying and concreting teachers in technical colleges in North Central, Nigeria.

Objective of the Study

The objectives of the study are:

1. Ascertain the level of pressure of occupational stress on the BBC teachers in Technical Colleges in North Central, Nigeria?

2. Determine the level of self-efficacy on BBC teachers in Technical Colleges in North Central, Nigeria.

Research questions

The following research questions are asked:

1. What is the level of pressure of occupational stress on BBC teachers in Technical Colleges in North Central, Nigeria?
2. What is the level of self-efficacy on BBC teachers in Technical Colleges in North Central, Nigeria?

Hypotheses

The following null hypotheses are formulated to guide the study and will be tested at 0.05 level of significance:

Ho1: There is no significant relationship between the level of pressure of occupational stress and the productivity of BBC teachers in Technical Colleges in North Central, Nigeria.

Ho2: There is no significant relationship between level of self-efficacy and the productivity of BBC teachers in Technical Colleges in North Central, Nigeria.

Methodology Research Design

Correlational research design was adopted for this study. A correlational research design method is a non-experimental research design method that examine the statistical relationship between two or more variables. The population of the study consist of 83 Blocklaying, Bricklaying and Concreting Teachers (BBC) from all the Technical Colleges in North Central Nigeria accredited by National Board for Technical Education (NBTE) and offering BBC as a trade. The researcher used a structured questionnaire titled "occupational stress, self-efficacy questionnaire' as its research instrument. The data for the study was collected and organized based on the research questions and hypotheses of the study. SPSS 23 was used in the computation of the collected data from the field. The study adopted a regression analysis to estimate the data of the study.

Result and Discussion

Research Question One: How are the Pressures of occupational stress on BBC teachers in Technical Colleges?

Table 1.

S/No	Item	Mean	Standard Deviation	Remark
1	Time pressures and deadlines	3.51	0.79	EP
2	Workload	3.32	0.79	CP
3	Task outside of my competence	3.07	0.72	CP
4	Security of employment	3.24	0.77	CP
5	Staff shortage	3.29	0.79	CP

6	Poor physical working condition	3.71	0.82	EP
7	Lack of support from senior staff	2.29	0.73	MP
8	Shortage of essential resources	3.01	0.71	CP
9	Lack of participation in planning/decision making	2.26	0.67	MP
10	Lack of privacy	1.41	0.55	NP
11	Dealing with relatives	1.33	0.60	NP
12	Unsocial hours	2.81	0.81	MP
13	Unsafe environment	3.52	0.79	EP
14	Coping with new technology	3.00	0.70	CP
15	Lack of specialized training for present work	1.97	0.57	NP
	Grand Mean	**2.78**		**CP**

Key: EP= extreme pressure CP= considerable pressure MP= moderate pressure NP= no pressure

Table 1 shows the mean values of 15 item fall within the range 2.50 and 3.49 indicating that respondents rated it as considerable pressure, The grand mean of the respondents as presented above is 2.78 meaning that the respondents rated the pressure of occupational stress of BBC teachers in technical colleges as considerable pressure.

3.2 Research Question Two: What is the level of self-efficacy of BBC teachers in Technical Colleges?

Table 2

S/No	Item	Mean	Standard Deviation	Rank
1	I can always manage to solve difficult problems if I try hard enough	3.34	0.77	ML
2	It is easy for me to stick to my aims and accomplish my goals	2.57	0.91	ML
3	I consider myself sufficiently qualified to face my task in my role as a teacher	3.01	0.79	ML
4	I am able to motivate students who show low interest in school work	2.46	0.66	LL

5	I am able to easily handle challenging work tasks	2.46	0.62	LL
6	I am able to provide an alternative explanation for example when students are confused	2.51	0.68	ML
7	Collaboration between teachers and management to make the school run smoothly	3.68	1.02	HL
8	Contribute view freely on important school matters	3.12	0.98	ML
9	I remain calm when facing difficulties because I can rely on my coping abilities	2.18	0.72	LL
10	Even with demanding students I am confident in my ability to motivate them for their learning	1.98	0.59	LL
11	Confident to address situations that test my ability	2.71	0.71	ML
12	I am easily able to get students to work together as a team	2.67	0.77	ML
13	I can easily establish a classroom management system with each group of students	3.55	0.81	HL
14	I easily get students to work together	1.90	0.62	LL
15	I ensure I respond to students feedback	2.98	0.76	ML
	Grand Mean	**2.74**		

Key: HL= High Level ML= Moderate Level LL= Low Level NL= No Level

Table 2 shows 15 item have mean scores ranging from 2.50 to 3.49 indicating that the respondents have a moderate level of self-efficacy .The grand mean of 2.74 depicts that the level of self-efficacy of BBC teachers is moderate.

Hypothesis One

H_0 1: There is no significant relationship between of level of pressure of occupational stress on teachers' productivity of BBC teachers in North Central Region, Nigeria. Based on the t-statistic value of the regression result obtained above as well as its corresponding p-value, the value -

3.022 and 0.003 are within the threshold of the rule of thumb that posited that a variable is statistical significant if the t-statistic value is greater than or equal to 2 irrespective of the sign or if the p-value is less than or equal to 0.05.

Regression Result 1

Coefficientsa

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta		
(Constant)	2.813	.331		8.486	.000
Level of pressure of Stress	-.346	.114	-.333	-3.022	.003

a. Dependent Variable: Level_of_BBC_Teachers_Productivity

The relationship between level of pressure of stress and teachers' productivity is shown in the above table using regression analysis. Result from the table shows that constant has a coefficient of 2.813 suggesting that if there were no pressure of occupational stress experienced by teachers of BBC, their level of productivity will be around 28.13%. Accordingly, Level of pressure of stress has an inverse coefficient -.346 signifying that as the teachers experience increased level of pressure of stress, their productivity declined by 34.6% significantly.

Hypothesis Two

The hypothesis is stated as follows;

Ho2: There is no significant relationship between teachers' level of self-efficacy and the Productivity of BBC Teachers.

The findings of the regression result shows that teachers' self-efficacy level has t-statistic value 0.257 and p-value of 0.012, this values suggest that teachers' self-efficacy level is significant based on the rule of thumb.

Regression Result 2

Coefficientsa

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta		
(Constant)	1.378	.196		7.047	.000
Level of self-efficacy	.260	.101	.290	2.587	.012

a. Dependent Variable: Level_of_BBC_Teachers_Productivity

The regression result presented, slope of the intercept has a positive relationship with the level of productivity of teachers such that if self-efficacy is hold fixed, and teachers' productivity will be 13.78%. Accordingly, a positive and significant relationship has been established between level of self-efficacy and teachers' productivity such that an increase in the level of self-efficacy of the teachers will lead to a corresponding increase in teachers' productivity by 26.0%. The variable is observed to be significant at 5% level of significance looking at the p-value and t-statistic values respectively.

Discussion of Findings

The findings of the study on table 1 revealed that most of the respondent feel considerable pressure when its relates to workload, task outside of their competence, security of employment, staff shortage, shortage of essential resources and coping with new technology. Accordingly, the overall mean of the respondents revealed a considerable pressure on the items captured in table one. The findings align with the assertion of Lazarus (1966) in his transitionary theory of stress that postulates that stress occur because of transaction that took place between man and his environment.

The findings of the result presented in table 2 shows that majority of the respondents feel moderate level of self-efficacy to the level of self-efficacy on their productivity. This is in conformity with the social learning theory put forward by Bandura (1977) suggesting that the central tenet of individual capacities to creates reality, self-regulate, encode knowledge, and carry out activities depend significantly on their cognitive talents which improves their performances.

Hypothesis one revealed an insignificant relationship between the mean score of level of pressure of occupational stress and teachers' productivity of BBC teachers in Technical Colleges in North Central, Nigeria. This was found, as the p-value is greater than the conventional 0.05 level of significance hence, the rejection of null hypothesis.

The findings of the hypothesis two presented on table 7 revealed a significant relationship between level of self-efficacy and teachers' productivity of BBC teachers in Technical Colleges in North Central, Nigeria. This was found, as the p-value 0.00 is less than the conventional 0.05 level of significance hence, the rejection of null hypothesis.

Conclusion

To conclude this, the study geared towards investigating the level pressure of occupational stress and self-efficacy on productivity of BBC teachers in Technical Colleges in North Central, Nigeria. Grounded on the statistical analysis as it has formerly been deliberated, it can be concluded that the work-related stress and teachers' productivity of BBC teachers of

Technical Colleges in North Central, Nigeria, possess a significant negative relationship whereas, the study concludes that self-efficacy on the other hand has a positive and significant relationship with teachers' productivity of BBC teachers of Technical Colleges in North Central, Nigeria.

Recommendation

Based on the results of the study on the level of pressure of occupational stress and self-efficacy on the productivity of BBC teachers in Technical Colleges in North Central, Nigeria, the following recommendations can be made:

1. Given the significant negative relationship between occupational stress and teachers' productivity, it is crucial to implement strategies that effectively manage and reduce stress levels among teachers.
2. Although self-efficacy had a positive relationship with teachers' productivity, it is still important to focus on building and enhancing teachers' self-efficacy beliefs.

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ADEQUACY OF HUMAN AND MATERIAL RESOURCES IN ELECTRICAL AND ELECTRONIC TRADE PROGRAMME IN MEETING THE 21ST CENTURY NEEDS OF CRAFTMEN IN NORTH-CENTRAL, NIGERIA

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Abstract

This study assessed the adequacy of human and material resources for effective implementation of electrical and electronic trade programmes in North-central, Nigeria. Two research questions guided the study. A descriptive survey research design was adopted for the study. The study was conducted in all the technical colleges offering electrical and electronic trade programmes in North Central, Nigeria. A total population of 189 respondents which consist of 119 Electrical and Electronic Trade (EET) teachers and 70 Administrators were used for the study. A 95 items structured questionnaire designed by the researchers and validated by two experts from Industrial Technology Education Department, Federal University of Technology Minna and one expert from Department of Research and Evaluation, Psychometrics, National Examination Council, Nigeria was used for data collection for the study. Cronbach alpha statistics was used to determine the internal consistency of the instrument and the overall reliability coefficient of the instrument yielded 0.97. The data collected for the study was analysed using frequency and percentage. The findings of the study revealed that human resources such as trade teachers, vocational teachers, language teachers, health personals, career counselors, ICT personals amongst others are not adequate while material resources such wiring board, ladder, scaffold among other few material resources were adequately available whereas, 58 material resources assessed were not adequately available. Based on the findings, the following recommendations were made among others that government should ensure that there is adequate recruitment of human resources and funds for the purchase of material resources

Keywords: Electrical and Electronic Trades, Technical Colleges, Human Resources, Material Resources, 21st Century, Craftsmen

Introduction

Technical Colleges (TCs) are institutions that provide students with sellable practical skills that would pave the way for comfortable living and enable them to contribute to economic growth of the nation. According to Lumo et al., (2024), TCs are broad spectrum of post-basic institutions that impart the necessary skills leading to the production of craftsmen and technicians for self- reliance and gainful employment. The broad aim of TCs is the production of enterprising and self- reliant craftsmen and technicians. FRN (2013) revealed that TCs were established to pursue the following goals, to: (a) provide trained manpower in the applied sciences, technology and business particularly at craft, advance craft and technical levels; (b) provide the technical knowledge and vocational skills necessary for agricultural, commercial and economic development; and (c) give training and impart the necessary skills to individuals for self-reliance economically. In addition to this, the National Board for Technical Education (NBTE), (2016) revealed that the curriculum of TCs is designed to facilitate the acquisition of practical skills to students in various trade areas which includes: Computer trades, Mechanical trades, Building trades, Woodwork trades, Hospitality trades, Textile trades, Printing trades,

Beauty culture trades, Business trades, and Electrical and Electronic trades (EETs) programme. Electrical and Electronic Trades (EETs) programme is an area of study where students acquire knowledge and practical skills on various electrical and electronic appliances to fulfil human needs. EETs is offered in technical colleges. Ogbuanya (2017) viewed the programme as a twin interdependent field of study that prepares and exposes students to the principles of designs, construction, installation, maintenance and entrepreneurial competences in electrical and electronic devices and appliances, as well as the teaching of electrical and electronic theory and practice. One of the goals of EETs programme is to produce competent personnel for power generation, transmission, distribution and utilization. Yusof et. al., (2023), highlighted the main objective of EETs programme to prepare and produce qualified graduates with the precise skills for participation in industrious work as well as for self-reliance.

The twenty-first century is best described as the age of science, technology, exploration, experimentation and development. 21st century needs are skills and abilities of the science age requires by today's craftsmen to succeed in their careers (Sulaiman C Ismail, 2020). The skills include critical thinking, creativity, collaboration, communication, information literacy, media literacy, technology literacy among others. These skills are intended to help students keep up with lighting-pace of today's modern markets and they are essential in this age of technology. All academic institutions are expected to perform the task of developing their graduates to possess the employable skills in such a way that when graduates are employed, they will be able to showcase the skills already acquired while in school. Thus, every nation must be abreast with such innovations to be economically viable. In view of this, Mbatha, (2021) opined that Nigeria needs to grow and compete favorably with other nations in business and industry, in new methods and new techniques.

Human resources deal with the body of staff involved in the direct or indirect management and coordination of available material resources for effective implementation of the EETs. As noted by Ludwikowska (2023), human resources are the people who make up the living part of an organization and whose capabilities represent its intellectual capital. Human resources include teachers, learners, curriculum developers, administrators, guidance counselors, industry professionals, and community members. This implies that human resource practically constitutes the workforce of an organization. Therefore, it is important to have an effective working relationship between the employees and the employer for the success of the organization. For various reasons, the teacher occupies a focal position wherever human resources in education are mentioned. The availability of educational resources (financial, human and material) is very important because of its role in the attainment of educational objectives (Mbatha, 2021).

Material resources are facilities and materials procured for effective training of the students in practical skills and applied scientific knowledge in EETs. These include tools, equipment, machines, instructional and training materials, consumables, finances, textbook, responsive curriculum and management. Material resources in EETs are classified into tools, materials and equipment. Ogbuanya (2017) posited that material resources needed for effective delivery of EETs includes wiring boards, meters, cold chisels, power hand drills, electric soldering iron, universal pipe bending machines, radio receivers, drill bit set, screw drivers (assorted), hydrometers, batteries (assorted), hammers, (assorted), steel rules (assorted), magnets (assorted), relays, switches (assorted), tubes (assorted), thermostats, conduit pipes, joint junction boxes, socket outlets, plugs (assorted), digital meters, analogue meters, oscilloscopes, function generators, television receivers, inductors (assorted), lead sucker, side cutters et cetera.

Statement of the Problem

Technical colleges (TCs) are designed to produce graduate that are well skilled, self-reliant and ready to create opportunities for self and the society upliftment. It is also clear that majority of the TCs graduates are currently unemployed partly because of lack of adequate skills and knowledge needed in the modern-day workplace (Okwelle & Ojotule, 2018). This ugly situation is a paradox that makes the adequacy of EETs programme in the 21st century seems doubtful and questionable. The graduates are also seen roaming the streets seeking for white collar jobs while some are involved in illegal dwellings when they should be useful to themselves and/or provide innovative solutions to everyday technological problems to enable the meet with the 21st skills needed of a craftsman. To reverse these nagging situations that contributes to the inability of EETs in meeting the 21st century needs of craftsmen, there is a need to assess the adequacy of EETs programme in term of human and material resources in meeting the 21st century needs of craftsmen in North- Central, Nigeria, Nigeria.

Aim and Objectives of the Study

The main aim of this study is to assess adequacy of human and material resources for effective implementation of electrical and electronic trade programmes in North-central, Nigeria. Specifically, the study is designed to determine the adequacy of:

1. human resources for effective implementation of EETs programme in meeting the 21st century needs of craftsmen
2. material resources for effective implementation of EETs programme in meeting the 21st century needs of craftsmen

Research Questions

1. How adequate are the human resources for effective implementation of EETs programme in meeting the 21st century needs of craftsmen?
2. How adequate are material resources for effective implementation of EETs programme in meeting the 21st century needs of craftsmen**?**

Methodology

Descriptive survey research design was adopted for this study. McCombes (2019) described descriptive survey research as one in which a group of people or items are studied by collecting and analyzing data from only few people or items that are representative of the entire group. The study was carried out in the technical colleges in North-Central Nigeria, which is made up of Niger, Kogi, Kwara, Benue, Plateau Nasarawa and Federal Capital Territory (FCT) Abuja. The targeted population for this study consisted of 189 respondents comprising of 119 EET teachers and 70 administrators. The choice of the population was because they are familiar with the human and material resources in Electrical and Electronic Trade programme and therefore are in a very good position to give authentic information on the adequacy of the programme in term of human and material resources.

The instrument for data collection for this study was structured questionnaire which was developed by the researchers. The instrument was face validated by two from the Department of Industrial and Technology Education, Federal University of Technology (FUT) Minna and One from Department of Research and Evaluation, National Examination Council (NECO. To determine the reliability of the instrument, it was pilot tested on (6) EETs Teachers and (5) administrators from Government Technical College (GTC) Bauchi. The reliability coefficient of the instrument used for the data collection for the study was 0.97 using Cronbach alpha statistics. The questionnaire was administered by the researchers with the help of 6 research assistants. The data collected for the study was analysed using frequency and percentage for

answering the research questions using Statistical Package for Social Sciences version 25.0. To obtain a comprehensive data required for this study, an observational checklist using NBTE standard requirements, and a well-structured questionnaire was used as the instrument for data collection.

Results

Research Question One: How adequate are the human resources for effective implementation of EETs programme in meeting the 21st century needs of craftsmen?
The data for answering research question one is presented in Table 1.

Table 1: Frequency and percentage score on the adequacy of human resources for effective implementation of EETs programme in meeting the 21st century needs of craftsmen
***N*=173**

S/N	Items	Quantity Required	Adequate		Inadequate		Decision
			f	%	***f***	%	
1.	Trades Teachers	1:40	75	43.4	98	56.6	Inadequate
2.	Science Teachers	1:40	98	56.6	75	43.4	Adequate
3.	Vocational Teachers	1:40	73	42.2	100	57.8	Inadequate
4.	Language Teachers	1:40	85	49.1	88	50.9	Inadequate
5.	Administrative staffs	5	106	61.3	67	38.7	Adequate
6.	Library staffs	1	92	53.2	81	46.8	Adequate
7.	Health personnel	2	83	48.0	90	52.0	Inadequate
8.	Messengers	1	90	52.0	83	48.0	Adequate
9.	Career Counselors	2:40	83	48.0	90	52.0	Inadequate
10.	Workshop/Lab attendant	2	94	54.3	79	45.7	Adequate
11.	ICT personnel	2	75	43.4	98	56.6	Inadequate
12.	Entrepreneurship Mentors	-	77	44.5	96	55.5	Inadequate
13.	Cleaners	2	87	50.3	86	49.7	Adequate
14.	Drivers	2	67	38.7	106	61.3	Inadequate
15.	Securities	2	77	44.5	96	55.5	Inadequate
	Grand F/AVRP		**1262**	**48.63**	**1333**	**51.37**	**Inadequate**

Key: *F*= Frequency, *AVRP*= Average percentage

Table 1 indicates that majority of the human resources for effective implementation of EETs programme in meeting with the 21st century needs of craftsmen were not adequate available based on the ratio of personnel to student set by NBTE for technical colleges in North-central, Nigeria. The table depicts that the trades teachers were inadequate by 56.6% to an adequate range of 43.4%.

Research Question Two: How adequate are the available material resources for effective implementation of EETs programme in meeting the 21st century needs of craftsmen?
The data for answering research question two is presented in Table 2

Table 2 Frequency and percentage score on the adequacy of available material resources for effective implementation of EETs programme in meeting the 21st century needs of craftsmen

N=173

S/N	Items	Quantity Required	Adequate		Inadequate		Decision
			f	%	***f***	%	
1.	Workbench	40	66	38.2	107	61.8	Inadequate
2.	Crowbar	20	71	41.0	102	59.0	Inadequate
3.	Conduit bender	20	81	46.8	92	53.2	Inadequate
4.	Stock and dies	10	57	32.9	116	67.1	Inadequate
5.	Conduit vice	20	54	31.2	119	68.8	Inadequate
6.	Clamp	40	80	46.2	93	53.8	Inadequate
7.	Winding machine	20	62	35.8	111	64.2	Inadequate
8.	Grease gun	10	69	39.9	104	60.1	Inadequate
9.	Wiring board	40	102	59.0	71	41.0	Adequate
10.	Oil can	5	70	40.5	103	59.5	Inadequate
11.	Ladder	5	94	54.3	79	45.7	Adequate
12.	Scaffold	1	106	61.3	67	38.7	Adequate
13.	Lamp	5	112	64.7	61	35.3	Adequate
14.	Goggle	40	71	41.0	102	59.0	Inadequate
15.	Hand gloves	40	89	51.4	84	48.6	Adequate
16.	First aid box	2	65	37.6	108	62.4	Inadequate
17.	Helmets	20	71	41.0	102	59.0	Inadequate
18.	Safety belts	20	41	23.7	132	76.3	Inadequate
19.	Apron	30	72	41.6	101	58.4	Inadequate
20.	Measuring tape	24	71	41.0	102	59.0	Inadequate
21.	AC ammeter	10	59	34.1	114	65.9	Inadequate
22.	DC ammeter	10	69	39.9	104	60.1	Inadequate
23.	AC voltmeter	10	63	36.4	110	63.6	Inadequate
24.	DC voltmeter	10	92	53.2	81	46.8	Adequate
25.	Analog multimeter	50	97	56.1	76	43.9	Adequate
26.	Digital multimeter	20	68	39.3	105	60.7	Inadequate
27.	Neon tester	20	71	41.0	102	59.0	Inadequate
28.	Voltage tester	20	117	67.6	56	32.4	Adequate
29.	Steel rule	25	113	65.3	60	34.7	Adequate
30.	Oscilloscope	2	83	48.0	90	52.0	Inadequate
31.	Signal generator	2	94	54.3	79	45.7	Adequate
32.	Screwdriver sets	40	51	29.5	122	70.5	Inadequate
33.	Allen keys	40	73	42.2	100	57.8	Inadequate
34.	Strippers	50	82	47.4	91	52.6	Inadequate
35.	Hammers	50	56	32.4	117	67.6	Inadequate
36.	Regular pliers	40	67	38.7	106	61.3	Inadequate
37.	Cutters	40	68	39.3	105	60.7	Inadequate
38.	Hacksaws	40	76	43.9	97	56.1	Inadequate
39.	Spanners	40	73	42.2	100	57.8	Inadequate
40.	Drill (electric manual)	&3	54	31.2	54	31.2	Adequate
41.	Pipe wrenches	20	59	34.1	114	65.9	Inadequate

42.	Punching device	20	80	46.2	93	53.8	Inadequate
43.	Crimping tools	40	65	37.6	108	62.4	Inadequate
44.	Rheostats	35	95	54.9	78	45.1	Adequate
45.	Inductors	30	92	53.2	81	46.8	Adequate
46.	DC motor	20	117	67.6	56	32.4	Adequate
47.	DC generator	20	113	65.3	60	34.7	Adequate
48.	1øAC motor	20	66	38.2	107	61.8	Inadequate
49.	1øAC generator	20	94	54.3	79	45.7	Adequate
50.	Relays	25	63	36.4	110	63.6	Inadequate
51.	Resistors	20	117	67.6	56	32.4	Adequate
52.	Transistors	20	113	65.3	60	34.7	Adequate
53.	Ceramic insulator	20	83	48.0	90	52.0	Inadequate
54.	Crocodile clips	50	94	54.3	79	45.7	Adequate
55.	Armature	20	63	36.4	110	63.6	Inadequate
56.	Conduit pipes (PVC)	50	92	53.2	81	46.8	Adequate
57.	Conduit pipes (Steel)	50	75	43.4	98	56.6	Inadequate
58.	Circuit breakers	40	67	38.7	106	61.3	Inadequate
59.	Battery charger	20	69	39.9	104	60.1	Inadequate
60.	Volt-ohm-milliammeter (VOM)	10	92	53.2	81	46.8	Adequate
61.	High Input Impedance voltmeter (VTUN or TVM)	5	97	56.1	76	43.9	Adequate
62.	Magnifying lens	10	72	41.6	101	58.4	Inadequate
63.	Flash/pen light	30	71	41.0	102	59.0	Inadequate
64.	Sandpaper	40	80	46.2	93	53.8	Inadequate
65.	Steel bowl	40	69	39.9	104	60.1	Inadequate
66.	Small bench vice	10	106	61.3	67	38.7	Adequate
67.	Overhead Projector	10	81	46.8	92	53.2	Inadequate
68.	VCR and IT monitor	5	113	65.3	60	34.7	Adequate
69.	Illustration color chart	40	83	48.0	90	52.0	Inadequate
70.	Nut drivers (HEX)	20	86	49.7	87	50.3	Inadequate
71.	Soldering iron	30	78	45.1	95	54.9	Inadequate
72.	Wire stripper	50	72	41.6	101	58.4	Inadequate
73.	Needle Pliers	40	83	48.0	90	52.0	Inadequate
74.	Steel-wire brush	15	75	43.4	98	56.6	Inadequate
75.	Pocket knife	50	62	35.8	111	64.2	Inadequate
76.	Heat sinks	30	79	45.7	94	54.3	Inadequate
77.	Files	40	60	34.7	112	64.7	Inadequate
78.	Desoldering device	30	55	31.8	118	68.2	Inadequate
79.	Alignment tools	15	61	35.3	112	64.7	Inadequate
80.	Glue gun	50	51	29.5	122	70.5	Inadequate
	Grand F/AVRP		**6273**	**45.32**	**7501**	**54.20**	**Inadequate**

Key: *F*= Frequency, *AVRP*= Average percentage

Table 2 revealed that wiring board, ladder, scaffold among other few material resources were adequately available whereas, 58 material resources were not adequately available even though

some of the technical colleges have certain number available but not up to NBTE minimum required standard. The result in Table 2 indicates that majority of the material resources for effective implementation of EETs programme in meeting with the 21st century needs of craftsmen were not adequately available based on NBTE minimum standard for technical colleges in North- central, Nigeria.

Findings of the Study

The findings on the adequacy of human resources for effective implementation of EETs programme in meeting with the 21st century needs of craftsmen in North-central, Nigeria revealed that six categories of personnel agreed to be adequate out of the 15 personnel that was been examined.

The findings on the adequacy of available material resources for effective implementation of EETs programme in meeting the 21st century needs of craftsmen in North-central, Nigeria revealed that only 22 items out of 80 items been assess was considered adequate. Hence, 58 items were considered inadequate.

Discussion

The findings relating to research question 1 indicates that majority of the human resources for effective implementation of EETs programme in meeting with the 21st century needs of craftsmen were not adequate available based on the ratio of personnel to student set by NBTE for technical colleges in North-central, Nigeria. In support of this findings, Gidado (1995) said that the major problems of education in Nigeria is that the human resources that are being trained are not sufficiently prepared to meet the complex demand of the teaching profession in Nigerian schools. Tanner and Tanner (2002) said that the success of a curriculum largely depend on availability and adequacy of human resources handling it. In skill-based courses, education as opposed to liberal education, human resource adequacy and teachers' preparation is more compounded because of the practical skills and competencies that must be imparted. This implies that teachers' quality is more critical in skill-based courses. Unfortunately, availability and adequacy of qualified teachers is disturbingly absent in our institutions unless those that are trained abroad but when they come home to teach, the necessary materials are either not available or adequate. In a study carried out by Edobor (2007) regarding the availability of human and material resources in vocational course, in secondary schools in the south-eastern parts of Nigeria, the discoveries were in line with Odunsanya (2006), Aina (2000) and NERD (2004), confirming the inadequacy of human and material resources in the teaching and learning of vocational courses.

The findings relating to research question 2 revealed that wiring board, ladder, scaffold among other few material resources were adequately available whereas, 58 material resources were not adequately available even though some of the technical colleges have certain number available but not up to NBTE minimum required standard. This finding agrees with Okebukola (2012) who reported in his study inadequacies in instructional materials/ material resources such as hand tools. Towe (2007) also reported that there was no evidence of practical work in a course which was supposed to introduce students to various skill-based programmes even where workshop and laboratories were available, they were deprived of functional essential tools, equipment and materials. Also, in-line with the finding Offorma (2005) noted that vocational and technical subjects are not effectively implemented as most of the subjects are not offered due to lack of teachers, workshops for practical work, and further noted that where there are teachers the delivery is usually theorized because of lack of competence on the part of the teacher or due to lack ofequipment, thus students graduate without any hands-on

experience. Abijo and Oyekanmi (2017), asserted that school, consumable material resources when provided will aid teaching learning programme and consequently improve academic achievement of students while the models guide their provision to schools could take any form as rational bureaucratic and political model whichever model is adopted according to him, there is always a common feature of differing allocation of facilities to schools.

Conclusion

The study assessed the adequacy of Electrical and Electronic Trades programmes in meeting the 21st century needs of craftsmen in North-Central, Nigeria. The findings of the study serve as the basis for making the following conclusion that trades teachers, vocational teachers, language teachers, health personnel, career counselors, workshop/lab attendant, ICT personnel, entrepreneurship mentors, cleaners, drivers and securities are not adequately available in technical colleges. It was also concluded that material resources for effective implementation of EETs programme in meeting the 21st century needs of craftsmen such as wiring board, ladder, scaffold, lamp, hand gloves amongst others were adequately available to some extent in technical colleges in North-central, Nigeria.

Recommendations

Based on the findings the following recommendations were made:

The federal and state government should ensure that there is adequate recruitment of human resources for effective implementation of EETs programme in meeting the 21st century needs of craftsmen.

Electrical and Electronics Trades material resources such as Workbench, Crowbar, Conduit bender, Stock and dies, Conduit vice, Clamp, Winding machine, Grease gun, wiring board, Oil can, Ladder, Scaffold, lamp, Goggle, Hand gloves and others should be adequately provided in technical colleges for effective implementation of Electrical and Electronics Trades curriculum.

The government at both federal and state level should provide adequate funds for the purchase material resources.

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ASSESSMENT OF OCCUPANTS' LEVEL OF FACILITIES AND SERVICES SATISFACTION IN THE RESIDENTIAL HOUSING ESTATES BUILT ENVIRONMENT IN LOKOJA, KOGI STATE

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Abstract
The study assessed residents' satisfaction with facilities and services in public housing estates in Lokoja, Kogi State. Guided by two research questions and two null hypotheses, a descriptive survey design was employed. The target population comprised 2,820 residents from fifteen public housing estates. Due to the large sample size, a multistage sampling method was employed. Initially, the estates were stratified by factors such as location and population density. From these strata, eight estates were randomly selected to ensure diversity. Within these estates, 453 residents were chosen through simple random sampling. Data were gathered using a structured questionnaire, validated by experts from the Federal University of Technology, Minna, and pilot-tested in Talba, Niger State. The questionnaire's reliability was confirmed with a Cronbach's Alpha of 0.80. Data analysis, performed using SPSS version 26, involved calculating means and standard deviations for the research questions and z-tests for hypotheses at a 0.05 significance level. Results showed moderate satisfaction with both facilities (mean = 3.12) and services (mean = 2.86). The study recommended that estate management in Lokoja implement regular maintenance and upgrades to improve resident satisfaction. Additionally, it recommended establishing an active service response team with accessible contact information to facilitate effective communication and timely maintenance responses.

Keywords: Occupants, Facilities and Services, Satisfaction, Residential Housing Estates, Built Environment

Introduction
The built environment and the quality of residential facilities and services have a profound impact on occupants' satisfaction and overall quality of life. As such, they are crucial considerations in urban planning, architecture, and real estate development. According to the United States Environmental Protection Agency (USEPA, 2022), the built environment encompasses all aspects of human life, including residential buildings, infrastructure for water and electricity, transportation systems, waste management, security measures, and recreational facilities. These elements significantly influence the comfort and satisfaction of residents. The built environment consists of man-made or modified spaces for living, working, and recreation, requiring substantial material resources to create. The impact of the built environment can be both positive, such as increased safety and productivity, and negative, like air pollution and reduced health quality.

Housing is a basic human need, on par with food and clothing, and serves as a key indicator of an individual's standard of living and societal status. Ensuring the provision of satisfactory housing that meets government standards and aligns with user needs and expectations has

always been a priority for both public and private housing sectors in Nigeria (National Housing Policy, 2022). In building projects, various services are interdependent and essential, emphasizing the importance of architectural, engineering, and construction expertise, particularly in urban areas. Lokoja, a rapidly growing urban center, is experiencing increased demand for housing due to population growth. Consequently, housing estates have been developed to meet this demand, but concerns remain about the quality of these estates and resident satisfaction with the provided facilities and services (Hassan et al., 2023). As Okafor (2016) notes, housing is a fundamental human need that significantly impacts health, welfare, and productivity across all socioeconomic groups.

Occupants' satisfaction in residential housing estates refers to the contentment residents feel regarding the quality and effectiveness of the facilities and services provided in their living environment (Simeon et al., 2022). This satisfaction encompasses various aspects, including the physical structure (space, noise control, lighting, ventilation), the availability and reliability of utilities (electricity, water, internet connectivity), and communal facilities and services (parking, security, green spaces, waste management, and recreational amenities). Resident satisfaction or dissatisfaction profoundly affects their comfort, well-being, and overall quality of life. Satisfaction is highly subjective, shaped by individual expectations and experiences, and is influenced by multiple factors such as cultural expectations, personal preferences, and social dynamics.

Understanding occupants' satisfaction levels is essential for urban planners, developers, and policymakers. It provides valuable insights for improving residential design, facility management, and housing policies, thereby enhancing residents' living conditions. Feedback on occupant satisfaction can inform better housing design practices, estate management strategies, and policy formulation aimed at improving urban living conditions. Resident satisfaction is an important area of study for professionals seeking to enhance the quality of life in residential areas (Parkes et al., 2022).

Wang and Wang (2020) highlight the importance of infrastructural facilities and services in ensuring the proper functioning and utilization of residential properties. The demand for these facilities extends beyond the physical structure to include additional installations and fittings that enhance their utility. In residential properties, satisfaction includes shelter, protection, comfort, convenience, health, privacy, and dignity. A decent housing unit must meet the economic, physical, and environmental needs of its occupants. Economic satisfaction, or getting value for rent paid, may be unrealistic if physical satisfaction, which includes uninterrupted power supply, water supply, and waste disposal, is not adequately addressed. Environmental satisfaction, encompassing social status and neighborhood security, also contributes to the perceived utility of residential properties.

Statement of the Research Problem

Residential housing estates in Lokoja are designed to provide a satisfactory living environment, offering essential facilities and services such as water supply, electricity, waste management, and recreational spaces.

However, inadequate planning and maintenance have resulted in issues like structural deterioration, plumbing problems, electrical faults, and overall degradation of the living environment. According to David *et al.* (2023), residents have expressed concerns over unreliable water and electricity supply, poor waste management, inadequate security, and the lack of recreational facilities. Furthermore, aspects related to the built environment, including

housing design, construction quality, integration with the natural environment, and neighborhood layout, are often neglected in planning, construction, and maintenance, despite their significant impact on residential satisfaction. Without a comprehensive understanding of the factors influencing satisfaction with facilities and services, it is difficult for architects, urban planners, and policymakers to develop effective solutions to improve living conditions.
This study aims to assess residents' satisfaction with the facilities and services provided in the residential housing estates in Lokoja, Kogi State, to better inform future planning and policy decisions. Understanding these key issues is crucial for enhancing the quality of life in these estates and ensuring that housing developments meet the needs and expectations of their occupants.

Purpose of the Study
The following are the purpose of the study:

1. Identify the level of occupant's satisfaction with the facilities provided in the residential housing estates in Lokoja, Kogi State.
2. Determine the level of occupants' satisfaction with the services provided in residential housing estates in Lokoja, Kogi State.

Research Questions
The following research questions guided the study:

1. What is the level of occupants' satisfaction with the facilities provided in the housing estates in Lokoja, Kogi State?
2. What is the level of occupants' satisfaction with the services provided in housing estates in Lokoja, Kogi State?

Research Hypotheses
The following null hypotheses were formulated and guided the study and was tested at 0.05 level of significance.

1. **Ho_1:** There is no significant difference in the mean responses of new and old occupants of residential housing estates as regards the level of occupants' satisfaction with facilities provided in the residential housing estates in Lokoja, Kogi State.
2. **Ho_2:** There is no significant difference in the mean responses of new and old occupants of residential housing estates as regards the level of occupants' satisfaction with the services provided in the residential housing estates in Lokoja, Kogi State.

Research Methodology
This study adopted descriptive survey research design. The study was conducted in Kogi State. Kogi State is located in the central region of Nigeria (North-Central). The target population of the study was 2820 old and new housing residents living in the fifteen (15) public housing estates in Lokoja, Kogi State. A multistage sampling technique was used for the study to select 8 public housing estate in Lokoja. A 30-items structured questionnaire was used as the instrument for data collection. The questionnaire was designed in line with the research questions, and structured on a five-point rating scale. The structured questionnaire was validated by three (3) experts from the Department of Industrial and Technology Education, Federal University of Technology Minna, The experts were asked to go through the instrument and make suggestions where necessary. In order to determine the reliability coefficient of the instrument, a pilot study was conducted in Talba housing estate in Minna Niger State using 20 residents from the housing estate. The total of 453 structured questionnaires was administered to the respondents in the eight sampled housing estates with the help of four (4) research assistants. Mean and standard deviation were used to answer the research questions while z-test was used to test the null

hypotheses at 0.05 level of significance. Real upper and lower limit of numbers was used in order to determine the level of agreement or disagreement of the respondents to the items. Statistical Package for the Social Sciences (SPSS version 26) was used for data analysis. The decision on each item of the research questions was based on the resulting mean scores interpreted relatively to the concept of real lower and limits of numbers as shown in Table 3.4. Furthermore, the decision to reject or retain the null hypothesis was based on the obtained p-value. If the p-value was less than or equal to 0.05 ($p \leq 0.05$), there was statistically significant evidence to reject the null hypothesis. If the p-value was greater than 0.05 ($p > 0.05$), the null hypothesis was retained.

Results

Research Question 1

What is the level of occupants satisfaction with the facilities provided in the housing estates in Lokoja, Kogi State?

The data for answering research question one is presented in Table 1.

Table 1: Mean and Standard Deviation of Respondents on the Level of Occupants' Satisfaction with the Facilities Provided in the Housing Estates in Lokoja, Kogi State. N = 362

S/N	Items	Mean ($\overline{\chi}$)	SD	Remark
1	Backup generators for constant supply of electricity	3.48	0.70	ML
2	Boreholes for constant water supply	3.20	0.45	ML
3	CCTV surveillance systems	2.48	0.59	LL
4	ATM facilities	3.42	0.69	ML
5	Paved roads	3.43	0.91	ML
6	Recreational centres	3.35	0.70	ML
7	Internet and cable TV infrastructure	3.19	0.81	ML
8	Shopping complex	3.39	0.70	ML
9	Car parking space	3.30	0.55	ML
10	Waste management systems	3.29	0.64	ML
11	Landscaped gardens	3.18	0.78	ML
12	Healthcare centre	2.48	0.68	LL
13	Street lighting	2.40	0.78	LL
14	Fitness centre	3.35	0.68	ML
15	Firefighting equipment	2.88	0.75	LL
	Grand Mean/SD	**3.12**	**0.68**	**Moderate**

Key: N = Number of respondents; SD = Standard Deviation; ML = Moderate Level; LL = Low Level

Table 1 shows the mean responses of the respondents on 15 items posed to determine the levels of occupants satisfaction with the facilities provided in the housing estates in Lokoja, Kogi State with a grand mean of 3.12. This implies that the level of occupants' satisfaction with the facilities provided in the housing estates is moderate. The standard deviation of the items ranged from 0.45 to 0.81 which implies that the 15 items had their standard deviation less than 1.96. This indicates that the respondents were not too far from the mean and were close to one other in their responses. This closeness of the responses adds value to the reliability of the mean. Hence, the occupants have moderate level of satisfaction with facilities provided in the housing estates.

Research Question 2
What is the level of occupants satisfaction with the services provided in housing estates in Lokoja, Kogi State?

The data for answering research question two is presented in Table 2.

Table 2: Mean and Standard Deviation of Respondents on the Level of Occupants' Satisfaction with the Services Provided in the Housing Estates in Lokoja, Kogi State

N = 362

S/N	Items	Mean ($\overline{\chi}$)	SD	Remark
1	Security	3.35	0.52	ML
2	Electricity supply	2.48	0.48	LL
3	Water supply	2.40	0.50	LL
4	Waste disposal services	3.34	0.70	ML
5	Landscaping and gardening maintenance	3.35	0.44	ML
6	Road maintenance	3.40	0.60	ML
7	Internet and Wi Fi	2.49	0.54	LL
8	Health clinics	3.01	0.80	ML
9	Car wash services	2.44	0.55	LL
10	Laundry services	3.40	0.64	ML
11	Restaurant or cafes	3.20	0.66	ML
12	ATM facilities	2.28	0.68	LL
13	Schools or educational facilities	3.21	0.80	ML
14	Shuttle services	2.26	0.60	LL
15	Fitness centres or gyms	2.35	0.79	LL
	Grand Mean/SD	**2.86**	**0.62**	**Moderate**

Key: N = Number of respondents; SD = Standard Deviation; ML = Moderate Level; LL = Low Level

Table 2 shows the mean responses of the respondents on 15 items posed to determine the level of occupants satisfaction with the services provided in the housing estates in Lokoja, Kogi State with a grand mean of 2.86. This implies that the level of occupants' satisfaction with the services provided in the housing estates is moderate. The standard deviation of the items ranged from 0.44 to 0.80 which further implies that the 15 items had their standard deviation less than 1.96 indicating that the respondents were not too far from the mean and were close to one other in their responses. This closeness of the responses adds value to the reliability of the mean. Hence, the occupants have moderate level of satisfaction with the services provided in the housing estates.

Hypothesis 1
There is no significant difference in the mean responses of new and old housing occupants as regards the level of occupants' satisfaction with facilities provided in the residential housing estates in Lokoja, Kogi State ($P<0.05$). Null hypothesis one was tested and the result is presented in Table 3.

Table 3: Z-test Analysis Showing the Significant Difference between the Mean Responses of New and Old Housing Occupants' As Regards the Level of Occupants' Satisfaction with Facilities provided in the Residential Housing Estates in Lokoja, Kogi State

		Levene's Test for Equality of Variances		Z-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	Z	Df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper
Facilities Provided	Equal variances assumed	11.240	.520	3.845	360	.034	.64740	.06842	.09128	.40820
	Equal variances not assumed			2.726	24.020	.152	.64740	.08502	.07580	.38082

(p>0.05) SD = Significant Difference

Table 3 shows the z-test analysis for the test of significant difference between the mean responses of new and old housing occupants as regards the level of occupants' satisfaction with facilities provided in the residential housing estates in Lokoja, Kogi State. The Levene's test was carried out to determine equality of variance. The test showed an F value of 11.24 with a p-value of 0.52 which shows that equal variances was assumed. Also, the z-test analysis showed a z-value of 3.85 and a p-value of 0.03 which is less than the bench mark of 0.05. This implied that there was significant difference between the mean responses of new and old housing occupants as regards the level of occupants' satisfaction with facilities provided in the residential housing estates in Lokoja, Kogi State. Hence null hypothesis one was rejected.

Hypothesis 2

There is no significant difference in the mean responses of new and old housing occupants as regards the level of occupants' satisfaction with the services provided in the residential housing estates in Lokoja, Kogi State (P<0.05). Null hypothesis two was tested and the result is presented in Table 4.

Table 4: Z-test Analysis Showing the Significant Difference between the Mean Responses of New and Old Housing Occupants As Regards the Level of Occupants' Satisfaction with the Services provided in the Residential Housing Estates in Lokoja, Kogi State

		Levene's Test for Equality of Variances		Z-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	Z	Df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper

	Equal variances assumed	9.248	.075	3.890	360	.024	.52044	.05408	.08408	.35404
Services Provided	Equal variances not assumed			2.735	24.100	.098	.52044	.08740	.04822	.39805

(p>0.05) SD = Significant Difference

Table 4 shows the z-test analysis for the test of significant difference between the mean responses of new and old housing occupants as regards the level of occupants' satisfaction with the services provided in the residential housing estates in Lokoja, Kogi State. The Levene's test was carried out to determine equality of variance. The test showed an F value of 9.25 with a p-value of 0.75 which means that equal variances was assumed. Furthermore, the z-test analysis showed a z-value of 3.89 and a p-value of 0.02 which is less than the bench mark of 0.05. Hence, null hypothesis two was rejected. This implied that there is significant difference between the mean responses of new and old housing occupants as regards the level of occupants' satisfaction with the services provided in the residential housing estates in Lokoja, Kogi State.

Findings of the Study

The following findings emerged from the study based on the research questions answered and the hypotheses tested.

1. The level of occupants' satisfaction with the facilities provided in the housing estates in Lokoja, Kogi State was moderate.
2. The level of occupants' satisfaction with the services provided in the housing estates in Lokoja, Kogi State was moderate.
3. There is significant difference between the mean responses of new and old housing occupants as regards the level of occupants' satisfaction with facilities provided in the residential housing estates in Lokoja, Kogi State.
4. There is significant difference between the mean responses of new and old housing occupants as regards the level of occupants' satisfaction with services provided in the residential housing estates in Lokoja, Kogi State.

Discussion of Findings

The findings of research question one revealed that occupants' satisfaction with facilities in Lokoja's housing estates was moderate. Facilities assessed included backup generators, boreholes, CCTV systems, recreational centers, parking spaces, paved roads, street lighting, and firefighting equipment. A significant difference in satisfaction levels was observed between new and old housing occupants. This difference likely result from the degradation of facilities in older residences compared to the generally better condition of facilities in newer properties.

The findings align with previous research indicating moderate satisfaction levels among residents in various locations: Abiodun and Kingsley (2020) in Benin City, Faisal (2023) in Hamad City, and Elahi (2024) in Mashhad. However, they differ from Ogbuefi and Okoro

(2019), which reported high satisfaction in private housing estates in Port Harcourt, potentially due to the superior management by private developers in those estates.

The findings on research two revealed that the level of occupants' satisfaction with the services provided in the housing estates in Lokoja, Kogi State was moderate. The services include: security, electricity supply, water supply, waste disposal services, landscaping and gardening maintenance, road maintenance, internet service and wifi, health clinics and car wash services among others. Also, the findings on hypothesis two revealed that there was significant difference between the mean responses of new and old housing occupants as regards the level of occupants' satisfaction with services provided in the housing estates in Lokoja, Kogi State. This implied that the respondents had different opinions regarding the level of their satisfaction with the services provided in the housing estates. This could be as

The findings align with several studies indicating moderate satisfaction levels with housing services: Azian et al. (2023) in Kenya, Abiodun and Kingsley (2020) in Benin City, and Faisal (2023) in Gaza Strip. They also confirm Ogbuefi and Okoro's (2019) finding of significant differences in satisfaction between private and public housing estate occupants. However, they contrast with Ogbuefi and Okoro's (2019) observation that private estate occupants in Port Harcourt reported high satisfaction, likely due to the superior facilities and services provided by private developers.

Conclusion

The study concluded that while essential facilities like backup generators, boreholes, CCTV systems, and street lighting are present, overall occupant satisfaction is only moderate. This suggests that the infrastructure, though in place, does not fully meet occupants' needs, with notable differences in satisfaction between new and old housing occupants. The moderate satisfaction with services such as security, electricity, water supply, and waste disposal indicates that these services also fall short of fully meeting occupants' needs. The disparities in satisfaction levels emphasize the need for targeted improvements, especially in older estates where facilities may be outdated or inadequate.

Recommendations

The following recommendations were made based on the findings of this study;

1. The management of housing estates in Lokoja, Kogi State should periodically carry out routine maintenance and general upgrade of existing facilities to improve the level of occupants' satisfaction with their facilities.
2. The management of the housing estates in Lokoja, Kogi State should establish an active service response team and their contact should be distributed to all occupants in the estate to enable effective communication and prompt response for cases of emergency.
3. The management of housing estates in Lokoja, Kogi State should create avenues such as suggestion boxes, social media platforms (Whatsapp group) and help lines where occupants will have the opportunity to share the challenges they face and necessary arrangement be made to address such challenges.

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VERAGING THE SYNERGY OF ARTIFICIAL INTELLIGENCE AND BIG DATA ANALYTICS FOR EFFECTIVE EVALUATION OF THE EDUCATIONAL SYSTEM IN NIGERIA

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Abstract
In recent years, there has been a growing interest in the application of Artificial Intelligence (AI) and Big Data Analytics (BDA) in various sectors including the education, with the potential to revolutionize the evaluation and assessment process. With authentic, quality and variety of data-driven evaluation of the Nigerian Educational System, a realistic educational model can be achieved. The paper therefore, discusses the state of Education in Nigeria, the concept of AI and Big Data and explores the possibilities of leveraging the synergy of AI and big data analytics for effective evaluation of the educational system in Nigeria. The paper postulates that, synergizing AI and Big Data Analytics in education system can result in early detection of faulty educational practices, forecasting of future of education with big data analytics, making proper educational policy and planning, development of relevant curricula and creation of personalized learning experiences. However, challenges include data quality, privacy concerns, and resource-intensive implementation. To address these limitations and leverage the Synergy of AI and big data analytics effectively, the paper suggests, improving data collection systems, addressing privacy concerns, developing infrastructure, building capacity and developing a strong big data analytics strategy.

Keywords: Artificial Intelligence, Big Data Analytics, Evaluation, Educational System

Introduction
The educational system plays a vital role in the development and progress of a nation. It is responsible for shaping the minds of the future generation and equipping them with the necessary knowledge and skills. For every system or professional practice to be successful, assessing and evaluating the process for accountability, identification of strength and weakness of the progress is paramount. Evaluation in education is as important as education itself. Evaluation reports usually tell what has been done right or wrong and what needs to be done. Effective educational programs like evaluation are connected to assessment schemes that help students grow, develop, and succeed, and such assessment schemes should be designed to meet the stated instructional goals and objectives or learning targets of both the teacher and the learner. However, evaluating the effectiveness of the educational system has always been a challenge. Traditional evaluation methods such as examinations and assessments are limited in their ability to provide comprehensive insights into the educational system. This limitation calls for a more robust and efficient evaluation system.

Decades ago, interest in Technology, especially the aspect of Information and Communication Technology in the education sector, because it enhances interactive and engaging learning experiences, greater access to resources, flexible learning environments, data-driven insights, and the development of vital digital skills in learners (Alharbi, 2020). Various technology tools have been integrated into the teaching and learning process (Chen *et al.*, 2020). With such tech tools like E-learning and e-assessment tools and information platforms like social media and many other interaction forums (online and offline), robust data can be obtained to evaluate the

education system for real-time monitoring and tracking of progress made in the education system (Sinha & Sharma, 2018; Arnold & Pistilli, 2012). To extract such robust data, there is need to leverage the potential of Artificial Intelligence (AI) and Big Data Analytics (BDA).

The State of Education in Nigeria

The state of the contemporary education system in Nigeria begins with the intrusion of the colonial masters. Nigeria's education system faces a multifaceted and complex educational landscape marked by both notable progress and persistent challenges. The progress made includes but not limited to **increased enrollment, expansion of Higher Education Sector** (Mogaji, 2019) and changes in policies and initiatives. **Despite these progress, serious challenges such as** inadequate infrastructure and funding (Adetula, 2022), a shortage of qualified teachers, and limited access to learning resources, disparities in access to quality education (Malala Fund, 2021; Antai & Anam, 2016), galloping out of school rate and dropout among other persist. According to UNESCO (2020), approximately 10.5 million children are out of school, making Nigeria with the highest number of out-of-school children globally.

Additionally, the current evaluation system heavily relies on written examinations, which tend to focus on rote memorization rather than critical thinking and problem-solving skills. The National Bureau of Statistics (NBS; 2020) reported that only 62% of teachers in primary schools were professionally qualified (NBS, 2020). No doubt, this alone can account to poor learning outcomes, with Nigeria performing poorly in international assessments like the Programme for International Student Assessment (PISA). Aside these challenges, the curriculums used in schools often does not meet the needs of the economy. World Bank (2021) highlighted that there is a gap between the skills taught in schools and those required by employers. This kind of mismatch may contribute to high unemployment rates among graduates, particularly in a youth-dominated population.

Nigeria has made strides in improving access to education, significant challenges remain, particularly in quality, gender equity, and the impact of conflict. Addressing these issues requires comprehensive reforms, increased funding, and collaboration among stakeholders to ensure that education can effectively contribute to national development. The need to overhaul the process demands a holistic evaluation of the educational system. The challenges identified requires a paradigm shift towards a more holistic evaluation system that takes into account individual student needs and learning outcomes.

Artificial Intelligence (AI)

AI refers to computer systems that can perform tasks that typically require human intelligence, such as visual perception, speech recognition, decision-making, and problem-solving (Kaul, *et al*, 2020). AI technologies include Machine Learning (ML) and Natural Language Processing (NLP) (Xu, *et al.*, 2021). ML as a subset of AI is machine learning (ML) trains algorithms to learn from and make predictions based on data, while it employs neural networks with multiple layers to analyze various factors of image and speech data (LeCun *et al.*, 2015) through it subset called Deep Learning. The other subset of AI which is the NLP focuses on the interaction between computers and humans through natural language. It enables machines to understand, interpret, and respond to human language in a valuable way. According to Jurafsky and Martin (2020), advancements in NLP have led to significant improvements in applications such as chatbots, translation services, and sentiment analysis.

AI can be utilized to analyze large volumes of educational data and draw meaningful insights. This can lead to more accurate and personalized evaluations of student performance. AI is

defined as the simulation of human intelligence processes by machines, particularly computer systems. These processes include learning (the acquisition of information and rules for using it), reasoning (using rules to reach approximate or definite conclusions), and self-correction (Russell & Norvig, 2020). The field of AI includes various subfields, such as machine learning, natural language processing, robotics, and computer vision. AI has diverse applications across various sectors, including healthcare, finance, education, and transportation.

Big Data Analytics

Big data analytics involves the extraction, analysis, and interpretation of large and complex datasets to identify patterns, trends, and associations.

Big data is characterized by the "Three Vs": Volume, Velocity, and Variety

- Volume: Refers to the massive amounts of data generated every second from various sources, such as social media, sensors, and transactional systems.
- Velocity: Indicates the speed at which data is generated, processed, and analyzed, necessitating real-time analytics.
- Variety: Encompasses the different types of data (structured, semi-structured, and unstructured) that need to be processed, such as text, images, and videos (Laney, 2001).

Big Data Analytics employs various methodologies, including: Descriptive Analytics; Predictive Analytics and Prescriptive Analytics. Descriptive analytics focuses on summarizing past data to understand what happened. Tools like dashboards and reports are commonly used here. Predictive analytics on the other hand, involves using statistical algorithms and machine learning techniques to identify the likelihood of future outcomes based on historical data (Shmueli & Koppius, 2011). The Prescriptive analytics is the advanced level of analytics which recommends actions based on predictive insights. Techniques such as optimization and simulation are utilized.

In the context of education, big data analytics can help identify factors that contribute to student success or failure, evaluate the effectiveness of instructional methods, and predict future performance. The integration of AI and big data analytics can provide a comprehensive evaluation of the educational system in Nigeria.

Benefits of Leveraging AI and Big Data Analytics in the Evaluation Process

a. Personalized Learning: AI-powered systems can adapt to individual student needs and provide personalized learning experiences. By analyzing large volumes of data, AI algorithms can identify knowledge gaps, suggest relevant learning materials, and provide tailored feedback.

b. **Early Identification of At-Risk Students:** Big data analytics can identify early warning signs of students at risk of dropping out or underperforming. By analyzing students' academic records, attendance, and social behavior, educators can intervene and provide appropriate support to improve outcomes. AI also have the ability to streamline assessment processes by automating grading and providing instant feedback to students. This capability not only saves time for educators but also allows for immediate identification of areas needing improvement. As noted by Sinha *et al.*, (2018), automated assessment tools enhance the quality of feedback and support formative assessment practices.

c. **Enhanced Teacher Performance:** AI-powered tools can assist teachers in various tasks, such as creating customized lesson plans, evaluating assessments, and providing real-time feedback. This can help alleviate the workload of teachers and improve the quality of instruction.

d. **Curriculum Development:** Big data analytics can identify areas of the curriculum that need improvement or revision. By analyzing student performance data, educators and policymakers can make data-driven decisions to enhance curriculum alignment with industry needs and societal demands.

e. **Efficient Resource Allocation:** AI and big data analytics can optimize the allocation of educational resources by identifying areas with the greatest need. This can help policymakers allocate funds, materials, and infrastructure strategically to improve educational outcomes.

Ensuring Success through Collaborative Effort:

To ensure the successful implementation of AI and big data analytics in the evaluation of the educational system in Nigeria, collaboration between stakeholders is essential. This includes cooperation between policymakers, educational institutions, teachers, students, and technology providers. Collaboration can help address challenges, share best practices, and ensure that these technologies are deployed in a manner that aligns with the unique needs and contexts of Nigeria.

Conclusion:

The synergistic combination of artificial intelligence and big data analytics holds immense potential for the effective evaluation of the educational system in Nigeria. By leveraging these technologies, personalized learning experiences can be offered, early identification of at-risk students can be achieved, and instructional methods can be enhanced. However, it is crucial to address ethical concerns and foster collaboration among stakeholders to harness the full potential of these technologies. The efforts to streamline and improve the educational system in Nigeria through AI and big data analytics should be a priority to ensure a brighter future for the nation.

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THE ROLE OF DIGITAL LIBRARY PLATFORMS IN SHAPING RESEARCH PRODUCTIVITY TOWARDS A PRODUCTIVE RESEARCHER

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Abstract
Research has always been a complex task, often overwhelming due to managing multiple projects and prioritising tasks. Historically, researchers relied heavily on physical libraries and extensive manual searches. The shift to digital libraries marks a significant transformation, enabling more efficient access to resources and tools for organising information. Digital library platforms streamline research by offering easy access to e-books, e-journals and multimedia content, along with advanced features like personalised recommendations and collaborative tools. This paper classified them into open-source and commercial solutions, each with its own strengths in managing digital content. These platforms have redefined research productivity by enhancing information retrieval, citation tracking, and plagiarism detection. However, they come with challenges, such as technological dependencies, financial constraints, and issues around copyright. Despite these hurdles, digital libraries play a central role in modern research, supporting open-access initiatives and improving the visibility and impact of academic work.

Keywords: Digital, Library, Platform, Productivity, Research

Introduction
Conducting research is a demanding endeavour, and many scientists often find themselves managing multiple projects simultaneously. This can lead to overwhelming feelings, resulting in moments where one might find themselves staring blankly at a to-do list, uncertain of which task to prioritise next. In such situations, it is common to default to less critical tasks or engage in procrastination, which subsequently diminishes productivity (Enago, 2020). According to Syed, (2019), a truly productive researcher is one who sustains high levels of productivity consistently over time. These researchers excel in managing their tasks, maintaining organisation, and making steady progress on complex projects.
Digitisation according to Dominik, (2022) refers to the pure conversion of analogue to digital data. This enables cost reductions, unlimited reproducibility, worldwide distribution within seconds, machine-evaluation, or further machine-processing. Thus, digitisation of analogue

information leads to profound changes, which are reflected in the use and application of information and communication technologies, changed business models, as well as in the organisation and in the processes of companies and institutions.

Digital library platforms, as described by *Brueck et al.,* (2019), are powerful tools designed to provide easy access to a diverse range of digital resources, such as e-books, journals, and multimedia contents. These platforms offer more than just access; they also provide efficient tools for organising and categorising content through metadata, which enhances users' ability to search and understand the resources within a broader context. Additionally, these platforms often incorporate advanced features such as personalised recommendations, collaborative tools, and interactive elements like virtual tours, enriching the user experience and promotion greater engagement with digital content (Ashikuzzaman, 2023).

Digital library platforms can be classified into open-source and commercial solutions, as noted by Timotheou *et al.*, (2023). Among the open-source options are DSpace- a flexible platform for managing digital content; Greenstone Digital Library- which allows for the creation of custom digital libraries; EPrints- designed for institutional repositories of research outputs; Digital Commons- supporting scholarly communication; and Islandora and Samvera- which offer robust digital asset management features through the Fedora Commons framework.

On the commercial side, platforms include Polaris ILS- which provides integrated library services; Follett Destiny Library Manager- known for streamlining library operations; Ex Libris Alma, a cloud-based solution for academic libraries; SirsiDynix Symphony- a popular integrated library system; Springshare- offering tools for research guides and library websites; and Hoopla- a digital media service that allows users to borrow a wide range of content through public libraries, with the convenience of syncing across devices.

The concept of "research productivity" merges the ideas of "research," which refers to the systematic investigation of phenomena to uncover new insights, and "productivity," which relates to the amount of work produced over time. In higher education, research productivity is often demonstrated through the publication of articles in academic journals, the release of books, or the presentation of papers at conferences (Alemu, 2023). Publications are widely recognised in the literature as a key measure of productivity, reflecting a researcher’s dedication and serving as the main channel for disseminating findings to the scientific community (Simisaye, 2019). This emphasis on research and publication drives knowledge advancement, leading to discoveries that benefit society.

When considering highly productive researchers, a key question arises: can they sustain their high levels of productivity over time? According to findings by Marek and Wojciech, (2024), about half of the most productive assistant professors maintained their productivity as they advanced to associate professor roles, and similarly, half of the top associate professors continued to be highly productive as full professors (52.6% and 50.8%). Interestingly, neither gender nor age, whether biological or academic, significantly influenced these outcomes. These results have important implications for hiring practices, suggesting that the productivity levels of scientists at the time of hiring can have long-term effects on institutions and national science systems, given that academic scientists often remain active in the system for many years.

Research Before the Age of Technology

Despite the convenience of modern tools like Google, sourcing relevant information for a literature review can still be a time-consuming task. Reflecting on this, it’s intriguing to

consider how researchers in the past managed such challenges without the internet, relying on extensive reading to uncover specific details. This comparison stresses the importance of the resources available today, as Grant, (2019) rightly noted, libraries subscribed to several services that surveyed literature, provided abstracts, and cross-indexed primary journals. Among these were the Science Citation Index and Science Abstracts, the latter having been published since 1898. These services were available in large, heavy print volumes that occupied considerable shelf space and represented a significant portion of the library's budget.

Footnotes have long been valuable for tracing the origins of ideas, forming a backward-looking reference trail. In the 1960s, computers were first used to reverse this process by sorting approximately 20,000 footnotes from professional journals. This innovation enabled researchers to track the progression of ideas forward in time, creating a new way to understand the evolution of scholarly thought (Walter, 2019).

Before the internet, conducting research and retrieving information was a much more laborious task. Libraries, encyclopaedias, and books were the main sources of knowledge, requiring students to spend countless hours searching through card catalogues and library shelves to find relevant materials. Encyclopaedias like the *Encyclopaedia Britannica* were commonly used for general knowledge, but they were limited in scope and often outdated. Unlike today's instant access to online databases and search engines, finding specific information back then demanded considerable time and effort (Josea, 2023).

In early 1967, during his first year as a graduate student, Andreas became curious about measurable cardinals but struggled to find a definition, as he recounted (2019). It wasn't until several months later, when Joe Shoenfield's book *Mathematical Logic* was published, that he finally found the information he was seeking. Although Dana Scott had published a paper on measurable cardinals and constructible sets years earlier, Andreas was unaware of it at the time. Graduate students heavily relied on libraries and librarians, often spending hours in the academic library's math section, moving from book to book and taking extensive notes on paper, as described by Buffy (2019). However, when a needed resource wasn't available in the library, they would request a loan from another institution. Librarians were also valuable as 'knowledge experts,' offering suggestions and guidance on where to find relevant materials—a skill Buffy wondered if modern librarians still possess. Additionally, students would often seek advice from colleagues on where to uncover the most valuable resources.

Digital Technology and Research: The Modern Era

The advent of digital technology has dramatically transformed research. Small innovations, like digitised finding aids, database searches, and smartphones in archives, have collectively transformed how researchers conduct their work. Much like the frog that fails to notice gradual changes in its environment, researchers may not fully grasp the extent of this transformation. Today, our research practices are deeply integrated with digital tools (Royalhistsoc, 2022).

According to Haleem *et al.*, (2022), technological advancements have given rise to online libraries, eliminating the need for physical space and fostering global interaction among students, teachers, and researchers. Online forums have also enabled subject experts to collaborate on curriculum evaluation, teaching methods, and assessments. By reducing paper use and increasing the efficiency of research, digital learning promotes sustainability, cuts costs, and enhances the reach and impact for both students and researchers.

Digital technologies, tools, and services serve multiple roles in research—they can be the subject of study, tools for creating new methodologies, and the environment where research

takes place, as highlighted by Tsatsou (2016). Depending on how the internet is used or perceived in a research project, different epistemological, logistical, and ethical issues arise. Digital research often involves investigating digital spaces like blogs, social networks, or virtual communities, developing methods using digital tools, and sourcing data from online platforms. These technologies can simultaneously shape research design, data collection, and analysis.

The Different Ways Digital Technologies has Changed Research

Information Search and Retrieval: Slamecka, (2024) observed that the 1990s brought a major advancement in information retrieval, as computer networks enabled users to simultaneously search multiple databases across various locations using standardised protocols. This shift laid the groundwork for the extensive use of online information resources, as noted by (Muhammad and Shakeel, 2022). Today, researchers benefit from easier and more effective access to data through online public access catalogues, digital libraries, e-databases, e-journals, and other online repositories, which are now widely utilised by students, faculty, and research scholars.

Scientists' long-held desire for immediate access to scientific literature has become more achievable with advances in network information systems and digital libraries. Although the core challenges of information retrieval have remained largely unchanged, the Internet has expanded access to literature searches for a wider audience. Digital libraries facilitate searching across extensive electronic collections, moving beyond simply digitised repositories. Historically managed by professional librarians, these searches are now increasingly conducted directly by scientists. The future of information retrieval is shifting towards semantic search technology, which will enhance the ability to search based on concepts rather than just keywords (Bruce, 2024).

Paraphrasing: Paraphrasing plays a vital role in academic and professional writing, allowing writers to rephrase ideas from credible sources, thereby establishing their own credibility and showcasing a deep understanding of the material (Young, 2024). Paraphrasing tools, as explained by Flyingvgroup, (2024), offer a streamlined way to achieve this by using advanced digital technology to rewrite content while preserving its original meaning and context, making the process as natural and seamless as if done by a human writer.

Plagiarism Check: Plagiarism is a common issue among students and professionals, often driven by time constraints and the perceived ease of copying others' work. A study by the International Center for Academic Integrity found that 62% of 71,300 undergraduate students and 40% of 17,000 graduate students admitted to cheating in their papers (Copyleaks, 2019). This widespread problem extends beyond academia into the workplace, involving not just text but also images, ideas, and other people's work without proper credit. To address this, plagiarism-checking software such as Turnitin and PlagTracker scans documents against billions of webpages and academic databases, making it easier to identify copied content and improve citation practices (ScoreDetect, 2024).

Citation Tracking and Referencing: Citation tracking, also known as citation analysis or cited reference searching, is a method used to evaluate the impact of research by counting how often a study or author is cited in other works. This process helps identify influential scholars and assess the significance of a study by examining the frequency and context of its citations, as well as the disciplines of the citing authors (University of Southern California Library, 2024).

To enhance citation and referencing accuracy, numerous digital tools have been developed. Many word processors, such as Microsoft Word and LibreOffice, come with integrated citation features. Standalone software like Citavi, Endnote, Mendeley, Zotero, ReferenceManager, ProCite, BibTex, and Perrla, along with digital platforms like Academia.edu, Google Scholar, Web of Science, ResearchGate, and PLOS Impact, offer specialised citation support (Dunlop, 2019). These tools differ in cost and accessibility, with some being free and others requiring a subscription, and can be used both online and offline.

Digital Object Identifier (DOI): The Digital Object Identifier (DOI) is a system designed to uniquely locate and link to digital information published online, often referred to as "the bar code on the Internet". This system provides a permanent internet link to electronic journal articles and offers comprehensive services including registration, analysis, and citation linking. Widely adopted by international publishers like Elsevier, Springer, and Wiley, DOI is well-established in sci-tech journals abroad. However, its use in domestic contexts is still in the early stages (Dai, 2015).

According to York, (2024), A Digital Object Identifier (DOI) provides a unique and permanent link to a resource, ensuring its long-term accessibility and citation. Typically assigned to academic outputs such as journal articles, books, and datasets, a DOI directs users to the specific URL of the resource. This system not only aids in locating and citing work but also assists with citation tracking.

Institutional Repository: An institutional repository is a digital archive that centralises, preserves, and provides access to an institution's intellectual output, such as research papers and theses. These repositories enhance institutional visibility and reputation while offering scholars broader dissemination, increased use, and greater professional visibility for their work. By making scholarly outputs accessible online, they play a vital role in promoting and preserving academic research (CARL, 2024). Among the various software options for implementing such repositories, open-source solutions like EPrints (http://www.eprints.org) and DSpace (http://www.dspace.org) are gaining popularity both nationally and internationally due to their straightforward implementation compared to other available software.

Open Access Initiative: Open Access (OA) essentially means free access for users, often referring to documents available on the web, also known as public domain documents. This term is commonly associated with scholarly material, meaning that electronic scholarly articles are available freely at the point of use. OA is a recent movement in the communication of scholarly research, where neither readers nor their institutions are charged for access to articles or other resources. OA is also known as open-access publishing and free online scholarship (projectsxtra.com, 2024).

Academic institutions are increasingly adopting institutional digital repositories as part of the open-access model, which supports immediate access to peer-reviewed research and enhances scholarly quality. In Japan, universities are encouraged to develop these repositories to boost knowledge sharing globally. Open access (OA) not only raises university profiles and visibility but also reduces journal costs and advances the mission of knowledge dissemination. OA broadens the reach of research, integrates local studies into global networks, fosters collaboration, and strengthens national science bases, aligning with higher education's goal of advancing knowledge (Musa & Kabir, 2017).

Challenges Faced by Researchers

While digital library platforms provide numerous advantages, they also present challenges. Ashikuzzaman, (2023) highlighted concerns such as the heavy reliance on technology, which can result in server outages, connectivity issues, and data loss, disrupting access. Additionally, not all resources are available digitally, and the authenticity of online sources can be compromised by misinformation and plagiarism. The digitization process itself is expensive and time-consuming, requiring considerable expertise. Moreover, copyright restrictions and licensing agreements can further limit access and usage of digital materials.

Rahmani, (2022) identified several challenges faced by digital library platforms, including financial constraints that limit their development and upkeep. There are also difficulties in securing specialised human resources necessary for effective management, along with issues related to digital equipment and internet infrastructure, which can impair accessibility. Additionally, concerns over copyright, intellectual property, and the security of digital resources are significant, as is the ongoing need for proper protection and maintenance of these resources.

Conclusion

Digital library platforms have significantly transformed research productivity by ensuring seamless access to information, organising resources, and facilitating the dissemination of scholarly work. These platforms provide essential tools for citation management, plagiarism detection, and efficient data retrieval, making them important to modern research practices. However, this shift towards digitisation comes with its challenges, including technological dependencies, financial limitations, and issues related to copyright and intellectual property. Furthermore, the need for specialised human resources and robust infrastructure remains a concern. Despite these obstacles, the advantages of digital libraries in enhancing the visibility and impact of academic work are evident. They align with global initiatives like open access, which promotes broader dissemination and collaboration. As institutions continue to embrace these technologies, addressing the challenges associated with digital library platforms will be crucial to ensuring their effectiveness and sustainability in supporting academic excellence and advancing the mission of higher education.

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LECTURERS' PERCEPTION OF THE INTEGRATION AND UTILIZATION OF LEARNING MANAGEMENT SYSTEM IN TEACHING BIOLOGY IN NORTH-EAST UNIVERSITIES, NIGERIA

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Abstract
The study adopted a survey research design. The population of the study was 398 biology lecturers in northeast public universities, out of which 199 were sampled. A structured questionnaire was administered and 92.96% response rate was achieved. Face and content validation of the instrument were done by three experts, two from Science Education Department and one from Measurement and Evaluation Department of ATBU, Bauchi. The internal consistency of the instrument was tested using Cronbach alpha and 0.90 was obtained. The instrument was distributed to the respondents with aid of trained research assistants. Data collected were analyzed using descriptive and inferential statistics. The study revealed that biology lecturers have positive perception towards the integration of learning management system for instructional delivery in northeast public universities and significant difference was found between the mean score of male and female biology lecturers on their perception. Additionally, perceived ease of use and perceived usefulness of LMS was found positive and significant difference was found between the male and female biology lecturers on their perceived ease of use. However, no significant difference was found between male and female biology lecturers on their perceived usefulness of LMS. It was recommended that training programmes focusing on the use of LMS be regularly put in place to increase the capacity of biology lecturers to manage, create courses and tracking, editing features, and evaluating students' performance.

Keywords: Learning Management System, Perceived Ease of Use, Perceived Usefulness

Introduction
The landscape of teaching and learning has continuously evolved with the advancement of technology, especially in the wake of the Covid-19 pandemic. The rapid development of Information and Communication Technologies (ICT) has transformed traditional classrooms into smart learning environments. This shift has made it easier for lecturers and students to access a wealth of knowledge online, engage in both synchronous and asynchronous learning, collaborate with one another, and share information (Dahlstrom, Brooks, & Bichsel, 2014). In academic institutions, the use of Learning Management Systems (LMSs) as part of the educational management system to enhance teaching processes in higher education is on the rise. According to Pishva, Nishantha, and Dang (2010), as well as Garcia, Abaratigue, and Alcantara (2021), teaching and learning has fundamentally changed due to the rapid development of technology in recent decades. Many universities in developed countries utilize various LMS systems for their academic activities (Alabi et al., 2019), all of which depend on existing ICT infrastructure.
Nowadays, it is common to find educational institutes operating their own Learning Management Systems (LMS) to provide a variety of online smart learning features for students. An LMS is a web-based system equipped with an extensive range of pedagogical and course administration tools (Yakubu, 2019). Through these tools, LMSs facilitate

group chats, discussions, document sharing, assignment submission, quizzes, grading, and course evaluations (Bove & Conklin, 2020). Furthermore, LMSs have the potential to accommodate teachers with diverse backgrounds, including variations in their field of study, teaching experience, culture, age, and gender (Tinmaz & Lee, 2020). In general, LMSs offer fundamental facilities such as limited access control for authorized individuals and provide different types of learning content and provide different types of communication tools.

Learning Management Systems (LMSs) generally offer essential features such as restricted access control for authorized users, various types of learning content, and communication tools. Recent technologies support a wide range of pedagogical practices in LMS settings (Tinmaz & Lee, 2020). In an LMS environment, teachers act as facilitators, creating a conducive learning space for students to engage with educational resources and develop into professionals ready for the information age (Kehrwald & Parker, 2019). LMSs also enable teachers to design adaptable pedagogical strategies and provide valuable resources for efficient information access tailored to individual student needs (Al-Fraihat et al., 2020). According to Murcia (2016), online facilitators empower learners to ask questions and utilize their existing knowledge to build new concepts. Facilitators encourage students to maintain their autonomy, enthusiasm, and motivation. Online instructors enhance learner engagement by actively participating in the LMS environment, such as by addressing participant questions, joining in course discussions, and providing feedback on student performance. Integrating LMSs into various classroom activities supports student learning and self-regulation (Alkhasawnh & Alqahtani, 2019; Al-Fraihat et al., 2020). LMS usage provides educators with modularity, customization, and flexibility (Kehrwald & Parker, 2019). Furthermore, some innovative online educators promote user-driven online learning environments through LMS usage, utilizing diverse media and communication tools while encouraging learner autonomy in selecting and utilizing online learning tools. Therefore, instructors can motivate learners to engage in collaborative strategies to pursue their interests in learning.

The use of LMS has caught the attention of many researchers, particularly in integrating technology into the classroom. According to Schoonenboom (2014), the adoption of LMSs is now a crucial part of higher education. Teachers in tertiary institutions increasingly utilize a learning management system (LMS) for instructional tasks. Therefore, LMSs are widely integrated into tertiary institutions globally (Klobas & McGill, 2010; Rubin, 2017; Lee et al., 2013). Cápay and Tomanová (2010) mentioned that the Constantine the Philosopher University in Nitra is currently using LMS Moodle extensively as a central environment for all its faculties and departments. Furthermore, Lee et al. (2013) stated that many universities and colleges in the U.S.A. have implemented an LMS to support teaching activities and student learning processes. At DePaul University, all coursework, learning resources, work collection and return, discussions, group work, and feedback are mediated through the LMS (e.g., Blackboard, Desire2Learn) (Rubin, 2017). Additionally, Hussein (2011) reported that 55% of the courses at King Saud University were offered through the learning management system. Likewise, Harisu, Deba, and Jibrin (2023) confirmed the availability of LMS in North-east Nigerian universities.However, Louwrens and Hartnett (2015) contend that the integration and utilization of LMS and online learning environments for teaching and learning in school settings are still in developmental stages. Moreover, a study by Harisu et al. (2023) on the readiness of Biology lecturers to use LMS for teaching revealed that they have positive attitudes and adequate skills. They suggested that, further studies should be conducted on the perception

of lecturers on the integration and utilization of LMS in north-east universities.

Perception is an important variable that is mostly considered by many researchers since it fosters the utilization of any teaching facilities. According to Eyo (2018) define perception as thoughts, beliefs, and feelings about people, situations, and events. Perception can provide information relevant to immediate goals and also lead to unintended learning. Lecturers' perceptions of teaching and learning influence the methods they use, which affects the outcomes of learning (Eyo, 2018). Perceptions improve with practice and experience and can be seen as the cultivation of attention. According to Baldwin and Howe (2012), negative perceptions can hinder learning as students may develop a dislike for the instructor and the lesson content. Conversely, positive perceptions can lead to better performance, with students actively participating and working as a team. Therefore, the study focused was to investigate the integration and utilization of LMS in teaching Biology in North-east universities.

Research Questions

The following research questions were raised to guide the study:

1. What is the Lecturers perception on the integration of LMS in teaching Biology in North- east, Nigeria universities?
2. What is the Lecturers perceived ease of use of the LMS in teaching Biology in North- east, Nigeria universities?
3. What is the Lecturers perceived usefulness of the LMS in teaching Biology in North-east, Nigeria universities?

Research Hypothesis

The following hypothesis was tested at 0.05 level of significant.

$H0_1$: There is no significant difference between the mean rating values of male and female biology lecturers' perception on the integration of learning management system for instructional delivery in public universities in north eastern Nigeria.

$H0_2$: There is no significant difference between the mean rating values of male and female biology lecturers on their perceived ease of use of learning management system for instructional delivery in public universities in north eastern Nigeria.

$H0_3$: There is no significant difference between the mean rating values of male and female biology lecturers on their perceived usefulness of learning management system for instructional delivery in public universities in north eastern Nigeria.

Methodology

The study adopted a survey research design. The population of the study consisted of 398 biology lecturers 92 are from Biology Education and 306 from Biological science in sixteen public universities in Nigeria. The respondents of this were 199 sampled from the population. A structured questionnaire with a four-point Likert – scale was administered, and 92.96% response rate was achieved. The instrument was face and content validated by three experts; two from Science Education Department and one from Measurement and Evaluation Department of Abubakar Tafawa Balewa University Bauchi. Their observations and corrections were used to develop the final copy of the instrument. The Cronbach alpha reliability coefficients for the instrument was 0.90. The instrument was distributed physically to the respondents with aid of trained research assistants. Data collected were analyzed using descriptive and inferential statistics through IBM Statistical Package for Social Sciences (IBM SPSS version 23.0).

Results

The results are presented in the following Tables

Table 1: Mean and Standard Deviation of the Biology Lecturers' Perception on the Integration of Learning Management System.

S/N	Items	N	Mean	SD	Remarks
1	LMS integration into teaching of biology has improved student outcomes	185	3.74	1.25	Agreed
2	Integration of LMS in teaching biology enhances students assessment and grading	185	3.81	1.22	Agreed
3	LMS regularly allow user to integrate multimedia content to enhance teaching of Biology concepts	185	3.81	1.15	Agreed
4	Integration of LMS has increased student engagement and participation in learning biology	185	3.85	1.16	Agreed
5	Integration of LMS feedback mechanism has help to enhance the teaching process of biology concepts	185	3.72	1.14	Agreed
6	Integration of LMS help to address the needs for diverse learners in a biology classroom	185	3.87	1.14	Agreed
7	I received timely and effective technical support when encountering issues with LMS	185	3.98	1.10	Agreed
8	Integration of LMS in teaching biology improve teachers professional practices	185	3.88	1.07	Agreed
9	Integration of LMS in teaching biology concepts improve the ICT skills of biology lecturers	185	3.88	1.07	Agreed
10	I feel satisfied integrating LMS into teaching biology courses	185	3.83	1.10	Agreed
	Grand mean		**3.84**	**1.14**	**Agreed**

Source: Fieldwork 2024

Table 1 shows the mean and standard deviation of biology lecturers' responses on their perception toward the integration of Learning Management System. All the 10 items had the mean scores above 3.0 with standard deviations above 1.0 which shows high variability among the responses. The grand mean of lecturers Perception on the Integration of LMS was 3.14 indicated that respondents have positive perception toward integration of Learning Management System for instructional delivery in their universities.

Table 2: Mean and Standard Deviation on the Perceived Ease of Use of Learning Management System

S/N	Items	N	Mean	SD	Remarks
1	Navigating LMS features is straightforward for me in teaching biology	185	3.97	1.10	Agreed
2	I find it easy to upload course materials to the LMS	185	3.97	1.05	Agreed
3	Setting up assessment like quizzes or exams within the LMS is intuitive	185	3.85	1.11	Agreed

4	I feel comfortable managing student assessment and grading through the LMS	185	3.75	1.26	Agreed
5	Customizing the LMS interface to suit my teaching preferences is easy	185	3.67	1.24	Agreed
6	I encounter minimal technical difficulties when using LMS tools in teaching biology	185	3.79	1.22	Agreed
7	Learning to use new LMS features is not challenging for me	185	3.72	1.08	Agreed
8	I perceive that LMS enhances my efficiency in managing course-related tasks	185	3.74	1.06	Agreed
9	I am confident in troubleshooting minor LMS issues independently	185	3.72	0.99	Agreed
10	I find LMS user-friendly for teaching biology	185	3.79	0.95	Agreed
	Grand mean		**3.80**	**1.11**	**Agreed**

Source: Fieldwork 2024

The result presented in Table 2 was used to answer this question. The Table shows the mean and standard deviation of biology lecturers' responses on their perceived ease of use of Learning Management System. All the 10 items had the mean scores above 3.0 with standard deviations above 1.0 which shows high variability among the responses. The grand mean of lecturers Perceived ease of use of LMS was 3.80 indicated that the respondents have perceived that Learning Management System are easy to use for them in instructional delivery.

Table 3: Mean and Standard Deviation of Biology Lecturers Perceived Usefulness of LMS.

S/N	Items on Usefulness	N	Mean	SD	Remarks
1	Using LMS enhances my efficiency in managing course-related tasks	185	3.69	1.09	Agreed
2	LMS positively impacts student engagement and interaction within the course	185	3.76	1.05	Agreed
3	LMS facilitates communication between lecturers and students	185	3.70	1.08	Agreed
4	LMS is useful in sharing course materials to the students	185	3.83	0.99	Agreed
5	LMS is useful in enhancing the teaching and learning experience of biology concepts	185	3.82	1.02	Agreed

6	The LMS supports tracking student progress in learning biology	185	3.85	0.98	Agreed
7	The LMS has multimedia resources that enhance teaching of biology courses	185	3.50	1.17	Agreed
8	The LMS reduces my administrative workload related to teaching biology	185	3.64	1.15	Agreed
9	The LMS enhances my overall teaching experience	185	3.62	1.21	Agreed
10	The LMS is beneficial for conducting assessments in biology	185	3.62	1.21	Agreed
	Grand Mean		**3.70**	**1.15**	**Agreed**

Source: Fieldwork 2024

The result of descriptive statistics on the perceived usefulness of biology lecturers toward use of learning management system in public universities presented in Table 3, indicated that all the items of the variable having mean scores of above 3.0 and standard deviation were above 1.0. The grand mean score of the items were 3.70. This result indicated that the biology lecturers in public universities in North Eastern Nigeria have the perceived the usefulness of LMS to be positive for instructional delivery.

Table 4: Independent Sample T-Test Analysis of Male and Female Biology Lecturers' Perception on the Integration of LMS for Instructional Delivery in Public Universities.

Variables	N	Means	SD	T	DF	P	Decision
Male	88	4.0455	0.98761				
Female	97	3.6464	0.78263	3.059	183	0.003	Rejected
Total	185	3.8459	0.88512				

Decision rule: Ho reject if $P \leq 0.05$ otherwise accept Ha

Table 4, shows the result of an independent-sample t-test carryout to compare the mean score of male and female biology lecturers on the awareness of learning management system for instructional delivery. The result displayed shows that there was slightly differences in the mean score between male biology lecturers (Mean = 4.0455, SD= 0.98761) and female biology lecturers (Mean = 3.6464, SD = 0.78263). The result of independent t-test shows that there is significant difference on the perception of male and female biology lecturers (P=0.003). Reference to the decision rule, the null hypothesis was rejected since p is less than 0.05. Therefore, it can be conclude that, both male and female biology lecturers in public universities of north eastern Nigeria differ on their perception toward integrating learning management system for instructional delivery.

Table 5: Independent Sample T-Test Analysis of Male and Female Biology Lecturers on their Perceived Ease of Use of LMS for Instructional Delivery in Public Universities

Variables	N	Means	SD	T	DF	P	Decision
Male	88	3.9216	0.91983				
Female	97	3.6804	0.78881	1.919	183	0.057	Rejected
Total	185	3.8010	0.85432				

Decision rule: Ho reject if $P \leq 0.05$ otherwise accept Ha

Table 5 shows the result of an independent-sample t-test carryout to compare the mean score of male and female biology lecturers on their perceived ease of use of learning management system for instructional delivery. The result displayed on the table shows that there was slightly differences in the mean score between male biology lecturers (Mean =3.9216, SD= 0.91983) and female biology lecturers (Mean = 3.6804, SD = 0.78881). The result of independent t-test shows that there is significant difference in the perceived ease of use of LMS between male and female biology lecturers (P=0.057). Reference to the decision rule, the null hypothesis was accepted since p is equal to 0.05. Therefore, it can be conclude that, male and female biology lecturers in public universities in north eastern Nigeria do significantly differ in their perceived ease of use of learning management system for instructional delivery.

Table 6: Independent Sample T-Test Analysis of Male and Female Biology Lecturers on their Perceived Usefulness of LMS for Instructional Delivery in Public Universities

Variables	N	Means	SD	T	DF	P	Decision
Male	88	3.7932	0.83333				
Female	97	3.6196	0.76358	1.479	183	0.141	Accepted
Total	185	3.7064	0.79846				

Decision rule: Ho reject if $P \leq 0.05$ otherwise accept Ha

Table 6 shows the result of an independent sample t-test carryout to compare the mean score of male and female biology lecturers on their perceived usefulness of learning management system for instructional delivery. The result displayed in the table shows that there was small differences in the mean score between male biology lecturers (Mean =3.7932, SD= 0.83333) and female biology lecturers (Mean = 3.6196, SD = 0.76358). The result of independent sample t-test shows that there is no significant difference in the perceived usefulness of LMS between male and female biology lecturers in north eastern Nigerian public universities being compared (P=0.141). Reference to the decision rule, the null hypothesis was accepted since p is greater than 0.05. Therefore, it can be conclude that, male and female biology lecturers in public universities in north eastern Nigeria do no significantly differ in their perceived usefulness of learning management system for instructional delivery.

Discussion of Findings

According to the finding of this study, biology lecturers have positive perception towards the integration of learning management system for instructional delivery in north eastern Nigerian public universities and significant difference was found between the mean rating score of male and female biology lecturers on their perception towards the integration of

learning management system for instructional delivery. This finding was consistent to the finding of Hero (2020) and Williams (2020) who revealed that majority of lecturers perceived LMS as an important technical tools and learning environment that support teaching and learning process. Also, Ugwoke, Edeh, and Ezemma (2019) revealed that majority of business education lecturers perceived LMS as an important technological tool and learning environment that supports teaching and learning of accounting courses, helps accounting students and teachers achieve the stated learning objectives, helps in arousing students interest in accounting and therefore should be made compulsory in all the universities in Nigeria. However, Hassan and Anas (2022) revealed that most teachers at Sokoto State University have a wrong perception of the role of LMS in facilitation instructions before using the LMS. Though, they reported that there is a significant difference between the teachers' perceptions before and after the workshop.

The study also found that learning management systems was found easy to use by biology lecturers in north eastern Nigeria public universities for instructional delivery and there is significant difference between the mean rating score of male and female biology lecturers on their perceived ease of use of learning management system for instructional delivery. This implies that the biology lecturers perceived ease of use of learning management system for instructional delivery in public universities in north eastern Nigeria. The finding coincided with the result of the study of Hameed and Swar (2016), Ellis (2018), Pappas (2018) Clement (2019) and Skillbuilder (2019) who reported that LMS has the following features ease of use.

The finding of this study shows that the biology lecturers in public universities in north eastern Nigeria perceived the usefulness of LMS to be positive towards the instructional delivery and there is no significant difference in mean rating score of male and female biology lecturers on their perceived usefulness of learning management system for instructional delivery. The finding corroborate with that of SkillBuilder, (2019), Alghamdi and Bayaga (2016) and Badri, Rashedi and Mohaidat (2013) which revealed that LMS help the users to improved their work better, allows them to do more interesting and imaginative work, Makes their work more productive, Have confident of using LMS, feel confident in solving LMS challenges during teaching and learning.

Conclusion and Recommendations

This study investigated biology lecturers' perception on the integration and utilization of learning management system for teaching in north-eastern Nigerian public universities in which their perception, perceived ease of use, and perceived usefulness are studied. Since the study revealed that biology lecturers have positive perception towards the integration of LMS, they perceived the ease of use and usefulness of LMS for instructional delivery, this means that they have integrated and are using the LMS for instructional delivery of biology concepts. This can therefore, be sustain if the lecturers are supported and encourage. The study therefore, recommended that relevant authorities should organize ICT and LMS training programmes regularly to increase capacity of the biology lecturers' skills to manage, create courses using add activity tool and tracking, editing features, edit created activity, and evaluating students' performance so as to maximize the numerous benefits in the use of LMS in instructional delivery. This training can be used to enhance their utilization of LMS.

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INFLUENCE OF AVAILABILITY, USE OF INFORMATION RESOURCES AND LIBRARY ENVIRONMENT ON ACADEMIC ACTIVITIES OF TEACHERS IN FEDERAL GOVERNMENT COLLEGE, MINNA, NIGERIA-PILOT STUDY.

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Abstract
The pilot study investigated the influence of availability, use of information resources and library environment on academic activities of teachers in Federal Government College, Minna Nigeria using five research questions to address the variables of the study (availability, use library environment and academic activities). Case study research was used, with the population of -forty teachers for pilot study. Checklist and structured questionnaire were used for data collection. Ticking, mean, and standard deviation was used to analyse data. Results show the returned rate of forty copies of questionnaire. Results showed that major respondents were male, possessed Bachelor degree, taught English, Mathematics, Biology, Economics and Civic Education respectively. Almost all information resources were available and that they have enhanced the research activities of teachers through usage. The study revealed both positive and negative influence of library environment on the academic activities of teachers. The study concludes that with availability use of information resources and influence of environment can have effect on academic activities of teachers in FGC Minna. The study recommends that the authority of the school should strive to acquire special collection to cater for students with disabilities and also make library environment conducive for patronage.

Keywords: Environment; Information resources; School library; Teachers; Use; FGC Minna

Introduction

For quality education to be ensured at Senior Secondary School level, there is the need for quality teachers that are capable of training and preparing candidates for post-basic secondary education. Apart from the possession of requisite professional qualifications (NCE, B.Ed and Master Degree and offer employment, they are expected to discharge their academic responsibilities, if they are to be relevant in teaching profession. The academic responsibilities otherwise known as academic activities of teachers include: teaching, conducting researches, publication, conference attendance, seminars and workshops, presenting papers at in-house and outside school, symposia, conferences etcetera.

Teachers are expected to carefully plan their lessons by following the topics and modules which in turn guide them in the development of lecture notes. This procedure guides teachers in the delivery of their lessons. Teachings are conducted in accordance with the school curricular and the time table. They need to conduct research in their teaching subjects and area of specialisation and further guide them in lecture delivery.

Teaching at secondary schools is an important academic activity, basic and post-basic-education. Teaching can be regarded as the imparting or dissemination of ideas and knowledge from the teachers to pupils, students or learners based on the subject and curriculum of the school. For teachers to be relevant in the profession, they need to constantly engage in conducting researches i.e. discovering new ideas through investigation on a particular phenomenon within the teaching subject or field of specialization.

Embarking on publication is not necessary for teachers at this level but it would be an added advantage if undertaken. It is one of the important academic activities at tertiary education, being one of the requirements for promotion. Teachers present papers (paper presentation) at symposiums or seminars organized by the school authority or external bodies respectively.

For academic activities to be carried out by teachers at secondary school level, there is the need for availability and use of information resources, conducive library environment and facilities. Relevant information resources are to be acquired by the school libraries and can be consulted by teachers to improve on the existing teaching methods and/or enhance teaching methods as well as developing new instructional materials respectively.

For academic activities to be carried out by teachers, it is important that library environments should be taking into consideration because library plays significant role in the well-being of personnel in any organization. Environment play significant role in the attainment of organization's objectives thus library endowment is a determinant factor in users effective patronage and use of information resources. In this case, the location of library, the available facilities and the conducive environment couple with available facilities such as shelves, chairs, desk, reading table are functions of accessibility and use of information resources (Di Marino & Lapintie, 2015). Constant utilizations of information resources based on the area of specialization of teachers can help them prepare papers for presentations at conferences or workshop, while those on programmes can consult information resources so as to carry out assignments, prepare for tests in examination as well as engage in research project/thesis write-up thereby meeting the graduation requirements.

Conducive library environment can facilitate the conduct of research activities by the teachers especially with functional air conditioners and good lightening; teachers can have access to relevant collection, consult them through research and publish them in reputable journal, textbooks, conference proceedings and lots of other publishing outlet. However, decoration of both internal and outside library environment with attractive paints, flower, and hedges as well as constant power supply, lighting and air –conditioners can lead to not only effective and regular patronage of library and its resources but also lead to attainment of library goals and objectives thereby enhance teacher's conduction of academic activities in schools. Therefore, location, conducive, attractive or otherwise of library environment are determinant factors to quality service provision and high level of patronage of collection and services respectively. It is in support of this that Mohammed and Saka (2012) reported that libraries in some Federal Government Colleges in North Central Nigeria are built facing the direction of North and South so as to protect against the effect of wind and sunlight and at the same time school libraries are built far from football fields and noisy environment. Although most school library in Nigeria do not meet the minimum standard in terms of library service delivery.

In order to successfully accomplish academic activities (lesson note plan, teaching, research and publication, attending conferences) there is the need for well-established, purposeful- built and functional libraries established at basic and post-basic education levels (Junior and senior secondary schools) to support academic activities of both students and teachers in particular. Towards the realization of this assertion, the Federal Republic of Nigeria in National Policy on Education (2013) maintain that school libraries are not only established in vacuum or empty, they must be stocked with current and relevant collections which should be in line with the curriculum of the school. Ideally secondary school library should acquire and store information resources such as textbooks (fiction and non-fiction), journals, e-resources, television and

radio, reference collections, magazines, newspapers, computers, Internet facilities, instructional materials (Ramasamy, 2021).

The available collections are to be accessed (accessibility) through library catalogue, Online Public Access Catalogues (OPAC), indexes, abstracts and bibliographies are to be consulted based on user's information needs and to some extent some users usually consult library staff on where and how to get access to the needed information resources.

1.2 Statement of the Research Problem

School library is one of the educational services which every proprietor and management of school strives to provide more so that school libraries are established to support the curriculum and overall educational programme of both primary and post-primary schools. Adequate school library is expected to support the learning and teaching role of pupils/students and teachers respectively. Well-equipped and well-stocked school libraries help to meet the information and academic needs of teachers more especially at post-primary school level as teachers use school libraries to consult books, instructional and learning materials for lesson note plan, support instruction practices e.g. teaching, conducting research, publication, paper presentation at seminars and conferences respectively. Teachers as reported by Adeniyi (2023) as the most hardworking, functional, obedient and simple to approach world-wide thus being the nation builders. For teachers to fully visit, patronize and use, there must be adequate collection, there must be conducive and friendly-library environment (adequate lighting with air conditioner, well painted and decorated with flowers inside and outside; well- furnished and favourable temperature with guide map or directions to various units of the library. To further buttress or ascertain, Akande (2022) enumerates the components of educational process to include: teachers, learners, learning environment, curriculum contents and funding.

Preliminary investigation by the researcher showed that most post-primary schools lack adequate and well-stocked libraries, and where there are average based school libraries, the environment is not conducive for consultation of information resources by both students and teachers. This situation has affected not only the use of information resources but also the academic activities of teachers in the area of lesson note planning and preparation, teaching, researches, seminars and conference attendance are negatively affected. Some of the empirical evidences were reported by Mohammed and Saka (2012), Bala, Mazah, and Hazami (2021), Ahmad and Saka (2021) as well as researchers reported non-implementation of secondary school library standard in FCT Abuja; on one hand and lack of functional school libraries on another hand as most teachers read at home in Nasarawa State and with inadequate collections/ facilities in most schools in Nigeria respectively.

This study therefore seeks to solve these anomalies as observed in school libraries by investigating the influence of availability, use of information resources and library environment on academic activities on teachers in Federal Government College, Minna, Nigeria.

Research Questions

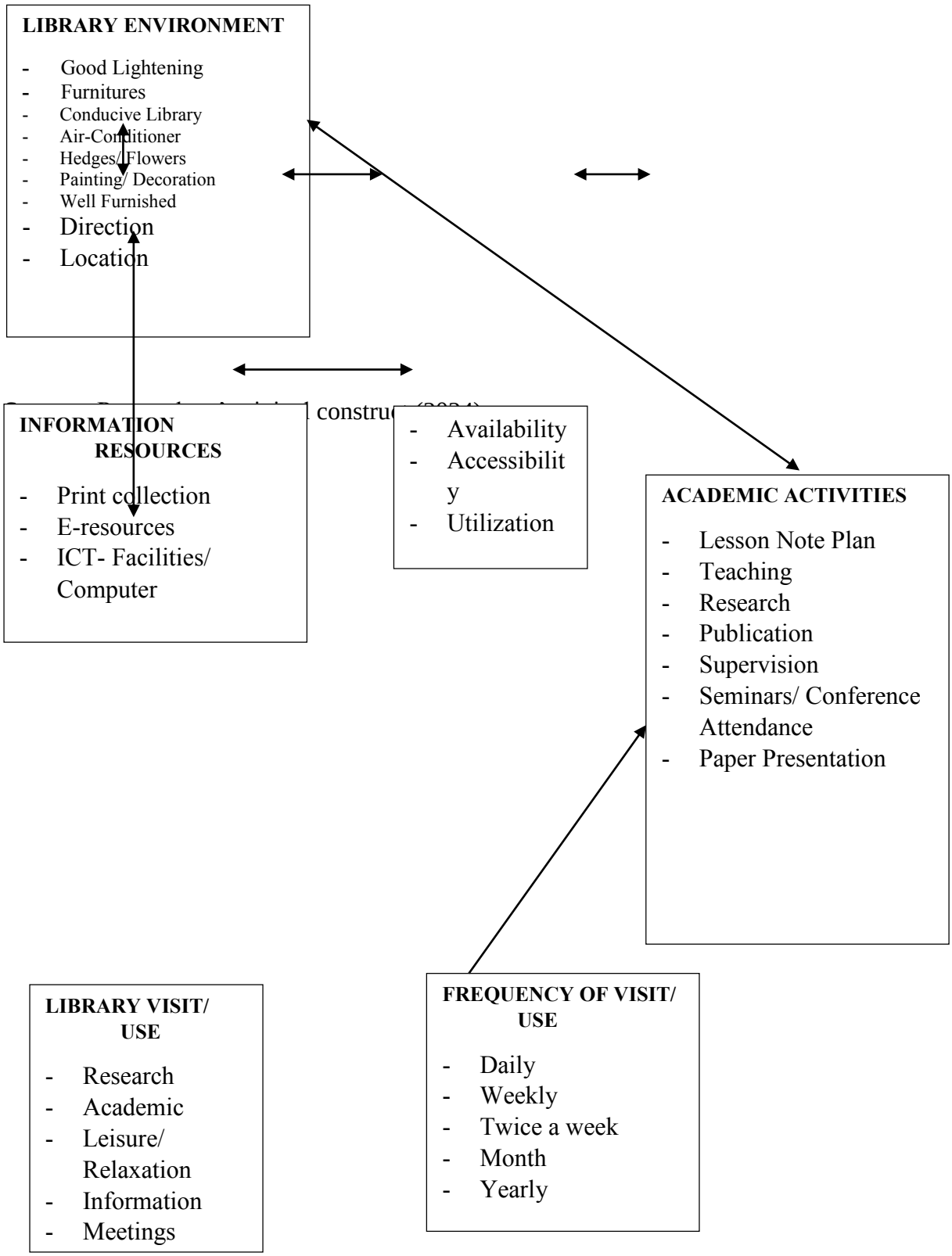
The study was designed to provide answers to the following research questions:

1. What are the types of information resources available for academic activities of teachers in Federal Government College, Minna, Nigeria?
2. What is the influence of available information resources on academic activities of teachers in Federal Government College, Minna Nigeria?
3. What is the influence of library use on academic activities of teachers in Federal Government College, Minna Nigeria?

4. What is the influence of library environment on academic activities of teachers in Federal Government College, Minna, Nigeria?

LITERATURE REVIEW

Conceptual Framework



The schema/model shows both the independent and the dependent variables of the study. The independent variables are the information resources, use and library environment, while the dependent variable is the academic activities carryout by teachers to include: lesson note plan, teaching, research, publication, paper presentation supervision and seminar/conference attendance respectively.

Adequate information resources in whatever format must be acquired and made available through access tools (catalogue, OPAC, bibliographies, abstracts. Library environment plays a vital role in the academic activities of teachers as a friendly library environment in terms of lightening, air-condition, decoration, well furnished, direction/guides as well as an effective discharge of academic activities by teachers. Library visit and use for research academic; leisure and information need as well as meetings friendly and making school library venue for meetings (PTA, teachers, etc.). Library visit and use for these purposes could be a daily, weekly, twice a week, month or yearly and all these determine the academic activities of teachers.

Ranganathan's Law of Library Science

Library use and library services are grounded on a popular theory by S.R. Ranganathan (1931) commonly known as the five laws of library science. Ranganathan's Five Laws of Library Science have been influential in shaping library practices and policies. They emphasize the user-centric nature of libraries, the importance of efficient operations, and the need for libraries to evolve to stay current in an ever-changing information landscape. These laws continue to guide librarians and library professionals in their mission to serve their communities and promote access to knowledge and information. This theory details the basic principles of operating a library and they are: The interpretation of this theory is that there should be access to library collection, matching the right book to its user(s) and that every book has a potential reader. However, libraries are enjoyed minimize time and effort to guaranty access use collections by the users. The current trend shows the migration of libraries to information technology era.

Review of Empirical Literature

Who-Bethels, Nwayor and Dyikuk (2022) conducted a study to determine the availability and utilization of technology-based facilities for teaching English Language continuous writing in secondary schools in Plateau State Nigeria. Four research questions and two null hypothesis were formulated. Descriptive survey was adopted with a population of 2,063 English Language teachers in 284 public secondary schools in Plateau State. A sample size of 205 teachers was drawn using multi- sampling technique. Data collection instrument used was the questionnaire, while mean and standard deviation as well as t-test were used in the analysis of data and testing of null hypothesis respectively. Results showed that insufficient availability and non-utilization of the available facilities. Technophobia, non-interest in the use of Internet facilities, power supply, use of traditional form of teaching and non-utilization of technology based-facilities were the challenges. There was significant difference between male and female teachers on the extent of utilization of technology-based facilities.

Anumkna *et al.,* (2021) conducted as research to determine the impact of environment pollution on school working resources in Imo State with particular emphasis on Ohaji/Egbema Local Government Area. Five research questions and two hypotheses were formulated. The study adopted survey design while target population consist of 3,400 students and 76 teachers in 17 secondary schools. A sample size of 359 respondents (300 students and 59 teachers). Rating scale questionnaire was used while mean and standard deviation as well as pearson product

moment correlation and Z-test were used to provide answers to research questions and to test the null hypothesis respectively. All 359 copies of questionnaire were completed and returned in usable form for the analysis. Results showed that gad flares were responsible for damage to school library collection, while temperature is responsible in discoloration of books and cracking plastic materials. The study recommended that air conditioners be installed in all the school libraries to reduce high temperature.

Ahmad and Saka (2021) examined the role of school libraries in education achievement of Junior Secondary School Students in Bosso Local government area in Niger State. Three research questions were formulated and include variables such as available collection, library use and challenges, and the role of school libraries. Descriptive research was adopted with target population of all students in 13 Junior secondary schools in Bosso LGA. Multi-stage sampling technique was adopted to randomly select 120 students from eight schools. Check list and structured questionnaire were data collection instruments used, while tabulation, mean and standard deviation was used to analyse data. The study discovered availability of both printed and electronic resources with the absence of video, projector and computer. There has been an increase in literacy level and educational achievement of students through the use of school libraries respectively. It recommends collaboration among state ministry of education, state universal basic education and Local Government Area (LGA) towards adequate funding and ensuring conducive environment.

Examining the influence of information resource availability, accessibility and use on research productivity among lecturers of Ibrahim Badamasi Babaginda University Lapai through pilot study, Mohammed, Udensi and Saka (2023) adopted five research questions using variables such as availability: extent of accessibility and use as well as influence of those variables on research productivity. One Null hypothesis was formulated design with population of 379 lecturers and 40 sample size of 40 lecturers were used for the study. Checklist and structured questionnaire were the data collection instruments used. The study show that information resources were accessed though there was epileptic power supply. There was significant relationship between availability of information resources and research productivity of lecturers. The study recommended the provision of digital resources and stand by generating plants.

Yaki, Saka and Sarki (2023) investigated the perception, access and use of electronic resources in teaching among lecturers in faculty of education in the three public universities in Niger State, Nigeria. The study was guided by three research questions indicating the perception level of accessibility and use as three variables in the study. Using descriptive survey design in a population of 200 lecturers, 102 was selected for the study, structured questionnaire was designed to captured the three research questions. Five post light scale instrument was validated and pilot- tested given reliability coefficient of 0.72, 0.070 and 0.74 using cronbach Alpha. Mean and standard deviation was used to analyse data while bench mark for accepting and rejecting was 3.00 and above and less than 3.00 respectively. Results show that lecturers in faculties/ school of education use e-resources for teaching though there were low accessibility to and use of e-resources on the part of lecturers. The study recommended that management of public universities should organize regular staff development programs for lecturers on instructional practices.

Methodology

Case study type of descriptive survey was adopted for this study (Umoru 2022) using only Federal Government College Minna library to find out the influence of availability, use of information resources and library environment on academic activities of teachers in. Population of the study comprises teaching staff, while 40 teachers were used for pilot study. Therefore, the population comprises 40 teachers in FGC Minna specially use for pilot study. Therefore, purposive and convenience sampling were used in pilot study (Okeke, Olise & Eze, 2022)

Checklist and structure questionnaire were used in data collection on available or otherwise various information resources; while structured questionnaire was used to find the perceived influence of availability, use of information resources and library environment on academic activities of teachers respectively. Frequency counts, mean and standard deviation (descriptive analysis) was used to analyse data. The criterion mean range i.e. 1-1.9 low, 2-2.5 moderate, 2.6-3.0 high, and 3.5-4 very high respectively.

Results and Disussion

Response rate showed the administration of the 40 copies of questionnaire with respect to the research question/variables on availability of information resources, perception of availability, and use of information resources as well as library environment in relation to academic activities of teachers in FGC Minna. The 40 copies of questionnaire were correctly filled, returned used for the analysis.

Table 1 showed the respondents by demographic information such as gender, highest educational qualification and teaching subjects respectively.

Table 1: Respondents by Demographic information

Gender	Frequency	Percentage (%)
Male	23	58
Female	17	52
Total	40	100
Educ Qualifications.		
First Degree	27	67.5
Master Degree	06	15
NCE	06	15
Qualification not stated	01	2.5
Total	40	100
Teaching subjects		
English Lang.	05	12.5
Mathematics	05	12.5
Biology	04	10
Civic Education	04	10
Economics	04	10
Inf. Com.Tech.	03	7.5
Chemistry	02	5
Geography	02	5
Physics	02	5
Agric. Science	01	2.5
Accounting	01	2.5
Christian Rel. Studies	01	2.5
Home Economics	01	2.5

History	01	2.5
Literature-in-English	01	2.5
Introductory Technology	01	2.5
Physical Health Educ.	01	2.5
Social Studies	01	2.5
TOTAL	**40**	**100**

Respondents by gender shows male response rate (27) were higher than their female counterpart of (13) revealing that male teachers perceive and patronize school library resources than the female teachers.

The table revealed that 27 (67.5 %) of the respondents obtained Bachelor degree in various subjects/ fields with highest qualification was master degrees and NCE 06 (15 %) despite the fact it is the minimum teacher's qualification for teaching primary schools. Teachers at FGC Minna, however, strive to obtain Bachelor and Master's degree.

Respondents by teaching subjects showed that 10 of the respondents teaches English Language and Mathematics respectively being the important subjects to be passed at credit level in WAEC, NECO, NABTEB examinations. It is assumed that these categories of the subject teachers patronised school library to meet their information research and teaching needs. Lowest number of the subject teachers taught Agricultural Science, Accounting, CRS, Home Economics, History, PHE, and Literature-in-English, social studies as the supporting subjects for WAEC, NECO, and NABTEB examinations respectively.

Table 2: Types of information resources available in Federal Government College Minna library

S/N	Information Resources	Available	Not Available
1.	Story Books (Fictions)	✓	
2.	Textbooks on various subjects (Non-Fiction)	✓	
3.	e-resources	✓	
4.	Journals	✓	
5.	Newspaper	✓	
6.	Magazines	✓	
7.	Government Documents	✓	
8.	Radio, Television & Video	✓	
9.	Television	✓	
10.	Video Sets	✓	
11.	Reference collection	✓	
12.	Atlas/Maps/Globes/Chart	✓	

13.	Manuscript	✓	
14.	Research Projects (Dip, HND, Degree/Higher Degree	✓	
15.	Computer	✓	
16.	Special Collection (for cripple, deaf and dumb etc)		✓

Table 2 shows that with exception of S/N 16 on special collection that is not available in FGC Minna Library, all other collections (print and non-print) are available for consultation by teachers. This show that inclusive education is not given priority in FGC Minna.

Table 3: Perceived influence of availability of information resources on academic activities of teachers.

S/N	Student	SA	A	D	SD	FX	X	STD
1	Information resources available in college library have enhanced my academic activities generally	16	22	2	0	132	3.30	.732
2	Textbook and journals available in my teaching subject have greatly assisted me in planning lesson note	19	4	13	4	118	2.95	1.108
3	Preparation of lesson note was efficiently carried out with the available and relevant information resources in school library	20	12	5	3	129	3.23	.947
4	Available information resources were-well arranged on shelves my research work	16	13	7	4	121	3.03	1.000
5	Information resources available in school library have assisted and encouraged me to participate in seminar and conference paper presentations	21	2	12	5	119	2.98	1.165
6	Computer connected to internet and e-resources in school library have helped me in conducting practical teaching	19	4	12	5	117	2.93	1.141
7	Relevant books journals/instructional materials available in school library have helped me in scholarly publications.	12	8	15	5	132	3.30	.723
8	Special and inclusive collections available in school library has assisted me in teaching students with disabilities	16	22	2	0	118	2.95	1.108

The table 3 on users' perception of the influence of the availability of information resources on academic activities of teachers revealed that the availability and relevance of print collections have enhanced the academic activities of teachers with the mean score of 3.30 and that low mean score of 2.95 show signifies disagreement with the students that the available textbooks, journals, special and inclusive collection have assisted teachers in lesson note plan and teaching students with disabilities respectively. This is contradiction between non-availability of special collection in Table 2 and Table 3 respectively. The respondents might be ignorant on what is special collection.

Table 4: Perceived influence of the use of information resources on Academic Activities of Tea

Table 4: reveals that there are seven items listed to determine Significant influence of the use

S/N	ITEMS	SA	A	D	SD	FX	X	STD
1.	I use books and journals in the preparation of lecture note	13	6	9	12	100	2.50	1.240
2.	E-resources are consulted to meet research needs	1	6	6	27	61.2	1.53	.847
3.	I use information resources in library on daily basis for teaching	14	4	10	12	100	2.50	1.261
4.	Information resources are consulted for preparation to attend and present paper(s) at workshops and conference	12	13	3	12	105	2.63	1.213
5.	Globes, charts, maps and other instructional materials in library are used for teaching students Practical in my teaching subjects	13	7	8	12	101	2.53	1.240
6.	Utilization of available information resources in library does not in any way enhance my research activities	15	5	8	12	103	2.58	1.279
7.	I do use library collection for academic activities	12	3	12	13	94	2.35	1.231

of Information resources on academic activities of teachers perceived in Federal Government College Minna. The results showed mean scores ranging between 1.53 and 2.63 respectively, with most of the respondents agreeing that information resources are consulted for preparation to attend and present paper(s) at workshops, seminars and conferences. While others disagree to the statement on consultation of E-resources to meet research needs of teachers.

Table 5: Influence of library environment on academic activities of Teachers

S/N	STATEMENT	SA	A	D	SD	FX	X	STD
1. 1.	Proximity of library to my office has helped in the conduct of research activities	20	4	5	11	113	2.83	1.318
2. 2.	Lighting in library enhances lesson note and lecture note preparation	27	5	8	0	131	3.28	1.198
3. 3.	Air – conditioners available in library do not function well and have been discouraging me from making preparation for seminar and conference attendance and paper presentation	9	15	7	9	104	2.60	1.081
4.	Decoration of college library with paints and flowers have encouraged me to conduct research	11	14	4	11	105	2.63	1.170
5.	Available space in library enables me to present seminar and workshop papers	21	9	3	7	124	3.10	1.150

6.	Furniture available in library does not encourage teachers to conduct research	16	9	11	4	117	2.93	1.047
7.	Library environment determines the type of academic activities to be undertaken by teachers	24	5	4	7	126	3.15	1.189

Table 5 reveals that there are seven items listed to determine the Influence of library environment on academic activities of teachers in Federal Government College Minna Nigeria. Results showed mean scores ranging between 2.60 and 315 respectively, with all the respondents agreeing that there was Influence of library environment on academic activities of teachers in the study area.

Discussion of Findings

In response to research question one, data analysis was carried out and the result showed the availability of almost all the information resources (fiction, non-fiction, electronic materials, and manuscripts, research works and computer) although special collections were not available. This shows that special collection and inclusive education is not given priority in the college curriculum. This finding contradicts that of Ahmed and Saka (2021) whose result showed availability of both print and non-print collection with the absence of video, projector and computer respectively.

Results to research question two on perceived influence of availability of information resources on academic activities of teachers indicated mean scores to be above average revealing a positive perception on the part of teachers. This finding contradicts the findings by Who-Betheles, Nwayor and Dyikuk (2022) as the result showed insufficient availability and non-utilisation of the available collection couple with technophobia facilities respectively.

Perceived influence of the use of information resources on academic activities of teachers in FGC Minna being the research question three showed the overall result that teachers use information resources to positively pursue their academic activities. However, teachers world-wide are expected to plan lecture note, update their knowledge through regular training, embark on research with the support of reading materials being stocked in libraries. This finding contradicts the research findings by Yaki, Saka and Sarki (2023) as the collaborative researchers reported that even though lecturers use e-resources in teaching, the challenge is on the part of ineffective accessibility to e-resources.

Research question four sought to find out the influence of library environment on the academic activities of teachers in FGC Minna. Result showed both the positive and negative influence of library on teachers' academic activities and these findings also contradicts that of Anumkua (2021) reported that glad flames and temperatures are responsible for the reduction in quality of library collection through damage and discoloration resources respectively.

Conclusion

The study concludes that with availability, use of information resources and influence of environment can have effect on academic activities of teachers in FGC Minna depending on the situation on ground which could be management policy on the use of school library, teachers can patronise library and its collection regularly or otherwise.

Recommendations

The study recommends that the

1. Authority of the Federal Government College Minna should strive to acquire special collections to take care of students with disabilities in the area of deaf and dumb, cripple, visually –impaired to enable school library support inclusive education.
2. The authority of Federal Government College Minna should make library environment conducive for patronage through decoration of library with flowers and hedges, painting, good lightening, air-conditioner and library be located in the environment far from noisy area as well as proximity to staff room respectively.

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ADAPTATION OF SUSTAINABLE TVET PRACTICES TO MITIGATE ECONOMIC CHALLENGES IN NIGERIA

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Abstract
This study examines the adaptation of sustainable practices in Technical and Vocational Education and Training (TVET) to address economic challenges in Nigeria. It aims to evaluate the impact of curriculum relevance and alignment on employment and job creation, the role of industry-academia collaboration in boosting economic resilience and competitiveness, and the effect of sustainability and innovation in training methods on skill development and workforce productivity. Using a descriptive survey research design, the study focused on third-year students from three departments within the School of Vocational and Technical Education at Kwara State College of Education, Ilorin—Agricultural Science Education, Business Education, and Technical Education. A sample of 120 students was selected for the study, and regression analysis was performed to test three hypotheses at a significance level of 0.05.The findings showed that curriculum relevance and alignment ($\beta = 0.336$, $P < 0.05$) significantly predict employment and job creation. Industry-academia collaboration ($\beta = 0.236$, $P < 0.05$) was found to positively impact economic resilience and competitiveness. Additionally, sustainability and innovation in training methods ($\beta = 0.226$, $P < 0.05$) were shown to enhance skill development and workforce productivity. The study concludes that adapting sustainable TVET practices is crucial for mitigating Nigeria's economic challenges. Recommendations include strengthening collaboration between educational institutions and industries to align curricula with market demands, focusing on training in green skills and sustainable technologies, and promoting public-private partnerships to enhance the quality and reach of TVET programmes.

Keyword: Sustainable TVET, Economic Resilience, Green Skills, Industry Collaboration, Workforce Development

Introduction
Nigeria, as one of Africa's largest economies, faces a range of economic challenges that impede its growth and affect its citizens' well-being. A major issue is its heavy reliance on oil, which constitutes a significant portion of government revenue and export earnings. This dependence makes Nigeria vulnerable to global oil price fluctuations, leading to budget deficits, currency devaluation, and economic instability when prices fall (Oyinlola, 2022). Additionally, the economy's over-reliance on oil stifles diversification, hindering growth in other sectors such as agriculture, manufacturing, and services.

Furthermore, unemployment and underemployment are persistent problems in Nigeria. Despite a young and expanding labour force, the economy struggles to create enough jobs. The mismatch between the education system's output and the labour market's demands exacerbates this issue. High unemployment contributes to poverty, social unrest, and crime, further destabilising the economy (National Bureau of Statistics, 2021). Chronic inflation erodes consumer purchasing power and raises the cost of living, driven by supply chain disruptions,

exchange rate volatility, rising import costs, fuel price hikes, and food insecurity. These factors disproportionately impact low-income households and increase inequality.

Inadequate infrastructure, particularly in transportation, energy, and healthcare, further impedes economic growth. Poor road networks, unreliable power supply, and inadequate healthcare facilities limit industrialisation, reduce productivity, and deter foreign investment. The power sector's frequent outages and insufficient generation capacity result in high operational costs for businesses and restrict the country's industrial output.

Addressing these economic challenges requires sustainable Technical and Vocational Education and Training (TVET) practices. Aligning TVET with economic demands can bridge the skills gap, enhance workforce productivity, and promote economic resilience. Sustainable TVET practices involve integrating green skills into curricula, preparing individuals for sectors like renewable energy, waste management, and sustainable agriculture (Okoye *et al.,* 2020). This approach not only fosters economic resilience by adapting to industry needs and technological advancements but also promotes inclusive growth by providing marginalised groups with access to education and training, thereby reducing inequality and contributing to broader economic stability and development in Nigeria.

Statement of the Problem

Nigeria faces persistent economic challenges such as high unemployment, poverty, and a widening skills gap. Although Technical and Vocational Education and Training (TVET) have potential to address these issues, the current system struggles to meet the evolving demands of the global and local labour markets. This misalignment results in a workforce ill-equipped for industry needs, perpetuating unemployment and underemployment. The core issue is the insufficient integration of sustainable practices within TVET programmes, which hinders the development of graduates with skills essential for economic growth, innovation, and environmental stewardship. There is an urgent need to adopt sustainable TVET practices to address these challenges and foster long-term development in Nigeria.

Objectives of the Study

This research is based on the assumption that adaptation of sustainable TVET practices will mitigate economic challenges in Nigeria. Specifically, it seeks to:

i. examine the impact of curriculum relevance and alignment on employment and job creation in Nigeria;
ii. explore the impact of industry-academia collaboration on economic resilience and competitiveness in Nigeria; and
iii. investigate the impact of sustainability and innovation in training methods on skill development and workforce productivity in Nigeria.

Research Questions

1. What is the impact of curriculum relevance and alignment on employment and job creation in Ilorin, Kwara State?
2. What is the impact of industry-academia collaboration on economic resilience and competitiveness in Ilorin, Kwara State?
3. What is the impact of sustainability and innovation in training methods on skill development and workforce productivity in Ilorin, Kwara State?

Research Hypotheses

Ho1: Curriculum relevance and alignment has no significant impact on employment and job creation in Ilorin, Kwara State.

Ho2: Industry-academia collaboration has no significant impact on economic resilience and competitiveness in Ilorin, Kwara State.

Ho3. Sustainability and innovation in training methods has no significant impact on skill development and workforce productivity in Ilorin, Kwara State.

Methodology

The study used a descriptive survey research design with a 15-item questionnaire on a five-point scale to gather data. The target population consisted of Year III students from the Agricultural Science Education, Business Education, and Technical Education Departments at Kwara State College of Education, Ilorin, who had completed industrial training. A sample of 120 respondents was selected from these departments. The questionnaire, rated from Strongly Agree (5) to Undecided (1), had a reliability score of 0.86 based on Cronbach Alpha from a pilot study. Research hypotheses were tested using Regression analysis at a 0.05 significance level.

Results

Ho1: Curriculum relevance and alignment has no significant impact on employment and job creation in Ilorin, Kwara State.

Table 1:

Multiple Regression Analysis showing the independent relationship of curriculum relevance and alignment and employment and job creation

Variables	Unstandardised Coefficient		Stand. Coefficient	t	Sig. p
	B	Std. Error	Beta		
(Constant)	21.275	11.348		1.875	0.000
Curriculum relevance and alignment	0.437	0.109	0.336	3.998	0.000
Employment and job creation	0.186	0.120	0.230	1.547	0.024

Table 1 indicates that both curriculum relevance and alignment ($\beta = 0.336$, $P < 0.05$) and employment and job creation ($\beta = 0.230$, $P < 0.05$) are significant independent predictors of the adaptation of sustainable TVET practices in Ilorin, Kwara State. These factors impact TVET's ability to address economic challenges in Nigeria.

Ho2: Industry-academia collaboration has no significant impact on economic resilience and competitiveness in Ilorin, Kwara State.

Table 2:

Multiple Regression Analysis showing independent relationship of industry-academia collaboration and economic resilience and competitiveness in Ilorin

Variables	Unstandardised Coefficient		Stand. Coefficient	T	Sig. p
	B	Std. Error	Beta		
(Constant)	21.275	11.348		1.875	0.000
Industry-academia collaboration	0.326	0.104	0.236	2.876	0.000

Economic resilience and competitiveness	0.173	0.110	0.130	1.423	0.022

Table 2 shows that industry-academia collaboration (β = 0.236, P < 0.05) and economic resilience and competitiveness (β = 0.130, P < 0.05) are significant independent predictors of applying TVET to address economic challenges in Nigeria. This suggests that collaboration between industry and academia impacts TVET's effectiveness in Ilorin.

Ho3. Sustainability and innovation in training methods has no significant impact on skill development and workforce productivity in Ilorin, Kwara State.

Table 3:
Multiple Regression Analysis showing independent relationship of sustainability and innovation in training methods and skill development and workforce productivity in Ilorin

Variables	Unstandardised Coefficient		Stand. Coefficient	T	Sig. p
	B	Std. Error	Beta		
(Constant)	21.275	11.348		1.875	0.000
Sustainability and innovation in training	0.298	0.114	0.226	2.676	0.000
Skill development and workforce productivity	0.103	0.120	0.150	1.313	0.022

Table 3 reveals that sustainability and innovation in training (β = 0.226, P < 0.05) and skill development and workforce productivity (β = 0.150, P < 0.05) are significant independent predictors of applying TVET to address economic challenges in Ilorin. This indicates that innovative training methods enhance sustainable TVET practices in the region.

Discussion of Findings
Findings indicate that curriculum relevance and alignment (β = 0.336), employment and job creation (β = 0.230), industry-academia collaboration (β = 0.236), economic resilience and competitiveness (β = 0.130), sustainability and innovation in training (β = 0.226), and skill development and workforce productivity (β = 0.150) are key predictors of adapting sustainable TVET practices in Nigeria.

Conclusion
The data analysis concludes that adapting sustainable Technical and Vocational Education and Training (TVET) practices is crucial for Nigeria to address economic challenges. Aligning TVET programmes with green technologies, fostering industry-academia partnerships, and promoting innovative training methods are essential. This approach equips the workforce with skills for economic resilience and competitiveness, preparing professionals to meet current and future industry demands, and supporting the long-term sustainability of the automobile technology sector.

Recommendations
TVET institutions in Nigeria should collaborate with industries to develop curricula that meet current market demands and future trends. Focusing on high-demand skills like digital literacy, renewable energy, and advanced manufacturing will better equip graduates for economic resilience, helping to reduce unemployment and underemployment. TVET programmes should also emphasise green skills and sustainable technologies, including renewable energy and waste management, to support Nigeria's transition to a greener economy. Public-private partnerships are essential for funding, infrastructure, and expertise to modernise TVET

institutions, ensuring training remains relevant and effective in driving economic growth and innovation.

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EXTENT OF ELECTRONIC INFORMATION RESOURCES UTILISATION AS CORRELATES OF JOB PERFORMANCE OF LEGAL PRACTITIONERS IN NORTHERN NIGERIA

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Abstract
This study investigated the extent of electronic information resources utilisation as correlate of job performance among legal practitioners in Northern Nigeria. The study was guided by 1 research objective, 1 research question and 1 research hypothesis. The population of the study consisted of 2,150 legal practitioners in 20 in Northern States including Abuja. The study employed descriptive survey research design to elicit information from the respondents. Multi-stage sampling procedure was used for selecting sample size of 362 legal practitioners from the population of 2,150 within the 20 states of Northern Nigeria including Abuja. The instruments used in collecting data are observation checklist and questionnaire. 362 copies of questionnaire were administered out of which 346 copies were filled, returned, and found useful. Data were analysed using descriptive and Inferential statistics. The study indicated that the extent of utilisation of electronic information resources by legal practitioners for optimal job performance in Northern Nigeria is low, with a grand mean score of 2.43. Hypotheses testing showed that There was an indication that the effective utilisation of electronic information resources by legal practitioners positively influenced their job performance in Northern Nigeria. Based on the findings from the study regarding the job performance and utilisation of electronic information resources of legal practitioners in Northern Nigeria, conclusion is drawn, and recommendations were provided.

Keywords: Electronic information resources, Job performance, Legal Practitioners, Nigeria, Utilisation

Introduction
The legal profession is a well-known and significant field with a global reach that significantly depends on up-to-date and pertinent information resources for efficient job performance. A lawyer's ability to present evidence and argue facts effectively rests on their ability to obtain reliable information. The Law Society of Western Australia (2017) highlights how crucially important electronic information resources are to legal practitioners for their job performance. In Nigeria, a duly trained professional lawyer who has fulfilled the educational requirements, cleared the appropriate examination and gained admission to the Bar is immediately registered with the Supreme Court.

The degree and caliber of an employee's performance in carrying out their duties is known as job performance, and it plays a critical role in determining whether an organization

succeeds or fails in the face of swift change. To determine an employee's capacity for job completion, it is imperative to measure, monitor, and assess their performance on an ongoing basis. Individuals should place importance on job performance since it can result in job satisfaction. As per Minh-Loan (2020), work performance pertains to the actions or conducts that facilitate the attainment of an organization's goals. It signifies the degree to which a person or a group fulfills the job requirements in accomplishing the organization's objectives. The way legal information resources are processed, arranged, saved, accessed, used and distributed has changed dramatically because of the advent of digital technology. Electronic resources such as e-books, e-journals, e-theses, and e-dissertations have emerged because of the shift from traditional media to electronic and digital formats. Geographical boundaries are eliminated as these resources are kept and made available globally, meeting a wide range of research demands. But for legal professionals to do their jobs well, these tools should be available and used by them. Electronic information resources will present challenges as well as opportunities for legal practitioners, as highlighted by Omekwu (2016).

Statement of the Research Problem

Printed information resources have been in use for centuries, tracing back to the advent of written languages. In contrast, electronic resources are a relatively recent development. The advent of information and communication technology (ICT) and electronic publishing has revolutionized the availability of information, transforming content traditionally found in print materials such as books, journals, and theses/dissertations into electronic formats. This shift is particularly significant for legal practitioners, as access to electronic information resources is crucial for effective job performance.

However, Moruf and Adeleke (2018) have shown that most of the legal practitioners' use of print information resources was limited to case defense, problem solving, issue investigation, and solution creation to assist and foster new understanding in their work performance. This is a problem presently because there are a lot of electronic information resources available and many of them are released online rather than in print. It has been noted that the propensity of Nigerian legal practitioners to use printed information resources rather than electronic ones may be due to the latter's unavailability or insufficiency (Yaliz-Solmaz and Aydin, 2016; Umar and Sokari, 2020). Considering this, the researchers made an effort to investigate the utilization of electronic information resources as correlates of legal practitioners' job performance in Northern Nigeria.

Aim and Objective of the Study

The aim of the study is to investigate the utilisation of electronic information resources as correlates of legal practitioners' job performance in Northern Nigeria. The specific objective is to:

1. identify the extent of utilisation of electronic information resources by legal practitioners on their job performance in Northern Nigeria;

Research Question

1. What is the extent of utilisation of electronic information resources by legal practitioners on their job performance in Northern Nigeria?

Research Hypotheses

The following null hypothesis will be tested at 0.05 level of significance:

1. There is no significant relationship between utilisation of electronic information resources by the Legal Practitioners on their Job Performance in Northern Nigeria.

Significance of the Research

It is anticipated that the results of this study will help legal professionals by increasing their accessibility and use of electronic information resources for their work. Additionally, it will teach them a positive outlook and comprehensive understanding of electronic information resources, which will help them perform their job better. It is expected that the results will provide guidance to legal practitioners regarding the necessity and significance of electronic information resources. This will allow them to investigate the advantages of electronic information resources and optimize their use for job performance.

Scope of the Study

This study's content focused on how legal practitioners' use of electronic information resources relates to their job performance. The scope includes legal practitioners' access to electronic information resources and how it influences their job performance and the caliber of work produced by them.

The geographical coverage includes all of the Nigerian states' northern ministries of justice. Federative Territory Abuja, Adamawa, Bauchi, Benue, Borno, Gombe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Kogi, Kwara, Nasarawa, Niger, Plateau, Sokoto, Taraba, Yobe, and Zamfara are the |States that make up the federal territory.

Literature review

According to Steel et al. (2019), job performance is generally described as actions or behaviors pertinent to organizational goals. These behaviors can be either unproductive or productive and should be considered as part of an employee's job performance. A more recent definition of job performance was found by Rhee et al. (2020) as the actions and results that employees take to further the objectives of an organisation. Thus, task performance and contextual performance should be included in job performance, which is defined as the efficacy of individual behaviors that support organisational goals.

Birhane's (2016) study investigated the factors affecting job performance among employees in the ABC Group of Companies, utilizing a mean score measurement scale.

The findings revealed that 32% of the respondents reported high job performance, while 26% of them exhibited moderate performance. Additionally, 8% of the respondents expressed neutral sentiments regarding various aspects of their job performance. However, 34.7% of them reported low job performance, with an average mean value of 3.34.

The study further highlighted that 67% of the respondents were dissatisfied with the current training practices, while nearly 30% held positive attitudes towards them. The mean score of 2.38 indicated that training had a low impact on job performance. Similarly, the average mean score for motivation was 2.41, reinforcing the overall assessment of low job performance within the organization.

Numerous empirical research has demonstrated that legal practitioners' usage of electronic resources is a useful strategy for boosting accessibility, work performance and convenience while discharging their duties. Oyediran (2020), for instance, concurred that e-resources make it easier to acquire pertinent and up-to-date material for learning, work performance and research development. Conversely, several research on electronic information resources have been undertaken, and some of these studies still show that most of these resources are

either underutilised or not used at all, and that there is little or no public awareness of their use. Researches indicated a growing trend in the use of electronic information resources among legal practitioners. A study by Lawal *et al.* (2019) investigated the utilization of electronic legal resources among legal professionals in Nigeria. The study found that a significant majority of legal practitioners used EIRs frequently, with over 75% indicating that electronic legal databases were an essential part of their research process. This study revealed that the use of electronic resources has become integral to the daily activities of legal professionals, aiding in quicker and more effective legal research.

Research Methodology

This study adopted a survey research design. This is because survey research is effective and efficient in gathering relevant data. The study's population comprised of 2,150 legal practitioners across 20 Northern States, including the Federal Capital Territory (FCT), Abuja. These states are Abuja (FCT), Adamawa, Bauchi, Benue, Borno, Gombe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Kogi, Kwara, Nasarawa, Niger, Plateau, Sokoto, Taraba, Yobe, and Zamfara.

A multi-stage sampling technique was employed to determine a sample size of 362 participants. Initially, a stratified sampling technique was used, dividing the population into mutually exclusive groups, or strata. After which simple random sampling through balloting was conducted to select three states from each of the three geo-political zones in Northern Nigeria. Finally, proportionate sampling was used to determine the sample size from each selected state, resulting in 362 participants.

Data was collected using a structured questionnaire with a four-point Likert scale and an observation checklist. Descriptive statistics, including frequency counts, percentages, means, and standard deviations were used to analyze the data. A weighted mean of 2.5 was used as the threshold for decision-making regarding the variables studied. Variables were classified as high if the weighted mean exceeded 2.5, moderate if it equaled 2.5, and low if it fell below 2.5. Similarly, a variable was considered agreed upon if the weighted mean was greater than or equal to 2.5, and disagreed upon if it was less than 2.5.

Results

Research Objective: Extent of utilisation of electronic information resources by legal practitioners on their Job performance in Northern Nigeria. In identifying the extent of utilisation of electronic information resources by legal practitioners on their Job performance in Northern Nigeria, in response to the objective of the study, sixteen items were assessed. The opinions of legal practitioners were required on the items in relation to the research question, *"What is the extent of utilisation of electronic inforation resources by legal practitioners on their Job performance in Northern Nigeria?"* The decision was based on a benchmark mean of 2.5. Their responses are attained in mean and standard deviation as well as complete information were also provided in Table 1.

Table 1: Extent of Utilisation of Electronic Information Resources by Legal Practitioners on their Job Performance in Northern Nigeria

S/N	Variable Decision (Responses)	N	X	SD
1.	I use E-books for job performance	346	2.47	Low
2.	I use E-journals for job performance	346	2.25	Low

3.	I use Legal Databases for job performance	346	2.27	Low
4.	I use CD databases for job performance	346	2.36	Low
5.	I use Legal website for job performance	346	2.44	Low
6.	I use Open access legal information for job performance	346	2.73	High
7.	I use E-resources for job performance	346	2.36	Low
8.	I use E-newspaper for job performance	346	2.17	Low
9.	use E-magazine for job performance	346	2.41	Low
10.	I use E-projects for job performance	346	2.52	High
11.	I use E-thesis for job performance	346	2.28	Low
12.	I use E-dissertations for job performance	346	2.10	Low
13.	I use E-reports for job performance	346	1.98	Low
14.	I use Audio Visual material for job performance	346	2.79	High
15.	I use Internet resource for job performance	346	3.30	High
16.	I use E-encyclopedias for job performance	346	2.52	High
	Grand Mean		**2.43**	**Low**

Source: Author's computation (2023) Key: VH = Very High, H= High, L =Low, VL = Very Low, N= number of retrieved questionnaires, X= Mean, SD= standard deviation and Weighted mean **(**2.50)

Table 1 illustrates the extent of utilisation of electronic information resources by legal practitioners and influences on their job performance in Northern Nigeria. The findings indicated a generally low level of utilisation, as reflected in the overall grand mean of 2.43. Notably, the highest mean value of 3.30 and a standard deviation of 0.826 were recorded for the statement "I use Internet resources for job performance." Similarly, the mean values for the statements "I use Audio Visual material for job performance," "I use Open access legal information for job performance," and "I use Eencyclopedias for job performance" were 2.79 (SD 1.009), 2.73 (SD 1.026), and 2.52 (SD 1.013) respectively.

However, among the sixteen statements surveyed, only five demonstrated a high extent of utilization, while the remaining eleven indicated low utilisation levels. Specifically, the statement with the lowest mean value of 1.98 (SD 0.886) pertained to the utilisation of E-reports for job performance. Consequently, the overall grand mean value of 2.43 falls below the benchmark of 2.50, underscoring the limited extent of electronic information utilization among legal practitioners for effective job performance in Northern Nigeria.

Hypothesis

Ho: There is no significant relationship between utilisation of electronic information resources by the Legal Practitioners on their Job Performance in Northern Nigeria.

Table 2: Relationship between utilisation of electronic information resources by legal practitioners and their job performance in Northern Nigeria.

		Job Performance	Utilization of Electronic Information Resources
Job Performance	Pearson Correlation	1	
	Sig. (2-tailed)		000
	N	346	346
Utilization Electronic Information Resources	Pearson Correlation	.795***	1
	Sig. (2-tailed)	.000	
	N	346	346

*Correlation is *** Statistical significance at the 1 per cent levels, **Statistical significance at the 5 per cent levels. *Statistical significance at the 10 per cent levels (2-tailed). Computed by the researcher using IBM SPSS version 20(2023)*

Table 2 shows the relationship between utilisation of electronic information resources **by** legal practitioners and job performance in Northern Nigeria. It revealed a correlation coefficient (r) = 0.795 and P value = 0.000, (p > 0.05). The p-value, being less than 0.05, signifies statistical significance at the 5% level. Thus, there exists a strong relationship between utilisation of electronic information resources by legal practitioners and job performance in Northern Nigeria. Therefore, the hypothesis which states that there is no significant relationship between the utilization of electronic information resources by legal practitioners and their job performance in
Northern Nigeria is rejected.

Discussions of the Findings

The outcomes of this research point to a prevalent underutilization of electronic information resources, as evidenced by an overall average score of 2.43. Out of the sixteen statements evaluated, only five displayed a substantial level of utilisation, while the remaining eleveen indicated considerably low levels of utilization. Notably, the statement with the lowest mean score of 1.98 (with a standard deviation of 0.886) pertained to the utilization of E-reports to enhance job performance. Consequently, the overall average score of 2.43 falls short of the established benchmark of 2.50, highlighting the limited adoption of electronic information resources among legal practitioners in Northern Nigeria to effectively enhance their job performance.

This finding contrasts with the conclusions drawn by Abbas and Song (2020), who conducted a study investigating the accessibility and utilization of electronic information resources in Agricultural Research Institutes within Kaduna State. Their findings unveiled a robust accessibility to electronic information resources and a high rate of utilization for research endeavours. Research scientists gained access to pertinent electronic resources on the Internet through passwords provided by institute libraries, specifically for Agricultural CD-ROM usage in their research activities. Various resources, including E-books, E-Journals, online databases, and CD-ROM/DVD materials, were harnessed for Laboratory and Field Research

purposes, thereby ensuring the quality of their research. The overarching deduction from their research suggests that improved accessibility to electronic information resources and a higher rate of utilization significantly bolster research activities. The study further suggested that Agricultural Research

Institutes in Kaduna state should actively engage stakeholders to invest in ICT infrastructure, computer networks, and expand access points, ultimately enhancing networking facilities within these institutes.

Hypothesis: Relationship between utilization of electronic information resources of legal practitioners and their job performance in Northern Nigeria.

The study revealed that there was significant strong relationship between utilization of electronic information resources of legal practitioners and their job performance in Northern Nigeria with R=0.795 and p-value of 0.000< 0.05 level of significance. The correlation between utilization of information resources and job performance underscores the relevance of using information resources for effective job performance among legal practitioners.

The study revealed that there is a significant relationship between the utilization of electronic information resources and job performance among legal practitioners in Northern Nigeria which underscores the essential role of technology in shaping contemporary legal practice. By embracing digital innovation and leveraging electronic resources effectively, legal professionals in the region can not only enhance their individual performance but also contribute to the advancement of the legal profession.

The findings of this study corroborated with findings of Bashorun *et al.* (2022), who examined information literacy competence and the use of electronic information resources by undergraduates in the Faculty of Law, University of Ilorin, Nigeria. The study adopted a descriptive survey design. the study revealed a significant relationship between information literacy competence and the use of EIRs. And undergraduates in the Faculty of Law, University of Ilorin have information literacy competence and their use of EIRs is above average.

The findings from the later and former studies underscore the significance of fostering on promoting effective utilisation of electronic resources across various professions. By providing access to electronic information resources, organizations can empower professionals to enhance their job performance, drive productivity, and achieve better outcomes in their respective fields.

Summary of the Findings

The extent of utilization of electronic information resources by legal practitioners for optimal job performance in Northern Nigeria is low.

There is a significant relationship between utilisation of electronic information resources and legal practitioners job performance in Northern Nigeria.

Conclusion

The study concluded that based on the findings of the study there is need for legal practitioners to improve their use of e-resources for better job performance. Today most professionals cannot perform well in their works without use of ICT facilities. Legal

practitioners are not exempted. The study has also revealed that there is a significant relationship of legal practitioners. Thus therefore shows that increased use of electronic resources of legal would improve the effectiveness and efficiency of legal work in the studied region. This would address the low utilization rate of the legal practitioners studied. This is necessary in order to improve overall job performance of the legal profession in Northern Nigeria.

Recommendations

To address the low utilisation of electronic information resources by legal practitioners in Northern Nigeria, the following recommendations are proposed:

1. Organising regular training programs and workshops by the ministries of justice in Northern Nigeria and the nation as a whole to enhance the digital literacy of legal practitioners. These programs should focus on the effective use of electronic information resources, including databases, legal research tools and online libraries. Investment for better infrastructure to ensure reliable access to electronic information resources. This could include expanding Internet connectivity, providing access to relevant legal databases, and ensuring that electronic resources are readily available and user-friendly.

2. There is need for the ministries of justice to Launch awareness campaigns to highlight the importance and benefits of using electronic information resources in legal practice. These campaigns can be conducted through professional legal associations, law schools, and continuing education programs.

3. Finally, there is need for the government of Nigeria to advocate the development of policies that mandate the integration and use of electronic information resources in legal practice. This could include guidelines from legal regulatory bodies or recommendations from professional associations.

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IMPROVEMENT OF BUILDING INFRASTRUCTURAL FACILITIES FOR EFFECTIVE TEACHING AND LEARNING IN TECHNICAL COLLEGES IN NIGER STATE, NIGERIA

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Abstract
The study was designed to determine the improvement of building infrastructures facilities for effective teaching and learning in technical colleges in Niger State, Nigeria. Six research questions and six null hypotheses were formulated to guide the study. Relevant literatures in line with the objectives of the study were reviewed. Descriptive survey research design was employed for the study. The targeted population for the study was the targeted population for the study was 1,481 subjects comprising of 169 teachers and 1,312 TC III students from the five Government Technical colleges own by Niger State. A proportionate stratified random sampling technique was used to select 10% of 1,312 of TC III students which is 132 as sampled. The instrument used was questionnaire titled: "Building Infrastructures Facilities Improvement Questionnaire (BIFIQ)". The questionnaire was subjected to validation by three experts. One Lecturer from the Department of Industrial and Technology Education, Federal University of Technology Minna, and two from technical college in Niger State.The reliability coefficient of the instruments was established to be 0.82 using Cronbach Alpha statistics. Mean and standard deviation were used as statistical tools for answering research questions, while z-test was employed to test the null hypotheses of the study at 0.05 level of significance. The findings of the study revealed that all the classroom facilities need improvement for effective teaching and learning in technical colleges with a grand mean score of 4.31 and also all the hostel facilities need improvement for effective teaching and learning in technical colleges with a grand mean score of 4.35. Findings from the hypotheses revealed that there was no significant different between the mean responses of teachers and students on the classroom facilities that can be improved for effective teaching and learning in technical colleges in Niger State and also there was no significant different between the mean responses of teachers and students on the hostel facilities that nearer to improved for effective teaching and learning in technical colleges in Niger State. Based on the findings of the study, it was recommended that the state government should provide funds for technical colleges' managements to produce and maintain building infrastructures facilities that are capable of improving effective teaching and learning.

Keywords: Improvement, Building Infrastructural Facilities, Teaching and Learning, Technical Colleges

Introduction
Building infrastructures create enabling environment for the comfort and security of teachers, students and their properties in the technical colleges. According to Riley, *et al.* (2010), a building infrastructure is a relatively permanent encloses construction structure over a plot of land, having a roof, walls, window usually often more than one level. In order to achieve the laudable objectives of technical education, both State and Federal government spend billions of naira in developing the building infrastructures facilities such as block of classes, hostels, libraries, lecture halls, clinics, workshops, laboratories, and staff offices among others. The importance of building infrastructures to facets of human endevours cannot be

overemphasized. Douglas (2016) disclosed that building infrastructure can be referred to as shelter and support for building operations and equipment. Building infrastructures in the technical college are designed and constructed to provide not only shelters but also, be an environment where students and their teachers can leave, work and achieve their educational goal. According to Fatoye and Odusami (2019), the achievement of technical educational goal is threatened by the inability of building infrastructure facilities to certify teaching and learning needs.

Moreover, the poor building infrastructures facilities have significant relationship with the teaching and learning in technical colleges, can cause illnesses among students and their teachers, resulting in higher rate of absenteeism, less time in classroom, and ultimately reduced academic achievement (Fatoye & Odusami, 2019). Teachers and students in technical colleges deserve a safe, healthy environment and befitting building infrastructures which facilitate effective teaching and learning. According to Okolie (2011), building infrastructures in technical colleges are designed to facilitate learning process which involves knowledge transfer by providing conducive and user-friendly environment for academic activities. They constitute the entire school plan to which school administrators, teachers and students' harness, allocate and utilize for the smooth and efficient management for any educational institutions for the purpose of bringing about effective and purposeful teaching and learning. This implies that well-coordinated buildings in technical colleges of learning facilitate learning and affect the academic performance of students. Chan (2018) confirmed that students taught in building infrastructures environment with good condition of facilities has consistently have higher score across a range of standard tests such as befitting classroom facilities.

The classroom facilities are suppose to be warm and welcoming, and learning exercises are intentional, drawing in and huge attention of the users. Adequate number of classrooms should be available to the technical education programmes. Ideally, each fully equipped to sit not less than forty (40) students at a time should be available to each programme (National Board for Technical Education {NBTE}, 2014). Classrooms are supposed to be customized learning environments that are made to expand positive connections among students to students and students and their instructors. Students feel that they have a place in the school network, and their studentships are esteemed and respected; their legacy and foundations are seen as resources (Lezotte, 2010). Henry *et al.,* (2021) explained that the classroom environment influences student's and teacher's behavior in many different ways. The shape of spaces, furniture arrangements, and signs are physical cues that transmit silent messages, and both teachers and students will respond. These environmental conditions stimulate movement, call attention to some things, but not others, encourage involvement, and invite students to hurry or move calmly. This environmental influence is continuous, and how well it communicates with the users will depend on how well the environment is planned likewise the hostel facility in the school.

The hostel facility is an accommodation provided for boarding technical college students for housing. The hostel accommodation is conceived to keep students within the learning environment to facilitate ease of accessing the education facilities. Klis *et al.,* (2008) described it as a dwelling, residence close to school places with dual functions: living and private studying. A hostel in the tertiary institution is an establishment that is set up to accommodate students within the school premises. Hostels are built and furnished with building services such as water supply, plumbing and drainage system, electricity and electronic installation, security devices, fire prevention and firefighting equipment. The student hostel is an accommodation that is specifically designed to accommodate students, such as a 'live-in' residential college,

boarding house or other purpose built development containing student units with other combined ancillary facilities which includes; study areas, common room, rooms, communal lounge, laundry, disposal system, toilets and kitchens (Sharma, 2012). Students' accommodation in technical colleges in Nigeria is severely overcrowded. The main cause of this perennial problem is the increasing number of students being admitted, without a commensurate increase in the number of hostel facilities or even maintaining the one available for teaching (Agbola *et al*., 2021). It was on this basis, the study is set to determine the strategies of improvement of the building infrastructures facilities for effective teaching and learning in technical colleges in Niger state, Nigeria

Statement of the Research Problem

Effective teaching and learning can only take place where the building infrastructures facilities are in good condition, standard and adequate for the use by both the teachers and students. Kagara and Ibrahim (2017) pointed out that a well-built school infrastructure facility contributes to a sound learning environment, enhance the overall quality of schools, impact the educational experiences and delivers better educational outcomes. Some of technical colleges in Nigeria are experiences poor maintenance of building infrastructure facilities (Ugwu, *et al.,* 2018). Adedeji (2022) noted that building infrastructures facilities have to be maintained to facilitate effective teaching and learning, but this is not the case in some of the technical colleges in Nigeria. Some technical college students learn under unhygienic and dilapidated classrooms and workshops. The lack of maintenance of the building infrastructures facilities in technical colleges leads to their deplorable state which is affecting the teaching and learning process. According to Wanjobi (2019) that a lot of problems seem to be bedeviling the technical colleges system ranging from poor building infrastructures facilities, inadequate instructional materials, unqualified teachers, old and dilapidated building infrastructures there by making the teaching and learning ineffective. The implication of this development is that student learning experience will be hindered with lots of obstacles ranging from teacher-student discomfort, poor teacher-student interest, liter school environment and others which will possibly affect the attainment of the effective cognitive and psychomotor skills of the targeted students. It is on this basis that this research study was conducted this study to ascertain the mechanisms for improving the building infrastructures facilities for effective teaching and learning in technical colleges in Niger State, Nigeria.

Purpose of the Study

The purpose of this study was to seek the improvement of building infrastructural facilities for effective teaching and learning in technical colleges in Niger State.

While the objectives are to:

1. Determine the classroom facilities that can be improved for effective teaching and learning in technical colleges in Niger State
2. Determine on how the hostels facilities that can be improved for effective teaching and learning in technical colleges in Niger State

Research Questions

The following research questions will guide the study

1. What are the classroom facilities that can be improved for effective teaching and learning in technical colleges in Niger State?

2. What are the hostel facilities that can be improved for effective teaching and learning in technical colleges in Niger State?

Hypotheses

The following hypotheses were formulated and will be tested at 0.05 level of significance to guide the study

HO_1 There is no significant different between the mean responses of teachers and students on the improvement of classroom facilities for effective teaching and learning in technical colleges in Niger State

HO_2 There is no significant different between the mean responses of teachers and students on the improvement of hostels facilities for effective teaching and learning in technical colleges in Niger State

Methodology

The research was carried out using descriptive survey research design. The study was conducted Niger State Government Technical Colleges. The targeted population for the study was the targeted population for the study was 1,481 subjects comprising of 169 teachers and 1,312 TC III students from the five Government Technical colleges own by Niger State. A 40-items structured questionnaire titled "Building Infrastructures Facilities Improvement Questionnaire (BIFIQ)". The questionnaire was subjected to validation by three experts. One Lecturer from the Department of Industrial and Technology Education, Federal University of Technology Minna, and two from technical college in Niger State.The reliability coefficient of the instruments was established to be 0.82 using Cronbach Alpha statistics. Out of 301 questionnaires administered 293 questionnaires representing 97% were dully filled and returned by the respondents. Mean and standard deviation were used as statistical tools for answering research questions, while z-test was employed to test the null hypotheses of the study at 0.05 level of significance. The decision on each item of the research questions was based on the resulting mean scores interpreted relatively to the concept of real lower and limits of numbers as shown in Table 3.4. Furthermore, the decision on the null hypothesis formulated for the study was based on comparing the significant value with ($P < 0.05$) level of significant, that is where the significant value was less than ($P < 0.05$), the hypothesis was rejected, while equal to or greater than ($P < 0.05$) level of significant the hypothesis was upheld.

Results

Research Question One

What are the classroom facilities that can be improved for effective teaching and learning in technical colleges in Niger State?

The data for answering research question one is presented in Table 1

Table 1: Mean and Standard Deviation of Respondents on the Classroom Facilities that can be improved for Effective Teaching and Learning in Technical Colleges in Niger State. N = 293

S/N	ITEMS	$\overline{X}$	SD	Remarks
1	Classroom environment	4.64	0.69	SA
2	Corridors/Verandah	4.48	0.70	A
3	Desks/Tables	4.54	0.62	SA
4	Chairs	4.61	0.64	SA
5	Walls	3.84	0.60	A
6	Floors	4.51	0.66	SA
7	Windows	4.62	0.76	SA

8	Switches	3.88	0.84	A
9	Electrical bulbs	3.93	0.80	A
10	Fans	4.65	0.62	SA
11	Chalkboard	4.52	0.70	SA
12	Toilets	4.60	0.86	SA
13	Wall Paint	4.11	0.65	A
14	Ceilings	4.47	0.60	A
15	Waste Disposal Facilities	3.86	0.76	A
16	Electricity Supply	4.14	0.64	A
17	Water supply	4.50	0.72	SA
18	Air condition	3.72	0.76	A
19	Firefighting equipment	4.26	0.82	A
	Grand Mean/SD	**4.31**	**0.72**	**Agreed**

Keys: N = Number of respondents, $\overline{X}$ = Mean; SD = Standard Deviation; SA = Strongly Agree; A = Agree

Table 1 shows the means responses of the respondents on 19 items posed to determine the classroom facilities that can be improved for effective teaching and learning in technical colleges in Niger State with a grand mean of 4.31 which implies that the respondents collectively agreed to all the items as the classroom facilities that can be improved for effective teaching and learning in technical colleges in Niger State. The standard deviation of the items ranged from 0.62 to 0.86 which further implies that the 19 items had their standard deviation less than 1.96 indicating that the respondents were not too far from the mean and were close to one other in their responses. This closeness of the responses adds value to the reliability of the mean. Hence all the classroom facilities need improvement for effective teaching and learning in technical colleges

Research Question Two

What are the hostel facilities that can be improved for effective teaching and learning in technical colleges in Niger State?

The data for answering research question two is presented in Table 4.2.

Table 2: Mean and Standard Deviation of Respondents on the hostel facilities that can be improved for effective teaching and learning in technical colleges in Niger State

N = 293

S/N	ITEMS	$\bar{x}$	SD	Remarks
1	Beds	4.62	0.60	SA
2	Bathrooms	3.94	0.55	A
3	Lockers	4.69	0.69	SA
4	Ceilings	3.75	0.61	A
5	Floors	4.28	0.67	A
6	Windows	4.06	0.65	SA
7	Switches	4.83	0.72	SA
8	Electrical bulbs	4.14	0.76	SA
9	Fans	4.65	0.76	SA
10	Reading chairsand tables	4.62	0.64	SA
11	Shelf	3.79	0.70	A
12	Toilets	4.55	0.78	SA
13	Wardrobe	4.59	0.70	SA
14	Common/TV Room	3.72	0.63	A
15	Cyber Café / Internet	4.52	0.70	SA
16	Reading Room	4.58	0.68	SA
17	Game room	3.81	0.72	A
18	Electricity Supply	4.70	0.75	SA
19	Water supply	4.64	0.81	SA
20	Air condition	4.30	0.70	A
21	Fire extinguishers	4.66	0.69	SA
	Grand Mean/SD	**4.35**	**0.69**	**Agreed**

Keys: N = Number of respondents; $\bar{x}$ = Mean; SD = Standard Deviation; SA = Strongly Agree; A = Agree

Table 2 shows the means responses of the respondents on 21 items posed to determine the hostel facilities that can be improved for effective teaching and learning in technical colleges in Niger State with a grand mean of 4.35 which implies that the respondents agreed to the 21 items as the hostel facilities that can be improved for effective teaching and learning in technical colleges in Niger State. The standard deviation of the items ranged from 0.55 to 0.81 which further implies that the 21 items had their standard deviation less than 1.96 indicating that the respondents were not too far from the mean and were close to one other in their responses. This closeness of the responses adds value to the reliability of the mean. Hence, the hostel facilities need improvement for effective teaching and learning in technical colleges

Hypothesis One

There is no significant different between the mean responses of teachers and students on the classroom facilities improvement for effective teaching and learning in technical colleges in Niger State ($P<0.05$). Null hypothesis one was tested and the result is presented in Table 4.7.

Table 3: Z-test analysis showing the significant difference between the mean responses of teachers and students on the classroom facilities improvement for effective teaching and learning in technical colleges in Niger State

		Levene's Test for Equality of Variances		Z-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	Z	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper
Classroom Facilities	Equal variances assumed	4.430	.421	4.145	291	.110	.42029	.06842	.08281	.38404
	Equal variances not assumed			2.735	20.640	.152	.42029	.08502	.06201	.42508

(p>0.05) NS = Not significant

Table 3 shows the z-test analysis for the test of significant difference between the mean responses of teachers and students on the classroom facilities that can be improved for effective teaching and learning in technical colleges in Niger State. The Levene's test was carried out to determine equality of variance. The test showed an F value of 4.43with a p-value of 0.42 which means equal variances was assumed. Also, the z-test analysis showed a value of 4.15 and a p-value of 0.11 which is greater than the bench mark of 0.05. Hence null hypothesis one was upheld. This implied that there was no significant difference between the mean responses of the respondents regarding the classroom facilities that can be improved for effective teaching and learning in technical colleges in Niger State.

Hypothesis Two

There is no significant different between the mean responses of teachers and students on the hostel facilities improvement for effective teaching and learning in technical colleges in Niger State (P<0.05). Null hypothesis two was tested and the result is presented in Table 4.8.

Table 4: Z-test analysis showing the significant difference between the mean responses of teachers and students on the hostel facilities improvement for effective teaching and learning in technical colleges in Niger State

		Levene's Test for Equality of Variances		Z-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	Z	Df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	Lower	Upper
Hostel Facilities	Equal variances assumed	6.472	.068	3.940	291	.410	.46201	.05902	.08428	.36404
	Equal variances not assumed			2.735	20.803	.138	.46201	.09242	.05822	.38801

(p>0.05) NS = Not significant

Table 4 shows the z-test analysis for the test of significant difference between the mean responses of teachers and students on the hostel facilities that can be improved for effective teaching and learning in technical colleges in Niger State. The Levene's test was carried out to determine equality of variance. The test showed an F value of 6.47 with a p-value of 0.68 which means equal variances was assumed. Furthermore, the z-test analysis showed a value of 3.94 and a p-value of 0.41 which is greater than the bench mark of 0.05. Hence null hypothesis two was upheld. This implied that there was no significant difference between the mean responses of teachers and students on the hostel facilities that can be improved for effective teaching and learning in technical colleges in Niger State.

Findings of the Study

The following findings emerged from the study based on the research questions answered and the hypotheses tested.

1. The classroom facilities need improvement for effective teaching and learning in technical colleges in Niger State include: desks/tables, chairs, toilets, floors, windows, electricity supply, switches, fans, electrical bulbs, chalkboard and ceilings among others.
2. There was no significant different between the mean responses of teachers and students on the classroom facilities that can be improved for effective teaching and learning in technical colleges in Niger State.
3. The hostel facilities need improvement for effective teaching and learning in technical colleges in Niger State include: beds, lockers, floors, ceilings, switches, wardrobes, toilets, reading chairs and tables among others.
4. There was no significant different between the mean responses of teachers and students on the hostel facilities that can be improved for effective teaching and learning in technical colleges in Niger State

Discussion of Findings

The major findings of the study were discussed in the order of the research questions and hypotheses formulated for study.

The findings on research one revealed that the classroom facilities that can be improved for effective teaching and learning in technical colleges in Niger State include: desks/tables, chairs, toilets, floors, windows, electricity supply, switches, fans, electrical bulbs, chalkboard and

ceilings among others. The analysis showed the strength of respondent's opinion towards the classroom facilities that can be improved for effective teaching and learning. Furthermore, the findings on hypothesis one revealed that was no significant different between the mean responses of teachers and students on the classroom facilities that can be improved for effective teaching and learning in technical colleges in Niger State.

In support of these findings is a study carried out by Joseph *et al.* (2022) who conducted a study on the analysis of school population growth in school population and educational infrastructures/facilities in Makurdi Local Government Area of Benue State. The findings of the study revealed that educational facilities such as chairs, toilets, floors, windows, electricity supply, switches, and fans in the schools did not meet the 2010 UBEC requirement for urban schools. Similarly, Lesanmi (2022) also found out that the facilities that needs urgent maintenance in federal HEIs in south-west Nigeria include; desks/tables, chairs, toilets, floors, windows, electricity supply, switches, fans, electrical bulbs, chalkboard ceilings and installation issues. The findings are also in concordance with the findings of Joseph *et al.* (2022) who revealed that there was no significant different between the mean responses of teachers and students as regard the school infrastructures/facilities that needs improvement in Makurdi Local Government Area of Benue State.

The findings on research two revealed that the hostel facilities that can be improved for effective teaching and learning in technical colleges in Niger State include: beds, lockers, floors, ceilings, switches, wardrobes, toilets, reading chairs and tables among others. The analysis shows the strength of the respondent's opinion towards the hostel facilities that needs to be improved for effective teaching and learning. Furthermore, the findings on hypothesis two revealed that there was no significant different between the mean responses of teachers and students on the hostel facilities that can be improved for effective teaching and learning in technical colleges in Niger State. This showed that the respondents had a similar view regarding the hostel facilities that needs to be improved for effective teaching and learning in technical colleges in Niger State.

These findings are in resonance with a study conducted by Liman *et al*. (2021) which found out that the public secondary school hostel buildings in Niger State such as:beds, lockers, floors, ceilings, switches, wardrobes, toilets, reading chairs and tables among others were in a poor but manageable condition requiring maintenance and renovation. Similarly, the study of Rachel *et al.* (2021) revealed that the hostel facilities that needs improvement in public primary schools in Belgut Sub-County include; beds, lockers, floors, ceilings, switches, wardrobes, toilets, reading chairs and tables among others. They also revealed that classrooms the school were overcrowded for learning and were not streamlined for wheelchairs. The findings also tie with the findings of Olusegun (2015) which revealed that there was gross inadequacy of students' housing facilities as a result of non-provision, obsolescence, and non-maintenance. The findings also goes in line with the findings of Adamu *et al.* (2019) who found out that 66.9% of the hostel facilities in Federal University of Technology Minna needs servicing while 32.9% are unavailable and unserviceable.

Conclusion

This study has determined the mechanisms for improving building infrastructures facilities for effective teaching and learning in technical colleges in Niger State, Nigeria. This was achieved by specifically determining the classroom facilities and hostel facilities that can be improved for effective teaching and learning in technical colleges in Niger State. This was achievable through analysis of opinions gathered from teacher and students in Niger State technical

colleges. The opinions of teachers and students in Niger State technical colleges revealed that building infrastructure facilities such as desks/tables, chairs, beds, lockers, electricity supply, water supply, chalkboard and toilets among others can be improved for effective teaching and learning. Also, roles such as organizing campaigns to raise money for infrastructure improvements and conducting regular inspection of building infrastructure facilities played by PTA and school administrators respectively are capable of improving building infrastructures facilities for effective teaching and learning in technical colleges in Niger State.

Recommendations

The following recommendations were made based on the findings of this study;

1. The state government should provide funds for technical colleges' managements to produce and maintain classroom facilities that are capable of improving effective teaching and learning.
2. The school management should set up a committee that will be responsible for carrying out regular inspection and supervision of hostel facilities capable of improving teaching and learning to ensure their efficiency at all times.
3. National Board of Technical Education (NBTE) during accreditation should ensure that office of staff in Niger State technical colleges have the necessary facilities that can improve effective teaching and learning.

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ASSESSMENT OF MOTOR VEHICLE MECHANIC WORK APPRENTICESHIP TRAINING IN OSUN STATE, NIGERIA.

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Abstract
The study assessed motor vehicle mechanic work apprenticeship training in Osun State, Nigeria. Three research questions and three null hypotheses guided the study. A descriptive survey research design was adopted for the study. The study was conducted in Osun State. A total of 105 respondents consisting of 45 motor vehicle mechanic craftsmen using non-probability purposive sampling techniques, and 60 apprentices randomly selected were used as the total population for the study. A 39-item structured questionnaire developed by the researchers, validated by three experts was used for data collection. The reliability coefficient of the instrument was 0.80 using Cronbach's Alpha statistics for the study. Mean and standard deviation were the statistical tools used for answering the research questions; In contrast, Z-test statistics was used to test the null hypotheses formulated for the study at a 0.05 significance level. The findings revealed that most of the identified current trends were required in motor vehicle mechanic work apprenticeship training. It was also discovered that motor vehicle mechanic work apprenticeship training faces many challenges. The findings further revealed that automobile industries needed to collaborate in the training of master craftsmen on current technologies in vehicle repairs/maintenance. Based on the findings, it was recommended that: There should be appropriate retraining for skills acquisition organized by the government through the social intervention programmes where motor vehicle master mechanics could be trained by experts to utilize autotronics devices to improve their effectiveness in troubleshooting and maintenance of modern vehicles.

Keywords: Assessment, Motor vehicle mechanic, Apprenticeship, and Apprenticeship training

Introduction

These days, we have witnessed a speedy evolution of automotive industries all over the world. As the years went by, there has been enormous technological improvement to the modern-day vehicle design for it to be safer, efficient, and comforting to the customer. These call for skillful apprenticeship training in motor vehicle mechanic work to be able to deal with modern-day maintenance and repairs of vehicles. Recently, apprenticeship has undergone modernization compared to traditional methods. In the past, individuals learned by observing the master at work. However, in contemporary apprenticeships, a different approach is used. Apprentices are required to document their observations while watching the master, and upon completion of the training, they receive a certificate. According to Nnonyelu and Onyeizugbe (2020),

apprenticeship is characterized as a practice or trade of craft conducted under a legal agreement that delineates the relationship between the master, and apprentice, and the terms of their service.

Apprenticeship training is an arrangement in which an apprentice learns a job, trade, or skill under the guidance of an expert otherwise known as a master. The service involves instruction from the master and hands-on learning experiences for the apprentice. Though, an apprentice is a young person who works for someone to learn their skill. In the view of Alike and Umunze (2019), apprenticeship refers to any system whereby a master craftsman agrees to employ a young individual to train them in a trade for a certain period, enabling them to acquire the necessary skills to become proficient in that trade, craft, or profession. Alla and McGrath (2021) described apprenticeship as an informal arrangement between a master trainer and an apprentice, wherein their shared responsibilities and duties are established orally or in written.

However, apprenticeship training in motor vehicle mechanic work in the context of this study is a practical activity that can help a learner acquire saleable skills in repairing expertly modern vehicles in line with the set standard under the supervision of a master mechanic. The practical training of motor vehicle mechanics is often carried out contemporaneously in the workshop. Sitzmann and Weinhardt (2018) view training as a process aimed at systematically enhancing work-related knowledge and expertise to enhance performance. Training is often geared towards immediate application, imparting skills useful in a specific context (Sahoo and Mishra, 2019). Practical training in motor vehicle mechanic work refers to the ability to use tools effectively and efficiently, the ability to undertake the work of the day such as engine repair, parts or components replacement, and the like, and the ability to diagnose problems associated with the repair of automotive vehicles (Baba *et al.*, 2018). Uwameiye (2019) however, noted that most motor vehicle mechanics acquire skills through informal apprenticeship training but these practical skills only involve assembling of parts. These practical skills are mostly devoid of diagnostic skills and knowledge information. As a result of this deficiency, apprentices were hardly able to perform any operations that were new to them, except those they had seen their master's carried out. In the training, the apprentices observe the master trainer perform the operations, and through imitation, the apprentices then practice the skills until they become proficient in the skills (Kamble and Bankapur, 2023). Nna (2011) stressed that modern motor vehicles contain a set of electronic mechanisms and controls. This requires competent and technically skilled motor vehicle mechanics who will bring sustainable development into the motor vehicle mechanic work maintenance sector. However, apprenticeship training cuts across various trades and professions. One of the trades whereby apprenticeship training is applicable is motor vehicle mechanic work.

Motor vehicle mechanic (MVM) work is an occupation aimed at producing competent vehicle mechanics with sound practical skills. According to Okwelle *et al.* (2017), motor vehicle mechanic work is one of the vocational training skill programmes operated basically through the informal setting with an apprenticeship mode of instruction. It is designed to produce competent motor vehicle artisans for the technological and industrial development of society. The informal training of apprentices in motor vehicle mechanic work is through competent motor vehicle mechanics. Abdulkadir *et al.* (2017) described a motor vehicle mechanic as a person trained in the diagnosis or repair of faulty motor vehicle components or systems. However, motor vehicle mechanic work apprenticeship training has required a high level of basic understanding of troubleshooting and maintenance skills because of the sophistication of technology used in modern vehicles. The best way to stay informed about the latest

developments and technologies in the field of motor vehicle mechanic work is by keeping pace with the current trends.

Current trends refer to a change or development towards something new or different. It is the general direction in which something is developing or changing over time. By staying up-to-date with trends in motor vehicle mechanic work, one can be best informed, be able to adapt quickly to new technologies in the field and be more appealing to potential apprentices. Okwelle *et al.* (2017) however, posited that keeping up with technology trends is essential in today's world as technology is constantly evolving. This situation required a general direction of change with the current trends in motor vehicle mechanic work. To become a master craftsman in motor vehicle mechanic work, at the end of apprenticeship training, one needed strong practical skill; good problem-solving and fault detection; good human relations, and great customer service skills. Audu *et al.* (2019) however revealed that the majority of master craftsmen in motor vehicle mechanic work lack the basic understanding of autotronic systems incorporated in modern vehicles. Most cars on our roads today are built with a lot of electronically controlled systems. Jalal (2013) discovered from a skill gap analysis that the majority of the mechanics in Nigeria lack the relevant knowledge about modern vehicle repairs. This requires advancement in apprenticeship training in motor vehicle mechanic work in line with the current trends to improve overall performance. However, despite the importance of apprenticeship training in motor vehicle mechanic work, this training is faced with various constraints.

Constraints are challenges restraining efficiency. Yukalang *et al*. (2017) described constraints as something that limits efficiency or performance at a given point in time. Therefore, constraints in this context refer to certain factors working against effective apprenticeship training in motor vehicle mechanic work in Osun State. Malette *et al.* (2022) revealed that apprenticeship still faces numerous challenges, including insufficient funding post-program, inadequate facilities for ensuring positive outcomes, and a lack of enthusiasm from both governmental and non-governmental organizations in funding the program. Malette *et al.* (2022) noted that one major setback of the program is its narrow scope of training, lacking sufficient theoretical content. Consequently, this results in a lack of creativity among apprentices and their difficulty in applying their skills to diverse situations. Additionally, the instruction tends to be individualized rather than institutionalized. Gessler (2019) highlighted the perception that apprenticeship is primarily for individuals who struggle in the formal educational system or whose parents cannot afford to sponsor their education. This perception makes it challenging to attract young graduates to the programme, as apprentices are often viewed as underachievers and not accorded the same respect as formal education counterparts. Eze *et al.* (2018) observed that modern technology has rendered some skills obsolete, necessitating the training and retraining of apprentices to update their knowledge and skills, thus enhancing productivity. Acquiring specific occupational skills is crucial for securing employment in established occupational fields, and the lack thereof may limit an individual's employability in our contemporary technological era. However, enhancing apprenticeship training in motor vehicle mechanic work can be achieved through various approaches or strategies.

Strategies are measures adopted to overcome challenges. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO) (2012) Education for All Global Monitoring Report, it is essential for governments to enhance the credibility of traditional apprenticeships by strengthening the training of master craftspeople, improving working

conditions for apprentices, and ensuring that skills are certified through a national qualification framework. Efforts should also be made to integrate classroom learning with practical workplace experience. Other essential elements for robust apprenticeship training, as outlined by Smith (2019) include incentives for employers to participate in an apprenticeship programme; development of occupational standards through ongoing research; embellishment of certification bodies to issue certificates; provision of funds for off-the-job classes; and the training programme for apprenticeship instructors among others. However, the essence of these measures is to enhance a strong apprenticeship training programme to be able to produce competent MVM craftsmen who can repair and maintain modern vehicles

Motor vehicle mechanic (MVM) craftsmen are skilled personnel, trained in automobile mechanic works. According to Hillier and Coombes (2014), MVM craftsmen are skilled personnel who specialise in motor vehicle maintenance, repairs, and sometimes modification of motor vehicles. However, on the other hand, Okwelle *et al.* (2017) described an MVM apprentice as a trainee who acquired technical skills through the informal setting at a designated motor vehicle mechanic workshop within a specified time duration. In this study, MVM craftsmen are skilled individuals or groups of individuals who are personally, trained in motor vehicle repairs and maintenance, while apprentices in MVM work are individuals who are receiving training under the guidance of a master mechanic to become competent MVM. The aim of motor vehicle apprenticeship training is generally to produce competent MVM craftsmen and women for technological and industrial development (Baba *et al.,* 2018). The study therefore sought to assess the motor vehicle mechanic work apprenticeship training programme in Osun State, Nigeria to identify weaknesses or strengths of existing systems in a structured way.

Statement of the Problem

The motor vehicle mechanic work apprenticeship training programme in Osun State, Nigeria, is crucial for developing a skilled workforce in the automobile repairs and maintenance sector. However, there are concerns regarding the effectiveness of the current training programmes. Apprentices may lack the necessary skills and proficiency to perform motor vehicle mechanic work tasks efficiently, leading to doubts about their abilities. This perception of deficiency in skill level may stem from undefined apprenticeship training programmes, outdated instructional methods, and a lack of exposure to modern vehicle technologies. Malette *et al.* (2022) highlighted several challenges facing apprenticeship training programmes, such as inadequate post-programme funding, insufficient facilities for ensuring positive outcomes, and a lack of enthusiasm from governmental and non-governmental organizations in providing support. Additionally, Liadi and Olutayo (2017) emphasized the perception that apprenticeship is mainly for individuals struggling with formal education or lacking financial support, making it difficult to attract young graduates. Eze *et al.* (2018) observed that obsolete skills due to modern technology necessitate apprentices' training and retraining to maintain productivity and employability in today's technological era. To address these issues require an improvement in the quality of motor vehicle mechanic work, as well as the adoption of various strategies to enhance the quality of apprenticeship training programmes in Osun State, Nigeria. The study therefore sought to assess motor vehicle mechanic work apprenticeship training in Osun State, Nigeria.

Aim and Objectives of the Study

The aim of this study was to assess motor vehicle mechanic work apprenticeship training in Osun State, Nigeria. Specifically, the study sought to achieve the following objectives:

1. Identify the current trends in motor vehicle mechanic work apprenticeship training in Osun State, Nigeria.
2. Find out constraints against motor vehicle mechanic work apprenticeship training in Osun State, Nigeria.
3. Determine strategies for improving motor vehicle mechanic work apprenticeship training in Osun State, Nigeria.

Research Questions

The following research questions guided the study.

1. What are the current trends in motor vehicle mechanic work apprenticeship training in Osun State, Nigeria?
2. What are the constraints against motor vehicle mechanic work apprenticeship training in Osun State, Nigeria?
3. What are the strategies for improving motor vehicle mechanic work apprenticeship training in Osun State, Nigeria?

Hypotheses

The following null hypotheses guided the study and were tested at a 0.05 level of significance.

H_{O1}: There is no significant difference in the mean responses of motor vehicle mechanic craftsmen and motor vehicle mechanic apprentices on the current trends in motor vehicle mechanic work apprenticeship training in Osun State

H_{O2}: There is no significant difference in the mean responses of motor vehicle mechanic craftsmen and motor vehicle mechanic apprentices on the constraints against motor vehicle mechanic work apprenticeship training in Osun State

H_{O3}: There is no significant difference in the mean responses of motor vehicle mechanic craftsmen and motor vehicle mechanic apprentices' strategies for improving motor vehicle mechanic work apprenticeship training in Osun State

Methodology

A descriptive research design was employed for the study. Floyd (2014) stated that descriptive survey research is a method of data collection using a questionnaire to collect data from a sample that has been selected to represent a population to which the findings of the data analysis can be generalized. The study was carried out in Osun State, South-West geopolitical zone of Nigeria. A total of 105 respondents comprising 45 motor vehicle mechanic craftsmen using non-probability purposive sampling techniques, and 60 apprentices randomly selected from the 3 senatorial zones of Osun state were used as the total population for the study. A structured questionnaire titled: Motor Vehicle Mechanic Work Apprenticeship Training Questionnaire (MVMWATQ) developed by the researchers and validated by three experts was used for the data collected for the study. The reliability coefficient of the instrument was 0.80 using Cronbach Alpha statistics.

Statistical Package for the Social Sciences (SPSS, version 23) was used for the data analysis. Mean and standard deviation were used in answering the research questions, while Z-test statistics was employed in testing the null hypotheses at a probability value of a 0.05 level of significance. The decisions for each research question were based on the resulting mean scores interpreted relative to the concept of real lower and upper limits of numbers as follows: 3.50 – 4.00 as Strongly Agree (SA); 2.50 – 3.49 as Agree (A); 1.50 – 2.49 as Disagree (D) and 0.50 – 1.49 as Strongly Disagree (SD). The standard deviation was calculated to find the

closeness or otherwise of the items in the respondents' responses. Using the Z-test was considered the most appropriate method of analysis for comparing the means of two variables. The decision on the null hypothesis of the study was based on comparing the p-value with alpha at 0.05 such that where the p-value is greater than alpha at 0.05, the null hypothesis was accepted, whereas when the p-value is less than alpha at 0.05 the null hypothesis was rejected.

Results

Research Question 1

What are the current trends in motor vehicle mechanic work apprenticeship training in Osun State, Nigeria?

Table 1

Mean Ratings of Respondents on the current trends in motor vehicle mechanic work apprenticeship training in Osun State, Nigeria

S/No	Items	$\underline{x}$ N= 105	SD	Remark
1.	Arithmetic proficiency	2.76	0.76	A
2.	Proficiency in reading and writing	3.48	0.59	A
3.	Communication skills	2.75	0.99	A
4.	Entrepreneurial skills	3.60	0.63	SA
5.	Computer literacy	3.51	0.50	SA
6.	Electronic Ignition System	3.65	0.70	SA
7.	Automated digital tyre air compressor and pressure gauge equipment	3.75	0.86	SA
8.	Automated tyre removal equipment	3.45	0.69	A
9.	Automated digital wheel balancing and alignment equipment	2.75	0.98	A
10.	On-board diagnostic (OBD) device	3.30	0.64	A
11.	Computer hard and software to manage complex repair work	3.45	0.49	A
12.	Incorporation of autotronic systems	3.35	0.72	A
13.	Use of video-supported technique in motor vehicle repairs	2.75	0.76	A
14.	Use of the Internet for information on diagnosing and repairing vehicles	3.45	0.59	A
15.	Online advice on motor vehicle repairs/maintenance	2.75	0.87	A
	Grand Mean/SD	**3.40**	**0.72**	**A**

N= Number of respondents; $\underline{x}$**=** Mean; **SD**= Standard Deviation; **SA**= Strongly Agreed; **A**= Agreed: **D**= Disagreed; **SD**= Strongly Disagreed

Table 1 revealed the mean responses of the respondents on fifteen (15) items posed to determine the current trends in motor vehicle mechanic work apprenticeship training in Osun State, Nigeria with a grand mean of 3.40. This implies that the respondents agreed with the majority of the items as the current trends in motor vehicle mechanic work apprenticeship training. The standard deviation of the items ranges from 0.49-0.99 indicating that the respondents were not too far from the mean and were close to one another in their responses. This closeness of the respondents adds value to the reliability of the mean.

Research Question 2

What are the constraints against motor vehicle mechanic work apprenticeship training in Osun State, Nigeria?

Table 2

Mean Ratings of Respondents on the Constraints Against Motor Vehicle Mechanic Work Apprenticeship Training in Osun State, Nigeria

S/No	Constraints Against Motor Vehicle Mechanic Work Apprenticeship Training	$\underline{x}$ N=105	SD	Remark
1.	Lack of comprehensive learning content	2.75	0.54	A
2.	Challenges of integrating work-based and classroom-based methods into apprenticeship training in motor vehicle mechanic work	3.45	0.90	A
3.	Lack of skillful training on the use of autotronic devices among motor vehicle mechanic master craftsmen	2.75	0.78	A
4.	Unsafe training environment	3.60	0.86	SA
5.	Lack of appropriate supervisor from master craft men	3.51	0.99	SA
6.	Negative public perception of informal apprenticeship training	3.65	0.58	SA
7.	Absence of an established curriculum for apprenticeship training in motor vehicle mechanic work	3.75	0.74	SA
8.	Lack of pedagogical skills among motor vehicle mechanic master craftsmen	3.45	0.29	A
9.	Socioeconomic limitations of both parents and master craft men	2.75	0.72	A
10.	Lack of necessary training equipment and tools	3.30	0.76	A
11.	Absence of comprehensive policy framework for apprenticeship training in motor vehicles mechanic work	3.45	0.59	A
12.	Lack of proficiency in reading, writing, arithmetic, and communication skills among motor vehicle mechanic craftsmen	3.15	0.88	A
	Grand Mean/SD	**3.30**	**0.72**	**A**

N= Number of respondents; $\underline{x}$= Mean; **SD**= Standard Deviation; **SA**= Strongly Agreed; **A**= Agreed: **D**= Disagreed; **SD**= Strongly Disagreed

Table 2 shows the mean responses of the respondents on the twelve (12) items posed to determine the constraints against motor vehicle mechanic work apprenticeship training in Osun State, Nigeria with a grand mean of 3.30. This implies that the respondents unanimously agreed with the majority of the items as constraints against motor vehicle mechanic work apprenticeship training. The standard deviation (SD) of the items ranged from 0.29-0.99 indicating that the respondents were not too far from the mean and were close to one another in their responses. This closeness of the respondents adds value to the reliability of the mean.

Research Question 3

What are the strategies for improving motor vehicle mechanic work apprenticeship training in Osun State, Nigeria?

Table 3

Mean Ratings of Respondents on the strategies for improving motor vehicle mechanic work apprenticeship training in Osun State, Nigeria

S/No	Strategies for Improving Motor Vehicle Mechanic Work Apprenticeship Training	$\underline{x}$ N=105	SD	Remark
1.	Automobile industries collaborations in the training of master craftsmen on current technologies in vehicle repairs/maintenance	2.75	0.39	A
2.	Improving working conduction for apprentices	3.45	0.23	A
3.	Ensuring that apprenticeship training is certified through a national qualification framework	2.75	0.92	A
4.	Integration of classroom learning with practical workplace experiences	3.60	0.27	SA
5.	Recruitment of qualified instructors with industrial experience for tailoring apprenticeship training to meet job requirements	3.52	0.68	SA
6.	Provision of comprehensive career education for apprentices in motor vehicle mechanic work	3.65	0.51	SA
7.	Provision of a training programme for apprenticeship instructors in motor vehicle mechanic work	3.75	0.46	SA
8.	Development of research and dissemination of best practices in apprenticeship training in motor vehicle mechanic work	3.45	0.51	A
9.	Provision of modern tools and equipment in motor vehicle mechanic work by master craftsmen for training of their apprentice	2.75	0.98	A
10.	Motor vehicle mechanic master craftsmen must be proficient in reading, writing, arithmetic, and communication skills	3.35	0.64	SA
11.	Motor vehicle mechanic master craftsmen must be computer literate in the use of hard and software to manage complex repair work	3.45	0.49	A
12.	Learning how to use current autotronic devices (On-Board Diagnostic (OBD) devices) for fault diagnoses by master mechanic craftsmen	3.25	0.72	A
	Grand Mean/SD	**3.31**	**0.72**	**A**

N= Number of respondents; $\underline{x}$= Mean; **SD**= Standard Deviation; **SA**= Strongly Agreed; **A**= Agreed: **D**= Disagreed; **SD**= Strongly Disagreed

Table 3 unveils the mean responses of the respondents on the twelve (12) items posed to determine the strategies for improving motor vehicle mechanic work apprenticeship training in Osun State, Nigeria with a grand mean of 3.31. The result of the analysis showed that the

respondents jointly agreed with the majority of the items as strategies for improving motor vehicle mechanic work apprenticeship training. The standard deviation (SD) of the items ranged from 0.23-0.98 indicating that the respondents were not too far from the mean and were close to one another in their responses. This closeness of the respondents adds value to the reliability of the mean.

Hypothesis One
There is no significant difference in the mean responses of motor vehicle mechanic craftsmen and apprentices on the current trends in motor vehicle mechanic work apprenticeship training in Osun State

Table 4
Two Independent Samples Z-test Results of Respondents on the current trends in motor vehicle mechanic work apprenticeship training in Osun State

Groups	N	df	$\underline{x}$	SD	Sig. (2-tailed)	Remark
Motor vehicle mechanic craftsmen	45	577	3.10	0.26		
Apprentices	60		2.90	0.25	0.62	NS

Significant at P>0.05 NS = No significant
The result of the analysis presented in Table 3 indicated that there was no significant difference (P<0.05) in the mean ratings of the respondents. These data supported the hypothesis, df = 577; 2-tail = 0.62. The mean and standard deviation for automobile technology lecturers were 3.10 and 0.26. The mean and standard deviation for motor vehicle mechanics craftsmen were 2.90 and 0.25 respectively; there is therefore a good reason to accept the null hypothesis.

Hypothesis Two
There is no significant difference in the mean responses of motor vehicle mechanic craftsmen and apprentices on the constraints against motor vehicle mechanic work apprenticeship training in Osun State

Table 5
Two Independent Samples Z-test Results of Respondents on the Constraints Against Motor Vehicle Mechanic Work Apprenticeship Training in Osun State

Groups	N	df	$\underline{x}$	SD	Sig. (2-tailed)	Remark
Motor vehicle mechanic craftsmen	45	578	3.16	0.24		
Apprentices	60		3.30	0.22	0.71	NS

Significant at P>0.05 NS = No significant

The analysis of the results presented in Table 4 indicated that there was no significant difference (P<0.05) in the mean ratings of the respondents. These data supported the hypothesis, df = 578; 2-tail = 0.71. The mean and standard deviation for automobile technology lecturers were 3.16 and 0.24. The mean and standard deviation for motor vehicle mechanics craftsmen were 3.30 and 0.22 respectively; therefore, there is a good reason to accept the null hypothesis.

Hypothesis Three
There is no significant difference in the mean responses of motor vehicle mechanic craftsmen

and apprentices on the strategies for improving motor vehicle mechanic work apprenticeship training in Osun State

Table 6
Two Independent Samples Z-test Results of Respondents on the strategies for improving motor vehicle mechanic work apprenticeship training in Osun State

Groups	N	df	$\underline{x}$	SD	Sig. (2-tailed)	Remark
Motor vehicle mechanic craftsmen	45	578	3.18	0.24		
Apprentices	60		3.30	0.21	0.75	NS

Significant at P>0.05 NS = No significant

The analysis of the result presented in Table 4 indicated that there was no significant difference (P<0.05) in the mean ratings of the respondents. These data supported the hypothesis, df = 578; 2-tail = 0.75. The mean and standard deviation for automobile technology lecturers were 3.18 and 0.24. The mean and standard deviation for motor vehicle mechanics craftsmen were 3.30 and 0.21 respectively; therefore, there is a good reason to accept the null hypothesis.

Discussion of Findings

The findings on research question one revealed that the respondents agreed with the majority of the items as the current trends in motor vehicle mechanic work apprenticeship training. The findings of the study conformed with the findings of Okwelle *et al.* (2017) who posited that keeping up with technology trends is essential in today's world as technology is constantly evolving. However, it is then not surprising that even though almost all the items were agreed upon, Audu *et al.* (2019) revealed that the majority of master craftsmen in motor vehicle mechanic work lack the basic understanding of autotronic systems incorporated in modern vehicles. This suggests the fact that motor vehicle mechanics master craftsmen needed to update their knowledge in the repairs and maintenance of modern vehicles to keep pace with the dynamics of technology.

The findings of hypothesis one revealed that there was no significant difference in the mean responses of motor vehicle mechanic craftsmen and apprentices on the current trends in motor vehicle mechanic work apprenticeship training. The null hypothesis of no significant difference was therefore upheld for the two groups. The implication of this is that the respondents did not differ significantly in their opinions on the 15 items. Generally, the findings of the study aligned with the assertion of Eze *et al.* (2018) who observed that obsolete skills due to modern technology necessitate apprentices' training and retraining to maintain productivity and employability in today's technological era. This shows that motor vehicle mechanic craftsmen needed retraining in the use of the latest autotronic devices to be more efficient, and be able to train and produce competent mechanics.

The findings relating to research question two revealed that the respondents jointly agreed with the majority of the items as the constraints militating against motor vehicle mechanic work apprenticeship training. This suggests that there are challenges with the methods of apprenticeship training in motor vehicle mechanic work. Malette *et al.* (2022) noted that one major setback of the program is its narrow scope of training, lacking sufficient theoretical content. Gessler (2019) corroborated these findings when he noted that the perception that apprenticeship is primarily for individuals who struggle in the formal educational system or whose parents cannot afford to sponsor their education also affects youth interest in apprenticeship training. Negative perception makes it challenging to attract young graduates to motor vehicle mechanic work. However, overcoming these challenges requires a change in

people's perceptions and attitudes toward motor vehicle mechanic work apprenticeship training.

The findings on the hypothesis revealed that there was no significant difference in the mean responses of motor vehicle mechanic craftsmen and apprentices on the constraints against motor vehicle mechanic work apprenticeship training. The null hypothesis of no significant difference was therefore upheld for the two groups. The implication of this is that the respondents did not differ significantly in their opinions on the 12 items. The agreement in their mean responses indicated that these issues required an improvement to enhance the quality of apprenticeship training programs The findings of the study aligned with the assertion of Malette *et al.* (2022) when they revealed that challenges facing apprenticeship training include, inadequate post-program funding, insufficient facilities for ensuring positive outcomes, and a lack of enthusiasm from governmental and non-governmental organizations in providing support. Addressing these challenges will enhance motor vehicle mechanic work apprenticeship training in producing competent motor vehicle mechanics who can repair modern vehicles.

Findings relating to research question three discovered that the majority of respondents did not differ in their opinion on the strategies for improving motor vehicle mechanic work apprenticeship training. The findings were in agreement with UNESCO, Education for All Global Monitoring Report (2012) when they advocated that governments should enhance the credibility of traditional apprenticeships by strengthening the training of master craftspeople, improving working conditions for apprentices, and ensuring that skills are certified through a national qualification framework. They further stressed that classroom learning experience should be integrated with practical workplace experience to enhance apprenticeship training attractiveness to youth. It is therefore imperative that all stakeholders in the automobile repairs and maintenance sector, including master mechanic craftsmen widen the scope of apprenticeship training in motor vehicle mechanic work to foster creativity among apprentices. With that, they would be able to apply their skills in diverse situations.

The findings on the hypothesis revealed that there was no significant difference in the mean responses of motor vehicle mechanic craftsmen and apprentices on the strategies for improving motor vehicle mechanic work apprenticeship training. The null hypothesis of no significant difference was therefore upheld for the two groups. The implication of this is that the respondents did not differ significantly in their opinions. The findings were in a pact with the view of Smith (2019) who suggested incentives for employers to participate in apprenticeship programmes; development of occupational standards through ongoing research; embellishment of certification bodies to issue certificates; provision of funds for off-the-job classes; and the training programme for apprenticeship instructors among others. It is envisaged that adopting these measures will enhance apprenticeship training in motor vehicle mechanic work.

Conclusion

The study assessed motor vehicle mechanic work apprenticeship training in Osun State, Nigeria. The findings of the study serve as the basis for making the following conclusion, Motor vehicle mechanics master craftsmen in motor vehicle mechanic work apprenticeship training needed appropriate training in the use of current autotronic devices (On-Board Diagnostic (OBD) devices) for fault diagnoses based on their performance gap. MVM craftsmen are deficient in the majority of the current technological developments in motor vehicle mechanic work. There should be automobile industry collaborations in the training of master craftsmen on current technologies in vehicle repairs/maintenance to be able to train and produce future competent mechanics for modern vehicles.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. There should be appropriate retraining for skills acquisition organized by the government through social intervention programmes where motor vehicle master mechanics could be trained by experts to utilize autotronics devices to improve their effectiveness in troubleshooting and maintenance of modern vehicles.
2. There should be an established curriculum develop by National Board for Technical Education (NBTE) for apprenticeship training in motor vehicle mechanic work to attract young graduates to the job.
3. The scope of apprenticeship training in motor vehicle mechanic work should encourage the integration of classroom learning with practical workplace experiences to foster creativity among apprentices. This can be done by the Association of Motor Vehicle Mechanics (AMVMs).

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STRATEGIES FOR IMPROVING SAFETY PRACTICES AMONG LOCAL METAL CASTING ARTISANS IN KANO STATE, NIGERIA

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ABSTRACT
This study investigated strategies for improving safety practices among local metal casting artisans in Kano State, Nigeria. Two research questions guided this study and two hypotheses were tested at 0.05 level of significance. The study adopted descriptive survey research design. The population for the study was 1551 respondents, comprising of 1500 Foundry artisans, 35 Metalwork Technology Industrial Personnel and 16 Metalwork Technology Lecturers/Instructors respectively in Kano State, Nigeria. Out of the 1500 artisans, 316 was sampled using Taro Yamane formula. A total of 367 respondents were used for the study. The instrument for data collection was 29 items questionnaire. Three lecturers from Federal University of Technology, Minna were involved in both face and content validity of the developed questionnaire. Cronbach's Alpha reliability coefficient was employed for checking reliability and the index was found to be 0.98 for the instrument. The data collected were analyzed using the Statistical Package for Social Sciences (SPSS) version 23. Mean and Standard deviation were used to answer the two research questions while one way Analysis of Variance (ANOVA) was used to test the two hypotheses at 0.05 level of significance. It was found out among others that: Strategies for improving safety practices in mould preparations in local metal casting operations include; adhering strictly to safe operating procedures during mould preparation activity, regularly inspection of foundry workers at each stage of mould preparation, using the appropriate mould preparation tool for specific task among others. Strategies for improving safety practices in metal handling practices in casting operation include: frequently reinforcing training on safe work practices around furnace during metal melting operation, among others. Based on the findings of the study, it was recommended that metal casting artisans should endeavour to adhere strictly to the techniques that are used to improve and enhancing safety in metal handling operations in metal casting practices in Kano State, Nigeria.

Keywords: Strategies, Safety Practices, Artisans, Local Metal Foundry.

Introduction
The production of metal castings is a complex process that has long been associated with worker injuries and illnesses that are related to exposure to chemical and physical agents generated or used in the casting process (Senthil Kumar and Navean, 2016). Foundry workers may be exposed to numerous health hazards, including fumes, dust, gases, heat, noise, vibration and nonionizing radiation. The continuous exposure to some of these hazards may result in irreversible respiratory diseases such as silicosis and it increases the risk of lung cancer and other diseases among the foundry workers Bichi *et al* (2020).

The foundry workers may also be exposed to safety hazards that can result in injuries including strain, burns, eye damage, loss of limb, and death. The major categories of adverse health effects include: Respiratory diseases; ergonomic injuries due to falling or moving objects, lifting and carrying, etc.; heat induced illnesses and injuries; vibration induced disorders; noise induced hearing loss; and eye injuries. The occurrence of these problems in a foundry should be considered as **s**afety **h**ealth **e**vents. The means for eliminating or significantly reducing each hazard are well known and readily available. According to Bichi *et al* (2021), the occupational injuries and illnesses in foundry workers, their working conditions, engineering controls and their work practice used in sand casting foundries are recognized. Based on the recommendations have been developed for reducing the safety and health risk related to working in sand casting foundries. The foundry operations that have been studied include handling of raw material such as scrap metal and sand; preparing sand ; making mold and cores; reclaiming sand and other material used in core and mold production rough cleaning of castings; melting and alloying metals; pouring; removing cores and shaking out castings; maintaining and cleaning all the equipment's regularly and periodically during and after casting.

According to Senthil Kumar and Navean (2016), casting, as it is commonly involving in pouring of molten metal into a mold that made in to an external shape of the article to be cast. The mold may contain a core which determines the dimensions of any internal cavity or hollow. Molten metal is introduced into the mold. After cooling occurs, the mold is subjected to a 'shakeout' procedure which releases the casting and removes the core. The casting is then cleaned and any extraneous metal is removed from it.

Statement of the Research Problem

Foundry next to construction (Prasad, 2019) belongs to industries with increased occupational risk. During the entire casting production process, employees are exposed to dangerous, harmful and hazardous factors that can cause occupational diseases and accidents at work. Foundry technological processes use various techniques and materials to make the model, mold and casting characterized by the diversity of their chemical composition and properties. The technological processes of making the casting used in foundries can pose a threat to the employee as well as to the environment. Most of the technological processes used in practice create problems at the workplace and for the environment. It is associated with the occurrence of: pollution, contamination, noise and other factors harmful to health and the environment. Epidemiological studies indicate an increased risk of lung and gastrointestinal, prostate, kidney and hematological cancers among foundry workers. The International Agency for Research on Cancer (IARC) concluded that there is sufficient evidence of a carcinogenic effect on people employed in the foundry industry and includes this industry as a carcinogen for humans (IARC 1987). The European Union (EU) includes technological processes in which there is exposure to polycyclic aromatic hydrocarbons present in carbon black, coal tar and coal tar pitch in processes that release carcinogens or mutagens. Hence the need to investigate strategies for standardizing safety precautions among local metal casting artisans in Kano state Nigeria.

Aim and Objectives of the Study

The aim of this study was improving the safety practices among local metal casting artisans in Kano state Nigeria. Specifically, the study sought to achieve the following objectives.

1. Identify strategies for improving safety precautions to be observed in mould preparation among local metal casting artisans in Kano state, Nigeria.
2. Suggest strategies for improving safety precautions to be observed in Metal handling practices in local casting operations in Kano state, Nigeria.

Research Questions

The following research questions were answered in this study:

1. What are the strategies for improving safety practices to be observed in mould preparation practices among local metal casting artisans in Kano State, Nigeria?
2. What are the strategies for improving safety practices to be observed in Metal Handling Practices among local metal casting artisans in Kano State, Nigeria?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

HO_1: There is no significant difference in the mean responses of metal casting artisans, metalwork industrial personnel and metalwork lecturers on the strategies for improving safety practices to be observed in mould preparation among local metal casting artisans in Kano State, Nigeria.

HO_2: There is no significant difference in the mean responses of metal casting artisans, metalwork industrial personnel and metalwork lecturers on the strategies for improving safety practices to be observed in metal handing practices among local metal casting artisans in Kano State, Nigeria.

Methodology

The study adopted descriptive survey design. The population for the study was 1551 respondents, comprising of 1500 Foundry artisans, 35 Metalwork Technology Industrial Personnel and 16 Metalwork Technology Lecturers/Instructors respectively in Kano State, Nigeria. Out of the 1500 artisans, 316 was sampled using Taro Yamane formula, therefore a total of 367 respondents were used for the study. Out of the 367-questionnaire administered, only 351 was returned making a percentage instrument return rate of 95 percent. The instrument for data collection was 29 items questionnaire. Three lecturers from Federal University of Technology, Minna validated the questionnaire. Cronbach's Alpha reliability was employed for checking reliability and the index was found to be 0.98. Mean and Standard deviation was use to answer the research questions while one way Analysis of Variance (ANOVA) was used to test the null hypotheses at 0.05 level of significance.

Results

Research Question One

What are the strategies for improving safety practices to be observed in mould preparation among local metal casting artisans in Kano state, Nigeria?

Table 1: Mean and Standard Deviation of Artisans, Industrial Personnel and Lecturers on strategies for improving safety precautions in mould preparation practices in casting operation.

S/N	ITEM	$x\square_1$ n=300	$x\square_2$ n=35	$x\square_3$ n=16	$x\square_A$	SD_A	D
1	Providing adequate ventilation to reduce hazards from mixture of moulding sand, water and binding materials	3.33	3.17	3.31	3.27	0.66	A
2	Using noise pads to dampen noise or reduce the impact of noise arising from moulding operation	3.32	3.29	3.31	3.31	0.59	A
3	Applying proper sanitary practices (good personal hygiene) during moulding operation to prevent slips and falls	3.34	3.31	3.25	3.30	0.64	A
4	Use of protective clothing and equipment during mould preparation	3.35	3.31	3.31	3.32	0.55	A
5	Making provision for dealing with emergency that may arise during mould preparation activity	3.15	3.14	3.25	3.18	0.66	A
6	Properly labelling of all hazardous substances use for moulding	3.50	3.51	3.44	3.48	0.51	A
7	Training foundry workers to inform them of possible foundry hazards associated with mould preparation operation	3.25	3.23	3.19	3.22	0.90	A
8	Training foundry artisans on how to control hazards during mould preparation	3.50	3.51	3.44	3.48	0.51	A
9	Providing regular inspection of workers at each stage of mould preparation	3.34	3.23	3.19	3.25	0.66	A
10	Adhering strictly to safe operating procedures during mould creation operation	3.34	3.23	3.25	3.27	0.65	A
11	Regularly checking moulding equipment to ensure they are in safe operating condition	3.34	3.17	3.38	3.30	0.63	A
12	Keeping records of moulding maintenance practices	3.32	3.34	3.19	3.28	0.62	A
13	Using simple mechanized machines to do strenuous tasks during moulding operation	3.15	3.14	3.25	3.18	0.66	A
14	Using air purifying respirators to reduce risk of inhalation of hazardous dust from mould sand	3.50	3.51	3.44	3.48	0.51	A
15	Regularly reporting status about damaged equipment in hazardous condition	3.25	3.23	3.19	3.22	0.90	A
16	Maintaining regular practices of house keeping	3.50	3.51	3.44	3.48	0.51	A
17	Keep regular use of safety devices	3.34	3.23	3.19	3.25	0.66	A
	GRAND MEAN	3.34	3.30	3.30	3.31	0.64	A

Data in Table 1.0 showed the opinions of the metal casting artisans, metalwork industrial personnel and metalwork lecturers on the strategies for improving the safety practices to be observed in mould preparation practices in casting operation in Kano state, Nigeria. The three categories of respondents unanimously agreed to all the items with mean value ranging from 3.18 to 3.48. This implies that the items presented are techniques for standardizing safety precautions to be observed in mould preparation practices in casting operation in Kano state, Nigeria. The grand mean of metal casting artisans, metalwork industrial personnel and metalwork lecturers are respectively 3.34, 3.30 and 3.30 indicating that the respondents unanimously agreed to the strategies presented for improving safety practices to be observed in mould preparation practices in casting operation in Kano state, Nigeria. Also the grand mean for total respondents which is 3.31 signified that the three groups of respondents agreed to the items as strategies for improving safety practices to be observed in mould preparation practices in casting operation in Kano State. Table 1 also showed that the standard deviation of the items ranges from 0.51 to 0.90. The 17 items had their standard deviation less than 1.96 showing that the respondents were not too far from the mean and were close to one another in their responses.

Research Question Two

What are the strategies for improving safety practices to be observed in metal handling practices among local metal casting artisans in Kano state, Nigeria?

Table 2: Mean and Standard Deviation of Artisans, Industrial Personnel and Lecturers on techniques on strategies for improving.
safety precautions in Metal Handling practices in casting operations

S/N	ITEM	x_1 n=300	x_2 n=35	x_3 n=16	x_A	SD_A	D
1	Provision of adequate personal protective equipment to reduce risk of burns from handling of hot molten metal	3.36	3.31	3.56	3.41	0.56	A
2	Maintenance of personal protective equipment associated with metal melting operation by workers	3.35	3.46	3.25	3.35	0.68	A
3	Periodically running shifts or reducing work time to reduce workers exposure heat arising from metal melting operation	3.35	3.17	3.56	3.36	0.61	A
4	Training foundry artisans on possible hazards that may arise from handling of hot molten metals	3.37	3.49	3.63	3.50	0.53	SA
5	Placing or posting conspicuous safety warning signs in areas concerning hot molten metals	3.16	3.20	3.50	3.29	0.70	A
6	Placing labels describing content on containers of hazardous hot molten metals	3.50	3.49	3.56	3.52	0.51	SA
7	Provision of warning signs in English and where appropriate in the predominant language of non –English reading workers (e.g Hausa language)	3.23	3.29	3.25	3.26	0.80	A
8	Frequently reinforcing training on safe work practices around furnace during metal melting operation	3.50	3.40	3.56	3.49	0.52	A
9	Eliminating sources of radiant heat in the metal heating zone	3.32	3.29	3.63	3.41	0.56	A
10	Eliminating sources of water vapour in the molten metal area	3.36	3.40	3.50	3.42	0.56	A
11	Reducing heat exposure heat exposure duration	3.36	3.31	3.56	3.41	0.56	A
12	Provision of proper exhaust ventilation to reduce exposure to hazardous fumes and dust	3.36	3.46	3.25	3.36	0.60	A
	GRAND MEAN	3.35	3.36	3.48	3.40	0.60	A

The data presented in Table 2 shows the views of metal casting artisans, metalwork industrial personnel and metalwork lecturers on strategies for improving safety practices to be observed in metal handling practices in casting in Kano State. The respondents strongly agreed to items 4 and 6 with mean value of 3.50 – 3.52. In their responses, the respondents agreed to items 1,2,3,5,7, 8,9 10,11 and 12 with mean score ranging from 3.26 – 3.49. The grand mean of metal casting artisans, metalwork industrial personnel and metalwork lecturers are respectively 3.35, 3,36 and 3.48 indicating that the respondents agreed to the strategies presented for improving safety practices to be observed in metal handling practices in casting in Kano State. Also, the grand mean for total respondents which is 3.40 signified that the three groups of respondents agreed to the items as strategies for improving safety practices to be observed in metal handling practices in casting in Kano State, Nigeria. The standard deviation of the items ranges from 0.51 - 0.80. The 12 items had their standard deviation less than 1.96 showing that the respondents were not too far from the mean and were close to one another in their responses.

Hypotheses Testing

Hypothesis One

There is no significant difference in the mean ratings of metal casting artisans, metalwork industrial personnel and metalwork lecturers on the strategies for improving safety practices to be observed in mould preparation practices among local metal casting artisans in Kano state, Nigeria.

Data that was used to answer Hypothesis Two is shown on Table 3.

Table 1.2: One-way ANOVA of mean scores of respondents on the strategies for improving safety practices to be observed in mould preparation practices in casting operation

Source	Sum of Square	Df	Mean Square	F	Sig. (p-value)
Between Groups	0.084	2	0.042	1.937	0.146
Within Groups	7.537	349	0.022		
Total	7.621	351			

The result of analysis as presented in Table 3 showed that there was no significant difference ($p < 0.05$) in the mean scores of the respondents. The hypothesis two was therefore upheld (accepted). The data supported the hypothesis two, $F(2, 349) = 1.927$, p (sig.) $= 0.146$. This result implies that the items presented are suitable strategies for improving safety practices to be observed in mould preparation practices in casting operation in Kano State (See appendix G for details of the data resulting from analysis).

Hypothesis Two

There is no significant difference in the mean ratings of metal casting artisans, metalwork industrial personnel and metalwork lecturers on the strategies for improving safety practices to be observed in metal handing practices among local metal casting artisans in Kano State, Nigeria.

Data that was used to answer Hypothesis Two is shown on Table 4.

Table 3: One-way ANOVA of mean scores of respondents on the strategies for improving safety practices to be observed in metal handing practices in casting operation

Source	Sum of Square	df	Mean Square	F	Sig. (p-value)
Between Groups	0.270	2	0.135	5.168	0.080
Within Groups	9.094	349	0.026		
Total	9.364	351			

The result of analysis as presented in Table 3 showed that there was no significant difference ($p > 0.05$) in the mean scores of the respondents. The hypothesis four was therefore upheld (accepted). The data supported the hypothesis four, $F(2, 349) = 5.168$, p (sig.) $= 0.080$. This result implies that the items presented are suitable strategies for improving safety practices to be observed in metal handing practices in casting operation in Kano State.

Findings of the Study

1. Strategies for improving safety practices in mould preparation practices among local metal casting artisans are: adhering strictly to safe operating procedures during mould preparation activity, regularly inspecting foundry workers at each stage of mould preparation, using the appropriate mould preparation tool for specific task, regularly checking to ensure moulding equipment are in safe working condition, keeping records of molding equipment maintenance as well providing adequate ventilation to reduce hazards resulting from mixture of mould sand and binding materials, among others.

2. Strategies for improving safety practices in metal handling practices among local metal casting artisans are: frequently reinforcing training on safe work practices around furnace during metal melting operation, provision of proper exhaust ventilation to reduce exposure to hazardous fumes and dust, placing labels describing content of containers of hazardous hot molten metals, provision of adequate personal protective equipment to reduce the incident of burns resulting from handling hot molten metals, among others.

3. There is no significant difference in the mean responses of metal casting artisans, metalwork industrial personnel and metalwork lecturers on the strategies for improving safety practices to be observed in mould preparation practices in casting operation in Kano State, Nigeria.

4. There is no significant difference in the mean responses of metal casting artisans, metalwork industrial personnel and metalwork lecturers on the strategies for improving the safety practices to be observed in metal handling practices in casting operation in Kano State, Nigeria.

Discussion of Findings

Findings on the strategies for improving safety practices to be observed in mould preparation practices in casting operation in Kano State revealed among others that, strategies for improving safety practices in mould preparation practices in casting operation are : adhering strictly to safe operating procedures during mould preparation activity, regularly inspecting foundry workers at each stage of mould preparation, using the appropriate mould preparation tool for specific task, regularly checking to ensure moulding equipment are in safe working condition, keeping records of moulding equipment maintenance as well providing adequate ventilation to reduce hazards resulting from mixture of mould sand and binding materials, among others.

The findings on adhering strictly to safe operating procedures during mould preparation activity is in line with the findings of Anshika (2017) who studied top ten foundry safety practices and discovered that a key parameter for high yield and safe operation is to strictly adhere to existing standard work procedure established to ensure safety precaution is improved in foundries.

The findings on regularly inspecting foundry workers at each stage of mould preparation, using the appropriate mould preparation tool for specific task, regularly checking to ensure moulding equipment are in safe working condition is in agreement with the research discoveries of National Institute for Occupational Safety and Health (NIOSH, 2015) who in a study on the control of occupational safety and health hazards in foundries found that to enhance safety precaution in mould preparation, engineering controls such as local exhaust ventilation, noise damping materials, machine guarding, molten metal splash barriers, and radiant heat shielding can be employed to provide a healthful and safe working environment for mould preparation in foundries.

The findings on hypothesis one revealed that, there is no significant difference in the mean responses of metal casting artisans, metalwork industrial personnel and metalwork lecturers on the strategies for improving safety practices to be observed in mould preparation practices in casting operation in Kano State, Nigeria. The hypothesis two was therefore upheld (accepted). This result implies that the items presented are suitable strategies for improving safety practices to be observed in mould preparation practices in casting operation in Kano State.

The findings on the strategies for improving safety practices to be observed in metal handling practices in casting in Kano State revealed among others that, strategies for improving safety practices in metal handling practices in casting operation are : frequently reinforcing training on safe work practices around furnace during metal melting operation, provision of proper exhaust ventilation to reduce exposure to hazardous fumes and dust, placing labels describing

content of containers of hazardous hot molten metals, provision of adequate personal protective equipment to reduce the incident of burns resulting from handling hot molten metals, among others.

These findings were collaborated by Edwin (2017) who studied values of foundry products for modern industries in the state and local government and found out that, an effective work practices program encompasses many elements, including safe standard operating procedures, proper housekeeping and sanitation, use of protective clothing and equipment, good personal hygiene practices, provisions for dealing with emergencies, workplace monitoring, and medical monitoring.

The findings on placing labels describing content of containers of hazardous hot molten metals was buttressed by Rajkolhe, and Khan (2014) who studied defects, causes and their remedies in casting process and found out in ideal situation, standardized work practices are supported by proper labeling and posting and training all of which will serve to inform personnel of foundry hazards and of the procedures to be used to guard against such hazards. Edosa (2015) in a study on developing the foundry industry for sustainable development found out that good supervision provides further support by ensuring that the work practices are followed and that they effectively protect workers from the hazards.

The findings on hypothesis two revealed that, there is no significant difference in the mean responses of metal casting artisans, metalwork industrial personnel and metalwork lecturers on the strategies for improving safety practices to be observed in metal handling practices in casting operation in Kano State, Nigeria. The hypothesis two was therefore upheld (accepted). From the results it can be deduced that the items presented are suitable strategies for improving safety practices to be observed in metal handing practices in casting operation in Kano State Nigeria.

Conclusion

From the findings of this study, it can be concluded that strategies for improving local metal casting practices were established. The strategies are in the area of mould preparation, safety precautions in mould preparation, metal handling and safety precautions in metal handling practices. The study has provided an additional literature to the existing body of knowledge in the strategies for improving safety to be observed in mould preparation and metal handling practices in metal casting operations in Kano State Nigeria. This provides empirical evidence for the use of the different strategies in improving mould preparation and metal handling practices as well as in enhancing safety precaution in mould preparation and metal handling practices.

Recommendations

Based on the findings from this study, the following recommendations are made:

1. Foundry artisans should endeavour to adhere strictly to the strategies that are used for improving and enhancing safety in mould preparation and metal handling operations in metal casting practices.

2. Kano State Government should create awareness of the various strategies that are used for improving and encourage the stakeholders to adhere strictly to these techniques to enhance quality and safe work practice in mould preparation and metal handling operations to improve metal casting practices in Kano State, Nigeria.

3. Kano State Government should make effort to purchase the modern computer and electronic equipment that can be used to enhance standard operational practices in mould preparation and metal handling practices in metal casting. Constant power supply to enable the stakeholders reduces their cost on using generators for their operations is also needed.

4. Quality training and periodic retraining programmes should be organized by government, association and other relevant agencies for foundry artisans to expose them on how to use modern electronic foundry equipment to enhance standardization in mould preparation and metal handling practices.

5. Industries, government, non-governmental agencies, private enterprises and communities should provide consumable materials necessary for practical activities and teaching strategies for improving safety precautions to be observed in mould preparation and metal handling practices in metal casting practices in Kano State, Nigeria.

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EFFECT OF ARTIFICIAL INTELLIGENCE ON ACADEMIC ACHIEVEMENT OF TECHNICAL EDUCATION STUDENTS IN TERTIARY INSTITUTION IN NIGER STATE

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Abstract

This study was designed to determine the effects of artificial intelligence on Academic achievement of Technical Education students in Tertiary Institution in Niger state. A pre-test, post-test, non-equivalent control group, quasi-experimental research design was adopted. 50 students constituted the subjects in the experimental group and 50 students constituted the subjects in the control group for the study. A total of 100 students were involved in the study. Three research questions which include a null and void hypothesis, tested at 0.05 level of significance, guided the study. The instruments were also subjected to face validation by three experts in Industrial and Technical Education. The reliability coefficient obtained was 0.76. Mean was used to answer the research questions; while T-test was employed to test the hypothesis. The study revealed that students taught Technical Education using the artificial intelligence had a higher mean score than students taught using the conventional teaching method in cognitive achievement test, psychomotor achievement test. In each of the cases, the high mean scores were found to be significant. Furthermore, the mean score of boys taught Technical Education using the artificial intelligence was higher than the mean score of girls taught using the same artificial intelligence in the cognitive achievement test, the researcher recommended that. The National Board for Technical Education (NBTE) should consider a review of the curriculum for Tertiary institutions with a view to incorporating the artificial intelligence into the teaching of Technical Education.

Keywords: Academic Achievement, Artificial Intelligence, Technical Education, Tertiary Institution

Introduction

Throughout the world, and in particular the countries of West Africa, governments are renewing efforts to promote technical education with the belief that skill formation enhances productivity and sustains competitiveness in the global economy. According Tsado (2020), in recent years, concerns have been raised by most African countries about the move towards making complementary to post-basic education. The challenge for preparing students for the 21 century, workplace basic skills therefore has necessitated a shift from instructional approaches based on the behavioral learning theories to those rooted in cognitive psychological learning theories for which artificial intelligence techniques is one (Avvolua-efebo, 2022). Constructivist according to Epstein and Ryan (2022) is based on the concept that learning is a constructive process in which the learner is building an internal illustration of knowledge on a

personal interpretation of experience. Constructivist is a theory of learning based on the idea that knowledge is constructed by the learner based on mental activity. Two important notions orbit around the simple idea of constructed knowledge (Demmert 2021). However explained that the first notion is that learners construct new understandings using what they already know. The second is that learning is active rather than passive. Learners apply their understanding in the light of what they encounter in new situations. If what learners encounter is inconsistent with their current understanding, their understanding can change to accommodate new experience. Learners remain active throughout this process; they apply current understandings, note relevant elements in new learning experiences, judge the consistency of prior and emerging knowledge, and based on that judgment, they can modify knowledge.

Artificial intelligence (AI) applications in education are becoming more popular and have gotten a lot of press in recent years. AI is a leap across creative and innovative thinking in various fields, including mathematics education. The current study indicates various research of AI in different context (Hwang, *et al.,* 2020). The use of AI can enhance our abilities in living a life covered in increasingly sophisticated technology. According to Cleminson (2020), based on the development of computer technology, AI continues to expand and innovate. AI enables students to develop and enhance more mathematical skills and cognitive skills in learning. Popenici and Kerr (2017) the role of technology in higher learning is to enhance human thinking and augment the educational process. AI helps students in finding answers faster and easier. All information about the lesson can be easily accessed by students using this innovative intelligence software. In this generation, students are more inclined to learn and explore new knowledge on their own, so this powerful tool of AI can help students to explore more without waiting for an educator. Cope *et al.* (2020) indicate, however, the role of AI will never 'take over' the duty of educator in any way. Furthermore, the deployment of these technologies for teaching, learning, student assistance, and administration faces various hurdles (Popenici & Kerr, 2017).

Over the years, teaching methods based on behavioural learning theory has been adopted to teach vocational subjects in the Tertiary institutions irrespective of the fact that technological advancement in industry requires that students be equipped with workplace basic skills such as thinking skills, problem solving and collaborative work skills which will make them adaptable to changes in work places. According to Rojevvski (2022) lecture and demonstration methods which are based on behavioural learning theory are the main teaching/learning methods employed for implementing the curriculum in the tertiary institutions. Apart from the fact that these methods are teacher-centred students are not given enough opportunities to participate in the classroom instruction. These methods which are predominantly used in teaching technical education in the tertiary institutions emphasize knowledge transmission from the teacher to passive students and encourage rote memorization of fact (Boyle, *et al.,* 2023). Besides, teaching methods which are based on behavioural learning theories are directed towards isolating the learner from social interaction and towards seeing education as a one-on-one relationship between the learner and the objective material being learned (Epistein and Ryan 2022). The consequence of the use of these methods in teaching vocational subjects such as technical education in the tertiary institutions is that students are unable to retain their learning and apply it in new situations (Rusbult 2015). Indicated that traditional teaching- learning approaches based on behavioural learning theory do not adequately equip students with higher-order thinking skills, collaborative and problem solving skills, but constructivist theory does, Perhaps, if thinking skills, oral discourse, authentic/situated learning, collaborative work and framing instructional techniques are combined during instruction to teach technical education in the Tertiary institutions, it will assist in developing students' thinking skills and problem

solving abilities which in turn may help them improve their learning methods employed by teachers in the tertiary institutions thus, seem inadequate for equipping the students studying technical education with the work place basic skills required for work in the building industries which is vast changing with technological advancements. This raises the questions as to whether beside the teacher-centered method there is no such teaching technique of the artificial intelligence which can influence this ugly trend in the subject.

According to Doolittle and Camp (2020) artificial intelligence environments offer the potential for locating learning in the context of real-life situations and problems. Such environments offer a rationale for curriculum integration that connects learning with the workplace .Therefore, if artificial intelligence techniques are adopted in the teaching of technical education in the Tertiary institutions, perhaps the students will be able to acquire workplace basic skills such as collaborative work skills, problem solving skills and thinking skills required in the vast technological world of work and be able to transfer learning under varying technological conditions. The problem of the study therefore was to determine the effects of using the artificial intelligence on academic achievement of technical education students in Tertiary Institution in Niger state.

Purpose of the Study

The purpose of this study was to determine the effects of the artificial intelligence on academic achievement of learning of technical education students in Tertiary Institution in Niger state. Specifically, the study sought to:

1. Determine the cognitive achievement scores of students taught technical education with the artificial intelligence and those taught using the conventional teaching methods.
2. Determine the psychomotor achievement scores of students taught technical education with the artificial intelligence and those taught using the conventional teaching methods.
3. Compare the cognitive achievement scores of male and female taught technical education using the artificial intelligence

Research Questions

The following research questions were formulated to guide this study:

1. What are the mean cognitive achievement scores of students taught with the artificial intelligence and those taught using the conventional teaching methods?
2. What are the mean psychomotor achievement scores of students taught technical education with the artificial intelligence and those taught using the conventional teaching methods?
3. What are the mean cognitive achievement scores of boys and girls taught technical education using the artificial intelligence?

Hypotheses

The following null and void hypotheses guided the study:

HO: There is no significant difference between the mean cognitive achievement scores of students taught technical education with the artificial intelligence and those taught using conventional teaching methods.

HO: there is significant difference between the mean cognitive achievement scores of students taught technical education with the artificial intelligence and those taught using conventional teaching methods.

Methodology

A quasi-experimental design was used for this study. This study was conducted in Niger State. The population for this study comprised all 100 second year students of Technical education two selected tertiary institutions in Niger State. In the quasi-experimental design of this study. The instruments used for data collection in this study are Cognitive Achievement Test (CAT); and Psychomotor Achievement Test (PAT). The instruments were also subjected to face validation by three experts in Industrial and Technical Education. The reliability coefficient of the Cognitive Achievement Test (CAT) was established using test-retest reliability. The teachers that teach each of the two groups subjected the students to pre-testing before treatment. The data collected from the pre-test and post-test of learning was analyzed using mean to answer the research questions. The null and void hypothesis was tested using T-test at 0. 05 level of significance.

RESULTS

Research Question 1

What are the mean cognitive achievement scores of students taught Technical education with artificial intelligence and those taught using the conventional teaching methods.

Table 1

Mean of pre test and post-test scores of Experimental and Control groups in the cognitive achievement test.

Group	N	Pre-test $\bar{X}$	Post-test $\bar{X}$	Mean
Experimental	50	3.85	35.60	31.75
Control ``	50	3.77	19.71	15.94

The data presented in table 1 shows that the experimental group had a mean score of 3.85 in the pre-test and a mean score of 35.60 in the post-test making a pre-test, post-test gain in experimental group to be 31.75. The control group had a mean score of 3.77 in the pre-test and a post-test mean of 19.71 with a pre-test, post test gain of 15.94. With this result, the students in the experimental group will perform better in the cognitive achievement test than the students in the control group.

Research Question 2

What are the mean psychomotor achievement scores of students taught Technical education with artificial intelligence and those taught using the conventional teaching methods?

Table 2

Mean of Pre-Test and Post-Test Scores of Experimental and Control Groups in the Psychomotor achievement test.

Group	N	Pre-test $\bar{X}$	Post-test $\bar{X}$	Mean
Experimental	50	2.92	45.84	42.92
Control ``	50	2.94	24.00	21.06

The data presented in table 2 shows that students in experimental group had a mean score of 2.92

in the pre-test and mean score of 45.84 in the post test. This shows a pre-test, post-test gain of 42.92. Also, the control group had a mean score of 2.94 in the pre-test and had a mean score of 24.00 in the post test giving a pre test, post test gain of 21.06. Therefore, this result indicates that students in the experimental group performed better that the students in the control group in psychomotor achievement test.

Research Question 3

What are the mean cognitive achievement scores of boys and girls taught Technical education with the artificial intelligence?

Table 3

Mean of Pre-Test and Post-Test Scores of Boys and Girls Taught Technical education with the Artificial intelligence achievement

Mean of Boys and Girls Taught Technical education with the Artificial intelligence in the cognitive achievement Post-Test and test of learning.

Group	N	Pre-test $\bar{X}$	Test for Learning
Male	70	35.67	34.33
Female	30	35.48	34.98

The data presentation above shows that boys had a mean score of 35.67 in the post-test and mean score of 34.33 in the test for learning. The girls also had a mean score of 35.48 in post-test and a mean score of 34.98 in the test for learning. The girls also had a mean score of 35.48 in post test and a mean score of 34.98 in the test for academic achievement. The result indicates that the girls performed better then male students in the test for achievement of learning.

Hypothesis

HO: There is no significant difference between the mean cognitive achievement scores of students taught Technical education with the artificial intelligence and those taught using conventional teaching methods

HO1: There is significant difference between the mean cognitive achievement scores of students taught Technical education with the artificial intelligence and those taught using conventional teaching methods

Table 4

Summary of T-Test of Significance between the Mean Scores of Experimental and Control Groups in Cognitive Achievement Test

Group	N	$\bar{X}$	SD	Df	t-value calculated	t-value critical	P
Experimental	50	64.24	9.59	49	28.45	1.68	0.00
Control	50	21.70	5.76				

Highly significant at the 0.05 level

From the result in the table above, the calculated t-value 28.45 is greater than the critical t-value 1.68 at 0.05 level of significance. Thus, there was a significant difference between the

performances of students taught technical education with the artificial intelligence and those taught using conventional teaching methods. This indicates that artificial intelligence enhanced students' academic achievement in technical education. The null hypothesis was therefore rejected and the alternative hypothesis accepted.

Discussion of Findings

The data presented in table 1 provided answer to research question one, finding revealed that students taught with artificial intelligence had a higher mean score than those students taught using the conventional teaching method in cognitive achievement test. In the same vein, the t-test presented in Table 4 confirmed that the difference between the mean scores of students taught with artificial intelligence and conventional teaching method was significant. The significant difference is attributed to the treatment given to the experimental group. This finding indicated that the artificial intelligence has a positive effect on students cognitive achievement in Technical education. This implies that the artificial intelligence (collaborative learning, oral discourse, thinking skill, authentic task and learning frame) is more effective than the conventional teaching method in enhancing students' cognitive achievement in Technical education. The findings that artificial intelligence has positive effect on students achievement is similar to the finding of Becker and Maunsaiyat (2022), who in (heir study found out that the adoption of artificial intelligence in the teaching of Thailand vocational Technical education students improved the students' achievement in Technical education than the students taught with traditional instructional method.

The analysis of the result of the psychomotor achievement test presented in Table 3 which provided answer to research question three showed that students taught with artificial intelligence had a higher mean score than those students taught using the conventional teaching method in psychomotor achievement test, The t-test presented in Table 4 confirmed that the difference between mean score of the students in both groups was significant. These findings indicated that the artificial intelligence has a positive effect on tertiary institution student's psychomotor achievement in Technical education. This finding may be attributed to the fact that those students taught with artificial intelligence engaged in an authentic task in an authentic environment using real objects such as tools and machines. There has been a great deal written about authentic activities in recent times as the influences of constructivist philosophy. According to Boyaci (2016) authentic activities is anything students are expected to do, beyond getting input through reading or listening, in order to learn, practice, apply, evaluate, or in any other way respond to curricular content' Similarly, Caberera and Nassa (2022) staled that authentic activities 'encourage and affirm learning but essentially, they encourage the learner to respond to the classroom teaching and learning rather than remain passive.

Conclusion

This study set out to determine the effects of the artificial intelligence on academic achievement of Technical education students in Tertiary institutions. The artificial intelligence (collaborative learning, oral discourse, thinking skill, authentic task and Framing) used in this study greatly affected the students learning of Technical education. This was reflected in the students' cognitive and psychomotor achievement of learning. In other words, students learnt Technical education and acquired psychomotor skills better when they were allowed to participate actively in the classroom teaching and learning by interacting with teacher, learning environment and their colleagues, work and learn together in groups. Also, students retained their learning for a longer time when they were allowed to think on possible solutions to a problem while engaging in practical activities with real objects, tools and machines collaboratively. It is hoped therefore, that if the artificial

intelligence is taken into consideration in the teaching of Technical education in the Tertiary institutions, craftsmen trained will graduate from the Tertiary institutions with knowledge, psychomotor skills, strong problem solving, creative thinking, collaborative work, and independent decision making skills which will make them adaptable to the present and envisaged changes in the Building industries occasioned by technological advancement.

Recommendations

Based on the findings of this study, the following recommendations are made;

1. Tertiary institutions lecturers should adopt the use of the artificial intelligence to the teaching of Technical education.
2. Government should provide tools and equipment needed to teach the slate- of- the art of Technical education in the Tertiary institutions.
3. Ministry of education and administrators of Tertiary institutions should always organize seminar, conferences and workshops to sensitize technical teachers on the use of the Artificial intelligence.

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IMPACT OF PROBLEM-BASED LEARNING ON THE ACHIEVEMENT OF BASIC SCIENCE AND TECHNOLOGY STUDENTS IN JUNIOR SECONDARY SCHOOLS IN CHANCHAGA LGA, NIGER STATE

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Abstract
This study investigated Impact of Problem-Based Learning on the Achievement of Basic Science and Technology Students in Junior Secondary Schools in Chanchaga LGA, Niger State. The population for the study was all the 1,552 students in Junior Secondary School II in Chanchaga Local Government Areas of Niger State. The design for the study is Quasi-experimental using pretest posttest non-randomized control group with an intact class. The sample consisted of a total of 52 students, make up 29 experimental group, 23 control group. Gender 16 males and 11 females. Two instruments, Basic Science and Technology and Technology achievement test (BSTAT) and Basic Science and Technology Interest Inventory (BSTII) were used. The instruments were subjected to validity and reliability test. The result obtained from trial testing was used to determine the reliability coefficient for BSTAT and BSTII using K-R20 (Kuder Richardson) and Cronbach alpha respectively. The reliability coefficient of BSTAT and BSTII is 0.73 and 0.77 respectively. The BSTAT was re-administered to the same 20 Students to test for the stability of the instrument since the BSTAT would be used for both pre-test and post-test in view of the research design. The scores from the two tests were calculated using Pearson Product Moment Correlation Coefficient. The calculated Pearson r is 0.69 which was considered good enough. The data collected were statistically analyzed using t-test. The results obtained showed that significant difference exists in the achievement and interest of subjects in Basic Science and Technology taught with problem-based learning. The application of Multiple Classification Analysis (MCA) showed that students in taught with problem-based learning strategy achieved and developed more interest significantly than those taught with lecture method. Based on the findings, problem-based learning is more effective in the enhancement of students' academic achievement and interest in Basic science and technology. The study recommended that the teaching of basic science and technology should be very flexible to incorporate new strategies. problem-based learning should be adopted and integrated into the Junior Secondary School Curriculum.

Keywords: Problem-based learning, students, achievement, basic science and technology

Introduction

Problem-Based Learning (PBL) has emerged as a transformative educational approach that holds significant potential in enhancing the achievement of Basic Science and Technology students in junior secondary schools (Bara & Xhomara, 2020). As educational paradigms shift to meet the demands of the 21st century, the traditional methods of instruction are increasingly being supplemented or replaced by more innovative approaches that emphasize critical thinking, problem-solving, and the application of knowledge to real-world scenarios. In this context, PBL offers a powerful tool for engaging students in active learning, promoting deeper understanding, and improving academic outcomes in subjects that are foundational to their future academic and career success.

Basic Science and Technology (BST) is a core component of the junior secondary school curriculum, designed to equip students with essential scientific knowledge and skills that are crucial for their overall intellectual development (Bara & Xhomara, 2020). However, the effectiveness of traditional instructional methods in teaching BST has often been called into question, particularly in terms of their ability to foster students' achievement in a meaningful and sustained way (Wang *et al.,* 2021). In many cases, students are required to memorize and regurgitate information without truly understanding the underlying principles or being able to apply what they have learned in practical situations. This approach not only limits students' engagement but also hampers their ability to achieve the higher-order thinking skills that are increasingly demanded in today's knowledge-based economy.

PBL, with its focus on student-centered learning and real-world problem-solving, presents a compelling alternative to traditional teaching methods in BST. By placing students in the active role of problem-solvers and encouraging them to explore, investigate, and collaborate, PBL helps to bridge the gap between theoretical knowledge and practical application (Bate *et al.,* 2014). This approach not only enhances students' understanding of scientific concepts but also develops their ability to think critically, work collaboratively, and communicate effectively—skills that are essential for success in both academic and professional contexts.

The connection between PBL and students' achievement in Basic Science and Technology can be understood through several key factors (Günter & Alpat, 2017). PBL fosters a deeper engagement with the subject matter. Instead of passively receiving information from the teacher, students in a PBL environment are actively involved in the learning process. They are encouraged to ask questions, conduct research, and explore different solutions to the problems they are presented with. This active engagement leads to a deeper understanding of the learning material, as students are required to think critically about the concepts they are learning and how they apply to real-world situations.

PBL promotes the development of higher-order thinking skills. Traditional instructional methods often focus on lower-order thinking skills, such as memorization and recall. In contrast, PBL challenges students to analyze, evaluate, and create higher-order thinking skills that are critical for success in the modern world. By working through complex problems, students develop their ability to think critically and creatively, skills that are essential for innovation and problem-solving in both academic and professional contexts. PBL enhances students' ability to apply what they have learned. In traditional learning environments, students often struggle to see the relevance of what they are learning to their own lives and future careers (Almulla, 2020). PBL addresses this issue by grounding learning in real-world problems that are relevant to the students' experiences and future goals. By working on these problems, students develop the ability to apply their knowledge in practical ways, bridging the gap between theory and practice. PBL promotes collaborative learning (Almulla, 2020). In a PBL environment, students are often required to work in teams to solve problems. This collaborative approach not only helps students develop important social and communication skills but also allows them to learn from each other. By working together, students are exposed to different perspectives and ideas, which can deepen their understanding of the material and enhance their problem-solving abilities. Despite the potential benefits of PBL, its adoption in Nigerian schools, particularly in the teaching of Basic Science and Technology, has been limited (Okolie *et al.,* 2021). This is partly due to the challenges associated with implementing PBL in a traditional educational system. These challenges include a lack of resources, insufficient teacher training, and resistance to change from both educators and students. However, as the demand for more effective educational approaches continues to grow, there is an increasing

recognition of the need to explore and adopt innovative teaching methods like PBL. This study is therefore motivated by the need to examine the impact of PBL on the achievement of Basic Science and Technology students in junior secondary schools.

Statement of the Problem

The objectives of teaching Basic Science and Technology is for students to develop interest in science and technology, acquire basic knowledge and skills in science and technology and apply scientific and technological knowledge and skills acquired to solve contemporary societal problems. These objectives have hardly been achieved over the years. This has been attributed to methods of instruction used by the science teachers which do not take care of the cultural background and the needs of the students. As a result, students have been viewing science taught to them in schools as foreign, abstract, unreal and meaningless. As a result, students merely memorize the contents and concepts taught, to pass their examinations with little or no interest which results in persistent poor achievement.

Various studies revealed that the effective utilization of ethno-science instructional approach influences students' achievement in science. Most of these research works focused in other areas of Woodwork, Electrical, Building, Metalwork, Technical Drawing, Biology, Chemistry, Mathematics and Physics. Much is yet to be done on Basic Science and Technology which is considered as foundation for students' acquisition of scientific and technological knowledge and skills for sustainable national development. The foregoing in mind necessitated the researchers to investigate effects of problem-based learning approaches on basic science and technology students' achievement in junior secondary school.

Purpose of the Study

1. The difference between the mean Basic Science and Technology achievement scores of Students exposed to Problem-based learning and those not exposed to it as measured by the Basic Science and Technology Achievement Test (BSTAT).
2. The gender difference between the mean Basic Science and Technology achievement scores of Students exposed to Problem-based learning and those not exposed to it as measured by Basic Science and Technology Achievement Test (BSTAT).
3. The difference between the mean Basic Science and Technology interest scores of Students exposed to Problem-based learning and those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII).

Research Questions

The following research questions guided this study:

1. What is the difference between the mean Basic Science and Technology achievement scores of Students exposed to Problem-based learning and those not exposed to it as measured by the Basic Science and Technology Achievement Test (BSTAT)?
2. What is the influence of gender on the mean Basic Science and Technology achievement scores of Students exposed to Problem-based learning and those not exposed to it as measured by the Basic Science and Technology Achievement Test (BSTAT)?
3. What is the difference between the mean Basic Science and Technology interest scores of Students exposed to Problem-based learning and those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII)?

Hypotheses

This study was guided by the following hypotheses and tested at 0.05 level of significance;

$H0_1$: There is no significant difference between the mean Basic Science and Technology

achievement scores of Students exposed to Problem-based learning and those not exposed to it as measured in the Achievement Test (BSTAT).

$H0_2$: Gender has no significant influence on the mean Basic Science and Technology achievement scores of Students exposed to Problem-based learning and those not exposed to it as measured by Basic Science and Technology Achievement Test (BSTAT).

$H0_3$: There is no significant difference between the mean Basic Science and Technology interest scores of Students exposed to Problem-based learning and those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII).

Research Method

This study adopted a quasi-experimental research design which is a non-equivalent pre-test post-test control group design. This is considered appropriate because, according to Hassan *et al.* (2016), there will be no randomization of the subjects into treatment and control groups. Intact classes were used to avoid disturbing the normal classes in terms of classroom schedule. The study was carried out in Chanchaga LGA, Niger State, the target population for this study consists of all the 1,552 JSS II Students in the Junior Secondary schools in Chanchaga LGA, Niger State, the sample for this study was made up of 52 Students. The study adopted multi-stage sampling technique to select the sample for the study. Purposive sampling technique was used to select two JSS II schools from Chanchaga LGA, Niger State. The purposive sampling technique was used based on the criteria that: the school was a public school. Then, simple random sampling technique was used to assign the schools to either the experimental group or the control group. Two instruments were used in collecting data for the study. They are the Basic Science and Technology Achievement Test (BSTAT) and the Basic Science and Technology Interest Inventory (BSTII). The instruments were used for the pre-test and the post-test. However, the items used for the post-test were reshuffled. BSTAT is a teacher made achievement test constructed from the Basic Science and Technology curriculum for JSS II. The test items were generated by the researcher. The BSTAT is a Thirty (30) item multiple choice

Face and content validity was established for BSTAT by presenting it to five experts in Science Education Department and industrial and Technology Education Department Federal University of Technology Minna. The result obtained from trial testing was used to determine the reliability coefficient for BSTAT. The internal consistency reliability coefficient was determined using the K-20 (Kuder Richardson) procedure. The calculated K-R20 BSTAT is 0.73. The internal consistency was considered high enough. To test for stability, the instrument was re-administered to the same 20 Students. Scores from the two tests were calculated using Pearson Product Moment Correlation Coefficient. The calculated Pearson r is 0.69. This was considered good enough. The test of stability became necessary since the BSTAT would be used for both pre-test and post-test in view of the research design.

For the Basic Science and Technology Interest Inventory (BSTII), Cronbach Alpha reliability method was used to test the internal consistency. An internal consistency reliability of 0.77 was obtained. This was considered high enough. Pre-test on both BSTAT and BSTII was administered to the Students in the experimental and the control groups prior to the commencement of treatment. That was done by the class teachers in charge. The scores of the pre-test served as a covariate to the Students' post-test scores. The Post-test on BSTAT and the post-test on BSTII were administered to the experimental and control groups immediately after the teaching exercise.

The data collected from the administration of the tests were analyzed in line with the research questions and hypotheses using Mean, Standard Deviation and Analysis of Covariance. The Mean and Standard Deviation were used to answering the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses at P< 0.05 level of significance.

Results

Research Question One

What is the difference between the mean Basic Science and Technology achievement scores of Students exposed to Problem-based learning and those not exposed to it as measured by the Basic Science and Technology Achievement Test (BSTAT)?

Table 1: Students' Basic Science and Technology Achievement Pre-test and Post-test Mean Scores and Standard Deviation

Experimental Condition	N	Pre-Text $\bar{X}$	SD	Post-Test $\bar{X}$	SD	Mean Gain Score
Experimental Group	27	23.37	12.57	43.04	21.77	19.67
Control Group	25	12.36	6.26	17.44	10.69	5.08
Total	52	18.08	11.40	30.73	21.40	12.65

Table 1 above shows that Students exposed to Problem-based learning had a pre-test mean score of 23.37, with a standard deviation of 12.57 while the post-test mean score was 43.04 and a standard deviation of 21.77. The mean gain score between the pre-test and the post-test in experimental group was 19.67.

The Students in the control group had a pre-test mean score of 12.36 with a standard deviation of 6.26 and a post-test mean score of 17.44 with a standard deviation of 10.69. The mean gain score for the control group was 5.08. The mean gain scores difference of the experimental and control groups 12.65. This suggests that the Students who were exposed to Problem-based learning achieved more than those who were not exposed to it. A corresponding hypothesis formulated to further answer the research question is HO_1.

Hypothesis One

$H0_1$: There is no significant difference between the mean Basic Science and Technology achievement scores of Students exposed to Problem-based learning and of those not exposed to it as measured in BSTAT.

Table 2: Summary of the 2 Way Analysis of Covariance (ANCOVA) of Students' Post-test mean Basic Science and Technology Achievement Scores

Source	Type III sum of squares	df	Mean square	F	Sig.	Decision at 0.05 level
Correlated model	14848.747[a]	4	3712.187	20.532	.000	
Intercept	080.933	1	808.933	4.474	.040	
Pre-test	5575.851	1	5575.851	30.840	.000	

Treatment	1691.231	1	1691.231	9.354	.004	S
Gender	47.525	1	47.525	.263	.611	NS
Treatment* Gender	99.520	1	99.520	.550	.462	NS
Error	8497.483	47	180.798			
Total	72454.000	52				
Correlated Total	23346.231	51				

a. R squared = .636 (Adjusted R Squared = .605)

The data in Table 2 indicate that Problem-based learning, which is treatment, as a main factor has a significant effect on Students' achievement in Basic Science and Technology. The calculated F-value of 9.354 is significant at 0.004 at 0.05 levels of significance. This implies that Problem-based learning significantly enhanced Students' achievement in Basic Science and Technology. The null hypothesis of no significant difference in the mean achievement scores of the experimental and control groups is, therefore, rejected

Research Question Two

What is the influence of gender on the mean Basic Science and Technology achievement scores of Students exposed to Problem-based learning as measured by BSTAT

Table 3: Means and Standard Deviation of Students' Scores in Basic Science and Technology Achievement Test by Gender

Gender of		Pre-test $\overline{X}$		Post-test Responden $\overline{X}$		Mean gain score
Males	16	18.21	11.84	29.72	22.51	11.52
Females	11	17.91	11.08	32.00	20.33	14.09
Total	27	18.08	11.40	30.73	21.40	12.65

Results in Table 3 above indicate that male Students had a pre-test mean Basic score of 18.21 and a post-test mean score of 29.72. The mean gain score of male Students is 11.52. The female Students had pre-test and post-test mean scores of 17.91 and 32.00 respectively. The females have a mean gain score of 14.09. Also at pre-test, male and female Students' standard deviations were 11.84 and 11.08 respectively while at post-test, male and female Students' standard deviations were 22.51 and 20.33 respectively. However, the female Students had a higher mean gain score than the males. A corresponding hypothesis formulated to further address research question three is Ho_3 which stated that Gender has no significant influence on the mean Basic Science and Technology achievement scores of Students exposed to Problem-based learning as measured by Basic Science and Technology Achievement Test (BSTAT).

Result in Table 2 indicates that there is no significant differences in the post- test mean Basic Science and Technology achievement scores of male and female Students. This is shown by the F-value of .263 in respect of gender as a factor in the study which is significant at .611 levels. This indicated that at 0.05 levels, the F-value of .611 was not significant. The null hypothesis of no significant influence of gender on the mean Basic Science and Technology achievement score of Students exposed to Problem-based learning still stands. This implies that the female Students did not achieve significantly

better than the male Students in BSTAT. Therefore, gender is not a significant factor in Basic Science and Technology achievement of Students. The null hypothesis is therefore not rejected.

Research Question Three

What is the difference between the mean Basic Science and Technology interest scores of Students exposed to Problem-based learning and of those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII)?

Table 4: Students' Basic Science and Technology Interest Pre-test and Post-test Mean Scores and Standard Deviation

Experimental Condition	N	Pre-Text $\bar{X}$	SD	Post-Test $\bar{X}$	SD	Mean Gain Score
Experimental Group	27	18.52	8.38	53.48	7.19	34.96
Control Group	25	15.80	3.95	49.20	6.06	23.40
Total	52	17.21	6.71	51.42	6.95	34.21

Table 4 indicate that the pre-test and post-test interest mean scores of Students exposed to Problem-based learning were 18.52 and 53.48 respectively with the standard deviation of 8.38 and 7.19 respectively. The mean interest gain score for the experimental group is 34.96. The pre-test score and post-test interest mean scores of Students in the control group were of 15.80 and 49.20 respectively with standard deviation of 3.95 and 6.06 respectively. The mean interest gain score for the control group is 23.40. This, therefore, suggests that Students exposed to self- instruction strategy had more interest in Basic Science and Technology than those not exposed. A corresponding hypothesis generated to further address research question two is Ho2.

H02: There is no significant difference between the mean Basic Science and Technology interest scores of Students exposed to Problem-based learning and of those not exposed to it as measured by Basic Science and Technology Interest Inventory (BSTII).

Table 5: Summary of 2-Way Analysis of Covariance (ANCOVA) of Students' Post-test mean Basic Science and Technology Interest Scores

Source	Type III sum of squares	Df	Mean square	F	Sig	Decision at 0.05 Level
Correlated Model	435.030[a]	4	108.757	2.521	.053	
Intercept	17106.047	1	17106.047	396.508	.000	
Pre-Test	54.194	1	54.194	1.256	.268	
Treatment	390.396	1	390.396	9.049	.004	S
Gender	149.201	1	149.201	3.458	.069	NS
Treatment* Gender	11.439	1	11.439	265	.609	NS
Error	2027.662	47	43.142			
Total	139968.000	52				
Correlated Total	2462.692	51				

Results in Table 5 indicate that Problem-based learning , which is the treatment, as a main factor has a significant effect on Students' interest in Basic Science and Technology. This is shown by the F-value of 9.049 which is significant at .004 and 0.05 levels. This implies that the null hypothesis of no significant difference in the mean interest score of Students exposed

to Problem-based learning in Basic Science and Technology and those not exposed is rejected. This suggests that there is a significant difference in the mean interest scores of Students exposed to self- instruction strategy in Basic Science and Technology and those not exposed.

Discussion of the Findings

The result of the study indicates that Problem-based learning has a significant effect on Students' achievement in Basic Science and Technology. Students who were taught Basic Science and Technology using Problem-based learning achieved significantly higher than those taught without using the strategy. The finding of this study is in line with the findings of some earlier studies on the positive effect of different learning strategies with respect to Students' achievement in Basic Science and Technology. The studies conducted by Usman, Hassan, Maik & Musa (2015); Cyril (2013) provide credence for the present study. The studies showed that there is a significant difference in the Basic Science and Technology achievement of Students in the treatment group that used self-instruction strategies than in the achievement of Students in the control group. The enhancement in Students' achievement in Basic Science and Technology could be due to the Students' understanding of the self- instruction strategy. The finding of this study suggests that Problem-based learning help Students to actively be in-charge of the learning process and to monitor the progress in learning exercise. As Students are deeply involved in active learning, they are able to learn the processes involved in solving BSTAT problems.

The result of this study showed that male and female Students in the experimental group performed better than their counterparts in the control group in Basic Science and Technology achievement. An important finding is that the female Students in the experimental group had higher mean achievement scores than their male counterparts. However, the analysis of covariance (ANCOVA) for gender as main effect indicates that gender has no significant influence on the Basic Science and Technology achievement of Students. This means that gender is not a significant factor in the use of the learning strategy. The finding is in consonance with the studies conducted by Atadoga & Lakpini (2013) and Ezeudu (2011) which also showed that there is no significant difference in the performance of boys and girls in Basic Science and Technology achievement using learning strategies.

These findings, however, contradict some earlier finding which portray gender as a significant factor in Basic Science and Technology achievement (Hassan *et al.*, 2016). The results obtained indicate that male Students had higher mean scores than the females in Basic Science and Technology Achievement Test. The findings of this study could be explained in line with the view of Ezeudu (2011) who stated that gender has no direct effect on Basic Science and Technology achievement. Exposing Students to Problem-based learning may have removed the differences that existed between the two genders. This implies that both male and female Students benefited significantly from the strategy. However, the non-significant difference in Basic Science and Technology achievement of male and female Students could also be attributed to effective use of Problem-based learning which ensured Students' active participation in the learning process.

The results of this study show that Problem-based learning significantly enhanced the interest of Students in Basic Science and Technology. Those in the treatment group had a significantly higher mean interest rating in Basic Science and Technology interest inventory than those in the control group. The finding of this study is in line with the findings of some earlier studies which indicated that interest determines the level of learning outcomes. Hassan (2016) found that students develop more competence in subjects they are interested. In effect, the interest students show in an activity or in an area of knowledge predicts how much they will attend to

it and how well they process, comprehend and remember it (Atadoga & Lakpini, 2013). As the students practice and realize some positive outcomes and success, they gain greater confidence in their ability to succeed in Basic Science and Technology. Their interest and urge to do more also increases. This could be the reason for the higher interest in learning Basic Science and Technology as demonstrated by Students in the experimental group.

Conclusions

This study indicated that using Problem-based learning for teaching multiplication and division in Basic Science and Technology enhanced Students' achievement and increased their level of interest in the subject. Male and female Students taught Basic Science and Technology content with Problem-based learning achieved equally and exhibited the same level of interest in the subject. This implies that gender has no significant influence in the achievement and interest of Students exposed to Problem-based learning in Basic Science and Technology. Equally, the interaction effect of teaching Basic Science and Technology content with Problem-based learning and gender was not significant in the achievement and interest of Students.

Recommendations

Based on the findings of this study and the educational implications, the following recommendations are made:

1. Students should be exposed to Problem-based learning since the findings of this study indicate that it has a facilitative effect on their achievement and interest in Basic Science and Technology irrespective of gender.
2. Evidence from the study indicates that the Problem-based learning could be taught so in-service teachers should, therefore, be taught this strategy as they themselves need to be equipped with the most effective ways of teaching their Students Basic Science and Technology.
3. Through these conferences, workshops, seminars and enlightenment programmes, teachers should be encouraged to make learning pupil-centred and not teacher-centred. They should ensure that Students are actively involved in the learning activity by allowing them to take active participation in every learning situation.

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PERCEPTIONS OF SCIENCE EDUCATION TEACHERS TO DIFFERENTIATED AND SCAFFOLDING INSTRUCTIONAL STRATEGIES AMONG SENIOR SECONDARY SCHOOL STUDENTS IN MINNA METROPOLIS

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Abstract
The study investigated the perceptions of Science Teachers towards Differentiated and Scaffolding Instructional Strategies among Senior Secondary School Students in Minna Metropolis. The study adopted Descriptive research design, the study obtained current information on the teachers' perception towards DI and SI in teaching science subject. The population consisted of 30 science teachers from difference discipline, 17 male and 13 female respectively. The instrument developed by the researcher was used to collect the data from the participants. Descriptive mean and standard deviation were used to answer the research questions and ANOVA was used to answer the questions. The findings revealed that there were positive perceptions of science teachers on the use of DI and SI. The findings further revealed that the male science teachers had more positive perceptions on the use DI and SI than the female teachers. It was recommended that the use of DI and SI in teaching science would ensure a positive outcome from the students when students are given the chance to participate in learning.

Introduction
Differentiated instruction is a diversity-based approach, it may offer a solution for an increasing diversity of the student. Differentiated instruction is defined as adjusting lessons to meet student learning needs by using regular assessment data to develop lessons and instructional groups (Tomlinson, 2022). Educators alter grade - level instruction to better meet student learning - style and learning level. Students of the same classroom may receive different instructional lessons on the same subject.

Differentiated instruction is typically presented to students in a small group format. Small group instruction allows educators to use different types of instruction for a particular group of students. These students may be at a different academic level than their aged peers. These students may need instruction of a grade -level concept not yet user friendly for them. These students may have "holes" in their academic portfolio for various reasons (Tomlinson, 2022), the need to differentiate instruction becomes eminent and seems a good fit for the current realities of diverse classrooms (Gaitas and Martins, 2017; Pozas *et al*., 2020). It is, therefore, imperative that teachers should be prepared to implement appropriate differentiation in their daily lesson.

Differentiation is a philosophy of teaching rooted in deep respect for students, acknowledgment of their differences, and the drive to help all students thrive (Smale-Jacobse *et al*., 2019). As Tomlinson (2015) point out, differentiation is an organized, yet flexible way of proactively adjusting teaching and learning to meet diverse students where they are and to help them achieve maximum growth as learners. This pedagogical framework calls upon teachers to adjust curricular contents, resources, instructional methods, learning activities, modes of assessment and aspects of learning environment in light of student's differences (Kovtiuh, 2017). As it recognizes the spectrum of differences among students and enables teachers to

attend to the specific learning styles of each student by adjusting what they teach and how they teach it (Koutselini, 2016; Tomlinson, 2015). Differentiated instruction aims to help students find their academic goals (Pozas *et al*., 2021). In order to achieve these goals, teachers as a facilitator must be able to vary their instruction based on student's need, it gives students a big picture of knowledge instead of isolated knowledge.

On the other hand, Instructional scaffolding, also known as "Vygotsky scaffolding" or just "scaffolding", is the teaching method that helps students learn more by working with a teacher or a more advanced student to achieve their learning goals (Sarikas, 2020).

Scaffolding is "supportive instructional structure that teachers use to provide the appropriate mechanisms for student to complete a task that is beyond their unassisted abilities" (Ray, 2017). van de pol, Volman, and Beishuizen (2010) described scaffolding as a process that includes contingency, fading, and transfer of responsibility. Contingency is the support that teachers initially give to students, such as modeling. Fading may be described as half - in, half - out or the "mulky" zone. The teacher is pulling away given support or scaffolding to give full control of task completion back to the student. Transfer of responsibility is the intended outcome. At this stage of the scaffolding process, students "own" the knowledge/skill to complete the task independently and are often able to assist others in completing the task.

The teacher role in scaffolding might include collaboration or discussion with a student to "brainstorm" solutions of an issue or complete a task. A second teacher role might be constantly asking the student questions about the task to help them develop "files" of information about the task. This assists students in building knowledge to increase student ability to explain concepts. A third teacher role is to constantly model and explain tasks in the ideal format of student's current maturation level. The ideal format is just beyond what the student can accomplish on their own, often referred to as student zone of proximal development (Ray, 2017).

The scaffolding instructional strategy is usually used to focus more on an individual student's learning needs just as differentiated instruction during instructional lesson or completion of a particular task than to a group of students, or it may also be present in the small group instruction. This strategy is often used unconsciously by the instructor to increase student engagement and completion of a task, such as a teacher might read a question for a student or have a conversation about what the question is asking. Teachers may give students a copy of the formula for area or the multiplication table that can be removed from the student when they can use the information provided fluidly.

When scaffolding is incorporated in the classroom, the teacher become more of a mentor and facilitator of knowledge rather than the dominant content expert. Although scaffolding is often carried out between the teacher and one student, scaffolds can successfully be used for an entire class. In teaching and learning situations, more complex content might require a number of scaffolds given at different times to help students master the content. In scaffold lesson, the teacher provide encouragement and praise as well as ask questions and have students explain their progress to help them stay focused on their learning goals. It also enables the teacher to help students become less dependent on instructional supports as they work on tasks and encourage them to practice the task in different contexts.

Differentiation and Scaffolding instructional strategies plays important role in teaching and learning processes as revealed by numerous studies. In spite of its importance, scaffolding

technique has long being neglected approach in teaching of science subjects. The processes of employing differentiated and scaffolding instructional strategies on the part of learners and explicitly teaching skills on the part of teachers, has been overlooked. This neglect come through strong emphasis on traditional teaching approach. One of the major difficulties facing education sector in Nigeria, is the low level of the academic performance of students in local and standardized examinations. It has become a great concern for researchers, educators and stake-holders in the educational sector over the years. It is observed that students usually failed in examinations due to improper teaching technique, motivation and lack of essential teaching aids for instructional delivery. Against this backdrop, the researcher is motivated to carry out this study with a view to use differentiated and scaffolding techniques to teach science subjects in our secondary schools in order to enhance their academic performance. Thus, this paper deemed it necessary to look specifically into the perception of differentiated and Scaffolding instructional strategies among senior secondary schools students in Minna Metropolis.

Research Objectives

The following objectives is a guide to the study to:

(1) determine the perception of science education teachers toward differentiated and Scaffolding instructional strategies among senior secondary schools students in Minna Metropolis

(2) examine the male and female science education teachers perception toward differentiated and Scaffolding instructional strategies

(3) determine the perception of science education teachers to differentiated and Scaffolding instructional strategies based on years of experience.

Research Questions

(1) what is the perception of science education teachers toward differentiated and Scaffolding instructional strategies among senior secondary schools students in Minna Metropolis?

(2) what is the perception of male and female science education teachers toward differentiated and Scaffolding instructional strategies?

(3) what is the perception of science education teachers to differentiated and Scaffolding instructional strategies based on years of experience?

Research Hypothesis

HO_1: There is no significant difference in the use of differentiated and Scaffolding instructional strategies among senior secondary schools students in Minna Metropolis

HO_2: There is no significant different in the perception science education teachers toward the use of differentiated and Scaffolding instructional strategies based on years of experience.

Research Methodology

This study adopted a quantitative research methodology. The Descriptive approach was followed, through the scale of Perceptions of science education teachers to differentiated and Scaffolding instructional strategies, which was developed and compatible with the objectives of the study. The participants of the study consisted of 30 (17 males and 13 females) who are specialized in different science options. The differentiated and scaffolding strategies in teaching science subjects includes six concept measures of achievement (student interest, assessment, lesson plan, content, process and product). The questionnaire was used to measure the perceptions of science education teachers was collected through cross sectional approach. (SPSS) package (i.e means and standards deviations, and ANOVA) was used for data analysis.

Sample and sampling Techniques of the study

The study sample consisted of (30) science education teachers using simple random sampling techniques. Both male and female science education teachers were selected through the available method (who expressed a desire to participate).

Results and Discussion

Answering Research Questions

Research Question 1: what is the perception of science education teachers toward differentiated and Scaffolding instructional strategies in Minna Metropolis? To answer this research question, mean and standard deviation were used, and the result was presented in Table below

Table 1: Mean and Standard Deviation of Secondary School Science Teachers perception towards differentiated and scaffolding instructional strategies

S/N	Items	Mean	Standard Deviation	Remarks
1	Results in students - centred learning process	3.57	.79	Agree
2	**I**ncrease student academic achievement	3.84	.75	Agree
3	Make teachers feel more competent as educators	3.31	.80	Agree
4	Is an effective strategies for students of all abilities	3.88	.68	Agree
5	Helps accommodate students personal learning styles	3.05	.86	Agree
6	Motivates students to get more involved in learning activities	3.29	.91	Agree
7	Promotes the development of students interpersonal skills(e.g ability to relate or work with others)	3.32	.78	Agree
8	Promotes students collaboration	2.89	.66	Disagree
9	Strengthens the teacher's role as a facilitator	3.80	.84	Agree
10	It is time consuming	3.69	.89	Agree
11	Demands identifying the zone of proximal development	2.54	.78	Disagree
12	Mix student's independent work and teacher's participation.	2.56	.65	Disagree
13	Smaller steps allow for reteaching opportunities when needed and provide a greater opportunity for student learning of larger, more complex content or activities	2.76	.88	Disagree
14	Students are given time to learn new information and asked to think about it	2.78	.74	Disagree
15	Involves grouping students to learn from each other while practicing their skills, task, or content learning as a group	3.15	.93	Agree
16	The teacher gives students a simplified version of a lesson, assignment, or needing , and then gradually increases the complexity	2.55	.95	Disagree

17	The teacher describes or illustrates a concept, problem, process in multiple ways to ensure understanding	3.48	.93	Agree
18	Critical thinking and problem - solving are important skills for students in this aspect	2.85	.91	Disagree
19	I used this strategies to encourage active learning, interaction, participation and collaboration among students	3.87	.86	Agree
20	As a teacher,I support student - centred learning	2.88	.97	Disagree
	Grand mean	3.19	.83	

N=30

Table 1 shows the results of science teachers' perception on the use of differentiated and scaffolding instructional strategies in secondary school. The average mean of 3.0 was used as the benchmark for positive perception and the mean of below 3.0 is considered as negative perception. Consequently, items 1, 2, 3, 4, 5, 6, 7, 9, 10, 15, 17 and 19 show the mean between 3.05 and 3.88 indicating that science teachers' have positive perception on the use of differentiation and scaffolding instructional strategies in teaching senior secondary school students in Minna Metropolis. It is important to highlight that more respondents in this population agreed that the school places a strong emphasis on the use of instructional strategies by science teachers in teaching with the highest mean ($x\square$=3.88; SD=0.68) and science teachers have sound understanding of alternative ways of teaching using different instructional strategies to foster students' learning. The grand mean of 3.19 shows that the science teachers in this population has positive perception on the use of differentiated and scaffolding instructional strategies in teaching senior secondary school students in Minna Metropolis.

The standard deviation grand mean is 0.83, indicating that there is no meaningful deviation of respondents' perception from each other, and the standard deviation mean of the group. This implies that the standard deviations spread in the data set are close to the group mean of the data set.

Research Question 2: what is the perception of male and female science education teachers to differentiated and Scaffolding instructional strategies? To answer this research question, mean and standard deviation were used, and the result presented in the table 2 (two).

Table 2: Mean and Standard Deviation of Secondary School of male and female science education teachers perception on differentiated and Scaffolding instructional strategies

	N	Mean	Std Deviation	Mean Difference
Male	**17**	**12.60**	**2.87**	
Female	**13**	**11.08**	**2.78**	**1.52**

Table 2 indicates the mean and standard deviation of the science teachers' perception towards the use of differentiated and scaffolding instructional strategies in secondary school. The mean of the male and female science teachers' perception to differentiated and scaffolding instructional strategies is 12.60 and 11.08. The standard deviation are 2.87 and 2.78, respectively which indicates the mean difference of 1.52 in favour of the male respondents.

Research Question 3: what is the perception of science education teachers to differentiated and Scaffolding instructional strategies based on years of experience? To answer this research question, mean and standard deviation were used and the result presented in Table 3 below

	Mean	Std. Deviation
1 - 10 years	20.15	2.01
11 - 20 years	12.62	2.54
21 years and above	10.18	3.32

Table 3 indicates the mean and standard deviation of the science teachers' perception towards the use of differentiated and scaffolding instructional strategies in secondary school based on years of experience. The mean of science teachers' perception towards the use of differentiated and scaffolding instructional strategies whose years of experience are 1- 10 years, 11 – 20 years and 21 years and above are 20.15, 12.62, and 10.18, respectively. Similarly, the standard deviation is 2.01, 2.54 and 3.32, respectively. The data indicates the science teachers with 1-10 year of experience have the highest mean (20.15) perception towards the use of differentiated and scaffolding instructional strategies. On the other hand, science teachers with 21 years and above have lowest mean perception towards the use of differentiated and scaffolding instructional strategies.

Testing of Null Hypotheses

The following null research hypotheses were formulated at 0.05 level of significance.

HO_1: There is no significant difference in the use of differentiated and Scaffolding instructional strategies among science teachers perception based on years of experience.To test for this hypothesis, t-test was used and the result is presented in Table 4.

Table 4 Summary of t-test Comparison of Male and Female science teachers perception on the use of differentiated and scaffolding instructional strategies

Variables	N	df	Mean	SD	t-value	p-value
Male	17	28	12.56	2.64	2.04	0.010
Female	13		11.33	1.90		

Significant $p<0.05$

Table 4 Show there is no significant difference between male and female science teachers perception on the use of differentiated and scaffolding instructional strategies. The difference between the two conditions were found to be statistically significant $t_{(2, 28)} = 2.04$, P-value = 0.010 at $P< 0.05$. Hence, hypothesis one was rejected. The null hypothesis which states that there is no significant difference between male and female science teachers perception on the use of differentiated and scaffolding instructional strategies is hereby rejected. Hence, it was concluded that the male teachers do have positive perception on the use of differentiated and scaffolding instructional strategies while teaching.

HO_2: There is no significant different in the perception science education teachers to differentiated and Scaffolding instructional strategies based on years of experience.

Table 5 ANOVA Comparison of Science Teachers' Perception towards the use of Differentiated and scaffolding instructional strategies in Secondary School based on Years of Experience

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	302.78	2	151.39	2.01	.000
Within Groups	351.68	28	12.56		
Total	654.46	30			

Table 5 presents the Analysis of Variance (ANOVA) results of science teachers' perception towards the use of differentiated and scaffolding instructional strategies in secondary school based on years of experience; 1- 10 years, 11 – 20 years and 21 years and above. The results indicate that there is a statistically significant difference in science teachers teachers' perception towards differentiated and scaffolding instructional strategies in secondary school among 1- 10 years, 11 – 20 years and 21 years and above $F(2,28) = 2.01$, $p(0.00) < 0.05$. Hence, hypothesis three which states that there is no significance difference in the perception of science teachers towards the use of differentiated and scaffolding instructional strategies in secondary school Minna, Metropolis based on years of experience is rejected. This implies that years of teaching experience has influence on science teachers' perception towards the use of differentiated and scaffolding instructional strategies in this population. Scheffes post-hoc was conducted to determine the direction of the significant difference and the analysis is presented below

Table 6: Scheffe's Post-hoc Analysis among 1- 10 years, 11 – 20 years and 21 Years and above Mathematics Teaching Experience

(I) Years of Exp	(J) Years of Exp	Mean Difference	Std. Error	Sig
1-10 Years	11-20 years	5.361*	1.010	.000
	21 years and above	2.030	1.236	.114
11- 20 Years	1-10 years	-5.361*	1.010	.000
	21 and above	-2.453*	1.352	.012
21 Years and Above	1-10 years	-2.030	1.236	.222
	11-20 years	2.453*	1.352	.021

Table 6 indicated that the observed significant difference was between 1 - 10 Years science teachers experience and 11 - 20 Years with the mean difference of 5.361, P-value of 0.00 which was significant at 0.05 level. There was a significant difference between 11 - 20 Years and 21 Years and above of science teaching experience, the mean difference is 2.453, *P*-value of 0.02, which was also significant at 0.05 levels. The mean difference was in favour of those who have 21 Years and above of science teaching experience. Therefore, 1 – 10 years and 21 Years and above of science teaching experience groups have better perception towards differentiated and scaffolding instructional strategies. However, 1-10 years of science experience contributed most to the significant difference.

Summary of the Findings

From the data collected, computed, analyzed and interpreted, the findings are summarized as follow:

3. Science education teachers have positive perception on the use of DI and scaffolding instructional strategies among senior secondary school students in Minna Metropolis
4. Male science education has high positive perception on the use of DI and scaffolding instructional strategies than their female counterpart
5. 1 – 10 years and 21 Years and above of science teachers' teaching experience groups have better perception towards differentiated and scaffolding instructional strategies. However, 1-10 years of science teachers' experience contributed most to the significant difference.

Discussion of Findings

The result revealed that science education teachers employed various DI strategies based on student data. Participants believed that using learning style inventories provided them an opportunity to ensure favorable outcomes for their students. Alavinia and Sadeghi (2013) asserted "learning styles are among the major determiners of an individual's success/failure in the course of learning". In addition, participants believed that it was vitally important to use assessment data as a foundation for employing the various DI and scaffolding strategies. Ongoing assessments are crucial and play an important role in providing teachers with the necessary information to create lessons that best fit the needs of their students (Loeser, 2018). According to Goddard *et al.,* (2019) "differentiated instruction is described as being most effective when teachers pre-assess students on content included in upcoming lessons or units, plan instruction based on assessment results, and allow flexibility for students in terms of process and product options".

The second research question revealed that participants believed female science education teachers face various challenges when trying to utilize DI and scaffolding strategies in the classroom.

In addition, participants believed that time is needed to effectively implement DI and scaffolding strategies. Smets (2017) suggested that teachers need time to collaborate with their colleagues to differentiate instruction effectively. According to a research by Smith and Robinson (2020), "the most common need expressed by the participants was time to collaborate within a grade level and across grades both for planning and to share expertise among colleagues".

Conclusion

In exploring science education teachers' perceptions about using professional development learning of DI and scaffolding strategies in the classroom, about the problems they may encounter trying to use new strategies after a training session, and about suggestions for improving the effectiveness of translating professional development into practice.

Recommendations

Based on the findings, the following recommendations are made:

1. More teacher-training should be conducted focusing on DI and scaffolding instructional strategies for science classes. The science teachers in the study differentiated mostly the process and product of instruction but seldom on the lesson content. Teacher training should focus more on strategies to differentiate science content.

2. Differentiated and scaffolding instruction should be continually implemented in high school science classes. Although the result of the study suggests that differentiated instruction did not significantly increase student learning outcomes as measured by the End-of-Course test, it positively impacted the learning process by increasing student engagement in class.
3. Further empirical studies should be conducted to determine the effectiveness of differentiated and scaffolding instruction in improving student learning outcomes.

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INFLUENCE OF UTILSATION OF COLLECTION DEVELOPMENT POLICY ON ACCREDITATION OF PROGRAMMES IN STATE UNIVERSITIES IN NORTH-WEST, NIGERIA.

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Abstract
This study investigates the influence of utilsation of collection development policy on accreditation of programmes in state own universities in North-west, Nigeria. The research ascertain the status of accreditation of programmes, determine the level of collection development policy in the state universities. Survey research method using descriptive research design was adopted for this study. The population of the study comprised of 197 professional librarians and 67 heads of departments. Total enumeration was used because the population size was small and manageable. Questionnaire was used as an instrument for data collection. A total number of 264 questionnaire were administered to the respondents out of which 205 (78%) were duly filled, returned and found useful. Collected data were analyzed using frequency counts and percentages, mean and standard deviation. The findings revealed that some programmes in the state universities obtained full accreditation and some got interim while very few with denial. It also revealed that the state universities were highly using collection development policy. The state universities equally have available information resources. It also revealed that cooperation between staff, qualitative resources, and good number of copies, library budget and seating capacity has great impact on accreditation of programmes. Lastly, it revealed that state universities faced some challenges during accreditation exercise. Recommendations were made line with the research findings.

Keywords: Utilisation, Policy, Accreditation, Universities and Information Resources

Introduction
Library has been regarded as a custodian of knowledge. Library is the store-house of knowledge for posterior use. Generally, library is an agency for dissemination of information. The basic function of library is education. The purpose of a library in modern society is to educate the community in a wider sense

University libraries are those libraries attached to the institutions of higher learning, it support teaching, learning, and research activities. University library is the heart of institution, without which the academic activities will not be successful and research will not yield any result. University libraries possess substantial position in educational institutions and are considered as integral part of the educational system. University libraries are weighed imported for running

and sustenance of the educational settings, it also provides university community with specific and relevant information materials which satisfy their information needs in a timely and organized manner. In Nigeria, university libraries primarily provide information and services to its patrons using a traditional strategy and, to a lesser extent, a digital approach. The digital approach makes use of new technology capabilities to make library resources and services more accessible. University libraries, according to organizational theory, are an organization within a bigger organization, whose purpose and functions are dictated by the larger organization's numerous elements Gabby and Shoham, (2017).

Accreditation of programmes is the process of self-study and external quality review used in higher education to scrutinize colleges, universities and higher education programmes for quality assurance and quality improvement. Accreditation of programmes in university libraries encourages library staff especially sectional heads, academic staff (lecturers) and school management to work hard toward successful accreditation to avoid interim or denial accreditation of programmes. It serves as a critical mechanism to ensure that educational providers maintain standards that meet the expectations of the educational community and society at large Duate and Vardasca (2023).

Collection development policy is an instrument designed to establish standards in library collections. Collection development policy is the systematic planning of library collections which includes such activities as the selection, acquisition, evaluation, ordering, and weeding of a libraries' collection. According to Okogwu and Ekere (2018) it is the systematic building of a library collection that is based on meaningful data rather than subjective choice. This, therefore, entail that collection development cannot be done at the whims and caprices of the librarian but with due consideration to the mission of the library as derived from the objectives of its parent institution. In the course selecting, evaluating, acquiring, weeding or planning any activity that will determine the state of the library collections, the mission of the library must always serve as the blueprint that guide every selection activities.

Research Problem

Preliminary investigation by researcher showed that accreditation of programmes in state university libraries in North-west, Nigeria are experiencing problems ranging from funds which are not readily available to improve learning facilities. Management seem not to meet up with the accreditation criteria, also some school records may not be adequately kept to ensure adequate information for accreditation, library facilities and lecture theatres seem not to be adequately ensured or provided by university management.

Aim ad Objectives of the Study

The aim of the study is to investigate influence of utilisation of collection development policy on accreditation of programmes in state universities in North-west, Nigeria. However, the specific objectives were to:

1. ascertain the status of accreditation of programmes in state universities in North-west, Nigeria;
2. asses the influence of utilisation of collection development policy on accreditation of programmes in state universities in North-west, Nigeria;
3. ascertain the problems of accreditation of programmes in the state universities in North-west, Nigeria.

Research Questions

The study were guided by the following questions;

1. what is the status of accreditation of programmes in the state universities in North-west, Nigeria?
2. what is the influence of utilisation of collection development policy on accreditation of programmes in state universities in North-west, Nigeria;
3. What are the problems of accreditation of programmes in state universities in North-west, Nigeria?

Review of Related Literature

Accreditation of Programmes

The concept of accreditation can be closely related to that of quality assurance in education. In recent times, various developments have taken place relative to the monitoring, evaluation and enhancement of the quality of different gears of higher education. It is in this vein, that accreditation bodies operate to guarantee that students receive an education continually with standards for entry into practice in their respective faculties and disciplines. Accreditation is defined as a type of quality assurance process under which services and operations of tertiary educational institutions and programmes are evaluated by an external independent body to determine if existing standards are met. Accreditation according to Obadara, and Alaka, as cited in Obiako, (2022) is the process of self-study and external quality review used in higher education to scrutinize an institution and/or its programmes for quality standards and need for quality improvement. It is a process of examining the availability and adequacy of resources, merit rating of resources and programmes in order to enhance quality of output Enefu and Okolo, (2021). This means that accreditation involves the process of ensuring that curricula, physical facilities, personnel, funds and so on to meet the needs of the university to achieve its stated philosophy and objectives.

In another word accreditation is awarded to higher education programs that meet the education requirement to set standards. It centers on a review of a program's content and delivery that includes area such as relevance, coherence, challenge, assessment, staffing, quality assurances and resources. Many institutions and department had failed accreditation by National Universities Commission (NUC) just because the libraries failed to meet the standard for information materials in those disciplines. It is important to assert that a university cannot exist and function properly without the presence of a library. This was the view of Afolabi (2014) in his study when he described a university and its library to be interdependent. This is because each is clearly indispensable of the other and this is the main reason why a university is established alongside with its library at all costs. Furthermore, Bello (2014) has it that accreditation of programmes offered by universities is key to ensuring standards across the institutions.

Collection Development Policy

Collection development policy involves several activities related to building and managing of variety of information resources to meet the desperate needs of users These activities include the assessment of users' needs, formulation and application of collection development policy, preparation of budget and fund management, selection and acquisition of materials in all formats, evaluation of materials to ascertain the extent they can meet the users' needs, planning for resources sharing and cooperative collection development activities, as well as promoting the use of library resources Gulnaz and Fatima, 2019; Johnson, 2018; Mwilongo *et al*., 2020). Collection development also includes tools like publishers' catalogues, current trade

bibliographies, National bibliographies, vendors list, discipline-based journals, suggestions from users, and so on (Mwilongo, 2020; Mwilongo *et al*., 2020).

The absence or poor adoption of CDP has greatly affected collection development activities of the libraries as most of the major components of collection development activities such as selection, acquisition, preservation, evaluation, and weeding of materials are done without haphazardly (Ameyaw, 2020; Frempong Kore, 2021; Harvey and James, 2014; Mwilongo *et al.*, 2020; Obiano, 2021). This has gone to affect the library collections as well as the learning, teaching, and research activities of the university institutions (Ameyaw, Entsua and Mensah, 2016; Obiano, 2021; Okogwu and Ekere, 2018; Mwilongo *et al.,* 2020).

Research Methodology

The study will adopt descriptive survey research design. The survey research will be suitable for the study because data generated will be collected and used to describe and interpret issues on the influence of utilisation of collection development policy on accreditation of programmes in state universities in North-west, Nigeria. The population of the study is 264. This consists of librarians from the state universities and head of departments of the programmes that participated in the 2023 NUC accreditation exercise in North-west, Nigeria. The researcher considered four (4) universities that are relatively secured. These are Yusuf Maitama Sule university kano (YUMSUK), Sule Lamidi university Jigawa , Musa 'Yaradua university, Katsina , Kaduna state university (KASU). This is due to the insecurity situation in Sokoto, Kebbi, and Zamfara states.

Results ad Discussions

Research Question One: What is the status of accreditation of programmes in state universities in North-west Nigeria?

Table 4.1 Status of Accreditation of Programmes in State Universities.

S/N	Courses Accredited	N	FULL	INTERIM	DENIED	AWAITING
1	Agriculture	32	1 (0.6%)	0 (0%)	0 (0%)	1 (0.6%)
2	Arabic	32	3 (1.9%)	1 (0.6%)	0 (0%)	0 (0%)
3	History and Strategic Studies	32	2 (1.2%)	0 (0%)	0 (0%)	0 (0%)
4	Hausa	32	3 (1.9%)	1 (0.6%)	0 (0%)	0 (0%)
5	Islamic Studies	32	2 (1.2%)	0 (0%)	0 (0%)	0 (0%)
6	Architecture	32	1 (0.6%)	0 (0%)	0 (0%)	0 (0%)
7	Computer Science	32	4 (2.5%)	0 (0%)	0 (0%)	0 (0%)
8	Mass communication	32	0 (0%)	1 (0.6%)	0 (0%)	0 (0%)
9	Estate Management	32	0 (0%)	1 (0.6%)	0 (0%)	0 (0%)
10	Environmental Management	32	1 (0.6%)	0 (0%)	0 (0%)	0 (0%)
11	Education Mathematics	32	6 (3.7%)	1 (0.6%)	0 (0%)	0 (0%)
12	Education Islamic	32	2 (1.2%)	1 (0.6%)	0 (0%)	1 (0.6%)

13	Education Economics	32	1 (0.6%)	0 (0%)	0 (0%)	1 (0.6%)
14	Library and Information Science	32	3 (1.9%)	0 (0%)	0 (0%)	1 (0.6%)
15	Education Biology	32	4 (2.5%)	0 (0%)	0 (0%)	1 (0.6%)
16	Education Chemistry	32	4 (2.5%)	0 (0%)	0 (0%)	1 (0.6%)
17	Education Physics	32	5 (3.1%)	0 (0%)	0 (0%)	0 (0%)
18	Education English	32	4 (2.5%)	0 (0%)	0 (0%)	0 (0%)
19	History	32	2 (1.2%)	0 (0%)	0 (0%)	1 (0.6%)
20	Law	32	4 (2.5%)	0 (0%)	0 (0%)	1 (0.6%)
21	Economics	32	2 (1.2%)	1 (0.6%)	0 (0%)	1 (0.6%)
22	Accounting	32	5 (3.1%)	0 (0%)	0 (0%)	0 (0%)
23	Business Administration	32	2 (1.2%)	1 (0.6%)	0 (0%)	1 (0.6%)
24	Entrepreneurship	32	3 (1.9%)	0 (0%)	0 (0%)	0 (0%)
25	Chemistry	32	4 (2.5%)	0 (0%)	0 (0%)	1 (0.6%)
26	Physics	32	4 (2.5%)	0 (0%)	0 (0%)	0 (0%)
27	Mathematics	32	4 (2.5%)	0 (0%)	0 (0%)	0 (0%)
28	Biochemistry	32	4 (2.5%)	0 (0%)	0 (0%)	1 (0.6%)
29	Biological Sciences	32	4 (2.5%)	0 (0%)	0 (0%)	0 (0%)
30	Microbiology	32	2 (1.2%)	0 (0%)	0 (0%)	1 (0.6%)
31	Anatomy	32	2 (1.2%)	0 (0%)	0 (0%)	0 (0%)
32	Public Administration	32	3 (1.9%)	0 (0%)	0 (0%)	0 (0%)
33	Sociology	32	1 (0.6%)	0 (0%)	0 (0%)	1 (0.6%)
34	Pharmacy	32	0 (0%)	0 (0%)	0 (0%)	1 (0.6%)

Table 4.1 shows the respondents view on the status of accreditation of programmes in state universities in North West Nigeria. The result showed that majority of the programmes got full accreditation in year 2023 in the following order 6 (3.7%) Education Mathematics, 5 (3.1%) Education Physics, 5 (3.1%) Accounting, 4 (2.5%) Computer Science, 4 (2.5%) Education Biology, 4 (2.5%) Education Chemistry, 4 (2.5%) Education English, 4 (2.5%) Law, 4 (2.5%) Chemistry, 4 (2.5%) Physics, 4 (2.5%) Mathematics, 4 (2.5%) Biochemistry, 4 (2.5%) Biological Sciences, 3 (1.9%) Arabic, 3 (1.9%) Hausa,

3 (1.9%) Library and Information Science, 3 (1.9%) Entrepreneurship, 3 (1.9%) Public Administration, 2 (1.2%) History and Strategic Studies, 2 (1.2%) Islamic Studies, 2 (1.2%) Education Islamic, 2 (1.2%) History, 2 (1.2%) Economics, 2 (1.2%) Business Administration, 2 (1.2%) Microbiology, 2 (1.2%) Anatomy. Other programmes that got interim accreditation were 1 (0.6%) Arabic, 1 (0.6%) Hausa, 1 (0.6%) Mass communication, 1 (0.6%) Estate Management, 1 (0.6%) Education Mathematics, 1 (0.6%) Education Islamic, 1 (0.6%) Economics, 1 (0.6%) Business Administration. Those that are awaiting for accreditation were 1 (0.6%) Business Administration, 1 (0.6%) Education Islamic, 1 (0.6%) Education Economics, 1 (0.6%) Library and Information Science, 1 (0.6%) Education Biology, 1 (0.6%) Education Chemistry, 1 (0.6%) History, 1 (0.6%) Law, 1 (0.6%) Economics, 1 (0.6%) Business Administration, 1 (0.6%) Chemistry, 1 (0.6%) Biochemistry, 1 (0.6%) Microbiology, 1 (0.6%) Sociology and 1 (0.6%) Pharmacy. Whereas, none of the programmes were denied accreditation in the year 2023 in these state universities.

Research Question Two: What is the influence of utilisation of collection development policy on accreditation of programmes in state universities in North-west, Nigeria?

Table 4.2: Influence of Utilisation of Collection Development Policy on Accreditation of Programmes in State Universities.

S/N	Statement	SA	A	D	U	N	Mean	Standard Deviation	Decision 3.30
1	Cooperation between library and faculty members in the selection process will lead to full accreditation of programmes.	81 (50.3%)	36 (22.4%)	11 (6.8%)	1 (0.6%)	192	3.52	.685	Agreed
2	Acquisition of current, qualitative and reliable materials will lead to passing of accreditation of programmes.	68 (42.2%)	46 (28.6%)	14 (8.7%)	1 (0.6%)	192	3.40	.712	Agreed
3	Adhering to the minimum number of copies to be	59 (36.6%)	51 (31.7%)	16 (9.9%)	3 (1.9%)	192	3.28	.772	Low

	acquired may influence full accreditation of programmes.								
4	Sufficient budget allocation for procurement of library materials will lead to failure of accreditation.	2 (1.2%)	26 (16.1%)	50 (31.1%)	51 (31.7%)	192	3.15	.795	Low
5	Inadequate sitting capacity in the library will influence accreditation of programmes.	16 (9.9%)	2 (1.2%)	58 (36.0%)	53 (32.9%)	192	3.25	.731	Low
6	Insufficient and outdated journals will lead to failure of accreditation of programme.	1 (0.6%)	44 (27.3%)	28 (17.4%)	56 (34.8%)	192	3.20	.804	Low

Key: Strongly Agree (SA); Agree (A); Disagree (D); Undecide (U).

Table 4.2 shows that six items was listed for professional librarians to respond on the influence of utilisation of collection development policy on accreditation of programmes in state universities in North-west, Nigeria. The result indicated that majority 81 (50.3%) of the respondents believe that they agreed cooperation between library and faculty members in the selection process lead to full accreditation of programmes. The respondents 68 (42.2%) equally agreed that acquisition of current, qualitative and reliable materials leads to passing of accreditation of programmes. Respondents 59 (36.6%) also strongly agreed that adhering to the minimum number of copies acquired influences full accreditation of programmes. Respondents with 50 (31.1%) disagreed that sufficient budget allocation for procurement of library materials lead to failure of accreditation. Respondents with 58 (36.0%) disagreed that

inadequate sitting capacity in the library influenced accreditation of programmes and also 56 (34.8%) of the respondents disagreed that insufficient and outdated journals will lead to failure of accreditation of programme.

Research objective Three: What are the problems of accreditation of programmes in state universities in North-west, Nigeria?

Table 4.3: Problems of Accreditation of Programmes in State Universities.

S/N	Statement	SA	A	D	U	N	Mean	Standard Deviation	Decision 3.30
1	Funds are not readily available to provide library facilities.	60 (37.3%)	54 (33.5%)	14 (8.7%)	1 (0.6%)	192	3.34	.701	Agreed
2	Faculty members are not cooperating with library to achieve accreditation of programmes.	48 (26.7%)	60 (37.3%)	18 (11.2%)	3 (1.9%)	192	3.18	.757	Agreed
3	School records may not be adequately kept to ensure adequate information for accreditation.	56 (34.8%)	58 (36.0%)	14 (8.7%)	1 (0.6%)	192	3.31	.693	Low
4	Library facilities and lecture theatres are adequately provided by university management.	42 (26.1%)	61 (37.9%)	22 (13.7%)	4 (2.5%)	192	3.09	.785	Low

5	Some universities in Nigeria seem not to meet up with the National Universities Commission, criteria, that are the NUC bench mark and fail accreditation.	49 (30.4%)	58 (36.0%)	18 (11.2%)	4 (2.5%)	192	3.17	.785	Low
6	University management does not comply to subscribe database before accreditation of programmes.	33 (20.5%)	68 (42.2%)	24 (14.9%)	4 (2.5%)	192	3.00	.755	Low
7	Limited time to prepare for accreditation of programmes.	48 (29.8%)	48 (29.8%)	27 (16.8%)	6 (3.7%)	192	3.06	.876	Low

Key: Strongly Agree (SA); Agree (A); Disagree (D); Undecide (U).

Table 4.3 shows that seven items was listed for professional librarians to respond on the problems of Accreditation of Programmes in State Universities in North-west, Nigeria. The result indicated that majority 60 (37.3%) of the respondents strongly agreed that funds are not readily available to provide library facilities. Respondents with 60 (37.3%) agreed that faculty members are not cooperating with library to achieve accreditation of programmes. Also, 58 (36.0%) of the respondents agreed that school records may not be adequately kept to ensure adequate information for accreditation. Respondents with 61 (37.9%) agreed that library facilities and lecture theatres are adequately provided by university management and equally majority of the respondents 58 (36.0%) agreed that some universities in Nigeria seem not to meet up with the National Universities Commission, criteria, that are the NUC bench mark and fail accreditation. The respondents 68 (42.2%) equally agreed that university management does not comply to subscribe database before accreditation of programmes. Respondents with 48 (29.8%) also agreed that limited time to prepare for accreditation of programmes.

Conclusion

Based on the findings of the study, it could be concluded that majority of programs in state universities in North-west Nigeria, was obtained full accreditation in 2023. However, some programs received interim accreditation others are still awaiting for accreditation while others are undergoing for resource verification. The findings of the study identified so many challenges that are facing for accreditation in state university libraries in North-west.

Recommendations

Based on the findings and conclusions drawn from the study, the following recommendations are made:

1. Despite state universities efforts towards accreditation exercise, there is still needs for the universities to continuously monitoring the progress of accreditation processes for programs that are still awaiting results or undergoing resource verification for improve quality education in the state universities in the North-west, Nigeria.
2. There is need for state university libraries to strictly adhere to collection development policy standards by strengthen weeding and preservation practices, enhancing ordering and organization, and collection evaluation for improved collection development practices and better serve the needs of accreditation exercise.
3. There is need for increased funding, collaboration between faculty members and libraries, improve record keeping, investment in infrastructure, adhere to NUC criteria and sufficient time for planning as this will supporting the accreditation of programs and improving the overall quality of education offered.

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EFFECT OF COMPUTER-BASED LEARNING ON STUDENTS ACHIEVEMENT IN BASIC SCIENCE AND TECHNOLOGY IN BOSSO LOCAL GOVERNMENT, NIGER STATE

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Abstract
The study was designed to see the effect to of computer-based learning on students' achievement in Basic Science and Technology in junior secondary schools in Bosso LGA, Niger State. The study was a quasi-experimental research design with a population of 860 JSS III students. The sample of the study comprised 210 students. Sample students were divided into two groups of 110 for experimental group and 100 for control group. Both groups were equated on the basis of their achievement scores in the pre-test and post-test in Basic Science and Technology. Two research questions and two hypotheses were answered and tested respectively. Mean and standard deviation was used to analyze the data for answering the research questions while analysis of variance (ANOVA) was used to test the hypotheses at 0.05 level of significance. Based on the findings, the study revealed among others that effect of experimental group in stimulating students' achievement in basic science and technology is higher than the effect of control group and there is an effect attributed to gender on students in the achievement in Basic Science and Technology. Based on the findings of the study the following conclusions were drawn. Having found out that the use of computer-based learning has improved student academic achievement in Basic Science and Technology. Therefore, there is the need to identify the type of feedback that is most effective in specific educational settings.

Keywords: Computer-based learning, students, achievement, Basic Science and Technology, technical colleges.

Introduction
The integration of Computer-Based Learning (CBL) into educational practices has become a significant focus in enhancing student achievement across various subjects, including Basic Science and Technology (BST) (Mantione, 2020). CBL involves the use of computers and digital tools to deliver educational content, assess student learning, and facilitate interactive learning experiences. In recent years, the use of CBL in BST education has gained traction due to its potential to improve student engagement, understanding, and performance (Zhao *et al.*, 2020). The effectiveness of CBL in promoting academic achievement is particularly relevant in regions like Bosso Local Government, Niger State, where traditional teaching methods may not fully address the diverse needs of students.

Student achievement, often measured by academic performance indicators such as test scores, grades, and comprehension levels, is a critical outcome of interest in educational research. In the context of BST, achievement reflects students' ability to grasp fundamental scientific concepts, apply them in practical scenarios, and perform well in assessments. Research indicates that CBL can enhance student achievement by providing a more personalized and adaptive learning environment (Peng *et al.*, 2019). Through interactive simulations, multimedia

content, and immediate feedback, CBL helps students better understand and retain complex scientific concepts, leading to improved academic outcomes.

Basic Science and Technology is a foundational subject in the Nigerian educational curriculum, encompassing key areas such as physics, chemistry, biology, and technology (Enemarie *et al.*, 2019). These subjects are essential for developing the scientific literacy and problem-solving skills necessary for students' future academic and career success. However, the traditional methods of teaching BST often rely on rote memorization and lecture-based instruction, which may not effectively engage students or foster deep understanding. CBL offers an alternative approach by providing interactive and visually rich content that can make abstract scientific concepts more accessible and engaging (Van der Kleij *et al.*, 2015). This shift in instructional methodology is crucial for improving students' conceptual understanding and academic achievement in BST.

Another important aspect of CBL is its ability to support differentiated instruction, catering to the diverse learning needs of students. In a typical classroom, students vary in their prior knowledge, learning styles, and paces of learning. CBL addresses these differences by offering customized learning paths and adaptive assessments that adjust to each student's level of understanding (Dönmez *et al.*, 2022). This individualized approach ensures that all students, regardless of their starting point, have the opportunity to achieve their full academic potential. In Bosso Local Government, where educational resources may be limited, CBL provides a scalable solution to deliver high-quality instruction that meets the needs of a diverse student population.

The study of the effect of Computer-Based Learning on students' achievement in Basic Science and Technology in Bosso Local Government, Niger State, is both timely and essential. As educational systems continue to evolve, integrating technology into the curriculum has the potential to significantly enhance student learning outcomes. By examining how CBL influences academic achievement in BST, this research will contribute valuable insights into the effectiveness of digital learning tools in improving educational outcomes in regions with similar educational challenges. This understanding can inform future educational policies and practices, ultimately leading to better educational opportunities for students in Bosso Local Government and beyond.

Statement of the problem

Despite ongoing efforts to improve science education, student achievement in Basic Science and Technology (BST) in Bosso Local Government, Niger State, remains below expectations. Recent statistics from the Niger State Ministry of Education indicate that the average pass rate for students in BST has consistently fallen below 50% over the past few years. For instance, in 2022, only 42% of students achieved a passing grade in BST exams (Niger State Ministry of Education, 2023), reflecting significant challenges in understanding and applying scientific concepts. This underachievement suggests that traditional teaching methods may not be effectively engaging students or facilitating the deep comprehension needed for success in BST. The persistent low performance in BST highlights the urgent need for innovative instructional approaches, such as Computer-Based Learning (CBL), to enhance student engagement and improve learning outcomes. While CBL has shown promise in other educational contexts by offering interactive and personalized learning experiences, its impact on student achievement in BST within Bosso Local Government has not been thoroughly explored. This study seeks to address this gap by investigating the effect of CBL on students'

academic performance in BST, aiming to determine whether it can serve as a viable solution to improve student outcomes in this critical subject area.

Purpose of the Study

1. Determine the differences in achievement of students taught Basic Science and Technology using computer based learning and those taught using traditional method.
2. To investigate the difference in the achievement of male and female students taught Basic Electricity with computer based learning.

Research Questions

1. What is the difference in the achievement of students taught Basic Science and Technology using computer based learning and those taught using traditional method?
2. What is the difference in the achievement of male and female students taught Basic Science and Technology using computer based learning?

Hypotheses

The following research hypotheses were tested in the study:

$H_{01.}$ There will be no significant difference between the mean achievement scores of students taught Basic Science and Technology using computer-based learning and those taught using traditional method.

$Ho_{2.}$ There will be no significant difference in the mean achievement scores of male and female students taught Basic Science and Technology with computer-based learning.

Methodology

Quasi-experimental research design was used for this study. The study was carried out in Bosso Local Government. The population for the study comprised 860 JSS III students in Bosso LGA. Simple random sampling was used to select four junior secondary schools in Bosso LGA with a total of 210 students. Therefore, the Sample size is 210 students which was subdivided into two groups of 110 for experimental group and 100 for control group. Basic Science and Technology Achievement Test (BSTAT) comprising multiple choice items, matching items, and items of short answers and the techniques of test construction was used as the instrument. BSTAT was validated by two experts from the Department of Industrial and Technology Education, Federal University of Technology, Minna. The instrument was trial tested on 25 JSS III students in Government Secondary School, Minna which is not part of the study. Cronbach Alpha was used to ascertain the reliability coefficient of the instrument to be 0.75. The data collected from the pre-test and post-test were analyzed using mean and standard deviation to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance.

Results

Research Question 1

What is the difference in the achievement of students taught Basic Science and Technology using computer based learning and those taught using traditional method?

Table 1: Mean and Standard Deviation of the Pre-Test and Post-Test Scores of the Experimental Group Using Computer-based learning and Control Group Using the traditional Method

Group	N	Pre-test scores X	SD	Post-test scores X	SD	Mean gain X
Experimental	110	61.24	9.78	82.53	8.78	21.29
Control	100	67.34	8.08	82.21	7.53	14.87

The data presented in Table 1 shows that experimental group had a mean achievement score of 61.24 and Standard Deviation of 9.78 in the pre-test and a Mean score of 82.53 and Standard Deviation of 8.78 in the post-test making a pre-test, post-test Mean gain of 22.29. Control group had mean achievement score of 67.34 and Standard Deviation of 8.08 in the pre-test and a post-test Mean of 82.21 and Standard Deviation of 7.53, with a pre-test, post-test Mean gain of 14.87. With these results, experimental group and control group are effective in stimulating students' achievement in basic science and technology but the effect of experimental group in stimulating students' achievement in basic science and technology is higher than the effect of control group.

Research Question 2

What is the difference in the achievement of male and female students taught Basic Science and Technology using computer based learning?

Table 2: Significance of Difference Between the achievement Scores on Pre-Test and Post-Test of Male and females of the Experimental Group

Group	Gender	N	Pretest X	SD	Post-test X	SD	Mean gain X
Experimental Group	M	72	33.30	9.61	67.20	10.72	33.90
	F	38	25.38	9.67	65.76	7.86	40.38
Control Group	M	75	30.00	9.60	63.04	10.35	33.04
	F	25	25.38	9.23	60.76	7.86	35.38

Table 2 shows that male students taught Basic Science and Technology with computer-based learning had a Mean score of 33.30 and Standard Deviation of 9.61 in the pre-test and a mean score of 67.20 and Standard Deviation of 10.72 in the post-test making a pre-test, post-test mean gain in the male students of 33.90. Female students taught Basic Science and Technology with computer-based learning had a mean score of 18.45 and Standard Deviation of 12.85 in the pre-test and a post-test mean of 68.41 and standard deviation of 12.69, with a pre-test, post-test mean gain of 49.96. Also, male students taught with traditional method had a mean score of 22.91 and Standard Deviation of 8.74 in the pre-test and a Mean score of 64.89 and Standard Deviation of 13.37 in the post-test making a pre-test, post-test Mean gain in the male students of 41.98. At the same time, female students taught Basic Science and Technology with traditional method had a mean score of 20.16 and Standard Deviation of 12.93 in the pre-test and a Mean score of 70.41 and Standard Deviation of 12.69 in the post- test making a pre-test, post-test Mean gain in the female students of 50.25. With these results female students taught Basic Science and Technology with computer-based learning and traditional teaching method had higher post-test mean scores than male students in the achievement test. Therefore, there

is an effect attributed to gender on students in the achievement in Basic Science and Technology.

Hypotheses testing

H_{O1}: There is no significant difference between the mean achievement scores of students taught Basic Science and Technology using Computer-based learning and those taught using tradition method.

HO_2: There is no significant difference in the mean achievement Scores of male and female students taught Basic Science and Technology Using Computer-based learning.

Table 3: Summary of Analysis of Covariance (ANCOVA) for Test of Significance of effect of treatments (problem-based learning and traditional teaching method) their Gender and interaction effect with respect to their Mean Scores on Basic Science and Technology Achievement Test

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	**6019.303[a]**	**14**	**429.950**	**9.284**	**.000**
Intercept	116029.049	1	116029.049	2505.394	.000
METHOD	3963.837	8	495.480	10.699	.000
GENDER	7.731	1	7.731	.167	.684
GENDER * METHOD	82.602	5	16.520	.357	.877
Error	4955.352	107	46.312		
Total	336096.000	122			
Corrected Total	10974.656	121			

a. R Squared = .548 (Adjusted R Squared = .489)

*Significant at sig of F< .05

The data presented in Table 3 shows F-calculated values for three effects: treatment, gender and interaction effect of treatments and gender on students achievement in Basic Science and Technology. The F-calculated value for treatment is 10.699 with a significance of F at .000 which is less than 0.05. Hence, the null-hypothesis of no significant mean difference between the effect of problem-based learning and traditional method on students' achievement in Basic Science and Technology is therefore rejected at .05 level of significance. The result implies that the mean difference between the effect of problem-based learning and traditional method was significant. The F-calculated value for gender as shown in Table 3 is .167 with a significance of F at .684 which is greater than .05. Therefore, the null hypothesis of no significant difference between the mean effect of gender (male and female) on students' achievement in Basic Science and Technology is accepted at .05 level of significance. This means that there was no significant mean difference between the effects of gender on students' achievement in Basic Science and Technology. The interaction of treatments and gender has F-calculated value of .357 with a significance of F at .877 which is greater than .05. Therefore, the null hypothesis of no significant interaction effect of treatments and gender is accepted. This means that there was no significant interaction effect of treatments given to students taught with problem-based learning and traditional method and their gender with respect to their mean scores on Basic Science and Technology achievement test.

Discussions of Findings

Findings revealed that problem-based learning and traditional method are effective in improving students' achievement in Basic Science and Technology, but the effect of computer-based learning in improving students' achievement in Basic Science and Technology is higher than traditional method.

This result, particularly that computer-based learning is effective in stimulating students' achievement in studying Basic Science and Technology, tends to support the writings of Sezer (2017) who wrote that the flipped classroom (experimental) yielded both greater academic achievement and greater motivation compared with the control group. This will give students' positive achievement and get them involved in the learning process and also give them more exposure to the lesson content, and more opportunities to connect with the material. The results could, therefore, be explained by the fact that teaching to students' strengths (intelligences/learning styles) engages the students in the learning process. This, consequently, increased their self-esteem and enthusiasm in studying Basic Science and Technology.

Findings also revealed that there is an effect attributed to gender on students in the achievement in Basic Science and Technology. The results agree with the findings of Yalams and Fatokun (2013) who concluded that gender was a major factor that influenced students' achievement. However, from the foregoing, it has been revealed that gender is a complex factor in academic achievement. Hence, many researchers as indicated in the preceding sentences sound inconclusive because while some researchers reveal a significant difference in the mean achievement scores of male and female students, others are rather reporting that gender does not in any way affect students' academic achievement.

Similarly, the result that computer-based learning model is effective in stimulating students' achievement in studying Basic Science and Technology supports Obi (2011) writings which stated that experiential learning is an excellent way to provide students with ownership over their learning progress. This also means the higher this ownership, the higher the intrinsic motivation to learn. The result could be explained by the fact that the experiential learning model engaged students in this group in the learning process through positive effects on students' achievement in studying Basic Science and Technology.

Finding from Table 3 of this study confirms that the performance of the experimental group was significantly better that the control group in the Post-test. The significant difference is attributed to the treatment. This is an indication that computer-based learning has a positive effect on students' academic achievement. Thus, the null hypothesis that there will be no significant difference in the performance of students taught Basic Science and Technology using computer-based learning and those with traditional method was accepted at 0.05 level of significances. Bracey (2012) found that students reacted favourably to computer-based learning (experiment group) scored higher in the Post-test than those taught with conventional lecture method (control group).

Conclusion

Based on the findings of the study the following conclusions were drawn. Having found out that the use of computer-based learning has improved student academic achievement in Basic Science and Technology. Therefore, there is the need to identify the type of feedback that is most effective in specific educational settings. As previously highlighted, there are several factors to consider when designing computer-based feedback: student achievement levels, nature of the learning task, and prior knowledge. In addition, designers need to make decisions

concerning the amount of learner control, attitudes toward feedback, and demands for efficiency. It is safe to conclude that it could be used to improve students' performance in Basic Science and Technology and other technical subjects. Teachers should therefore be encouraged to use it for instruction.

Recommendations

In the light of the findings revealed and conclusions drawn from the study, the following recommendations are made:

1. Teachers should adopt how to use computer-based learning to teach and also to adopt computer-based learning in teaching.
2. The teachers of different subjects' areas, especially from the rural schools, are trained in the use of computers in the classroom.

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IMPACT OF THE FLOATING FACILITATOR MODEL IN TECHNICAL COLLEGES ON STUDENTS' ACHIEVEMENT: IMPLICATIONS FOR ENTREPRENEURSHIP AND ECONOMIC DEVELOPMENT

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Abstract
The study investigated the impact of floating facilitator model on students' achievement in electrical/electronics technology in technical colleges. The study adopted a pretest-posttest quasi-experimental design with non-equivalent control group. The sample for the study consisted of 122 Technical Colleges II students. Purposive sampling was used to select four technical colleges in Niger state. The instrument used for the study is the Electrical/electronics technology Achievement Test (EEAT) designed by the researcher. Two research questions and two hypotheses were formulated to guide the study. The hypotheses were tested at 0.05 level of significance. The data collected were analyzed using mean and standard deviation and ANCOVA statistical tools. From the findings the result revealed that students taught electrical/electronics technology with floating facilitator model recorded a posttest mean score of 17.80 with a standard deviation of 7.05. The posttest mean score for students taught electrical/electronics technology with conventional method was 15.04 with standard deviation of 2.53. This shows that floating facilitator model enhance achievement better than conventional method. There was a significant difference in the mean achievement scores of students taught electrical/electronics technology using floating facilitator model and those taught using conventional teaching methods. Finally, it was recommended that teachers should adopt the use of floating facilitator model. This will go a long way in improving students' achievement in electrical/electronics technology.

Keywords: Floating facilitator model, teaching, technical colleges, students, electrical/electronics technology.

Introduction
The global landscape of education is rapidly evolving, with increasing emphasis on innovative instructional models that align with the demands of the 21st-century workforce. In technical and vocational education, where the practical application of knowledge is paramount, instructional models that effectively enhance students' skills are crucial (Oviawe *et al.*, 2017). Among these, the Floating Facilitator Model has emerged as a promising approach, particularly in technical colleges where students are trained in various specialized fields such as Electrical/Electronics Technology. This instructional model, which involves a facilitator moving between different groups or stations to provide targeted support, offers a dynamic and flexible learning environment that can significantly impact on students' learning outcomes. This study aims to explore the impact of the Floating Facilitator Model on students' achievement in Electrical/Electronics Technology in technical colleges and its broader implications for entrepreneurship and economic development.

Furthermore, technical and vocational education is a cornerstone of any nation's economic development (Adeyemi, 2023). It equips students with practical skills and knowledge essential for various industries, including electrical and electronics sectors, which are critical to technological advancement and infrastructure development. The quality of education in these areas directly influences the proficiency of the workforce, which, in turn, affects the economy's overall productivity and growth of the nation. However, traditional teaching methods in technical education, often characterized by rigid structures and teacher-centered approaches, have been criticized for failing to engage students effectively or foster critical thinking and problem-solving skills (Lancaster, 2017). This shortcoming has prompted the exploration of more student-centered and flexible instructional models, such as the Floating Facilitator Model. Similarly, the Floating Facilitator Model is an instructional approach where a facilitator moves around the classroom, providing individualized support and guidance to students or groups engaged in different tasks or projects (Pitts, 2022). Unlike traditional models, where the teacher delivers content from a fixed position, this model allows for greater interaction and responsiveness to students' needs. In the context of Electrical/Electronics Technology, where students often work on complex projects that require hands-on skills, the Floating Facilitator Model can help bridge the gap between theory and practice by offering immediate feedback and personalized instruction. This model also encourages collaborative learning, as students work in groups and benefited from peer-to-peer interactions, fostering a deeper understanding of the subject matter.

Research has showed that the Floating Facilitator Model can lead to improved academic achievement in technical subjects (Ogbuanya & Akinduro, 2017). By providing targeted support, facilitators can address individual learning gaps, enhance students' problem-solving abilities, and promote a more active learning environment. In Electrical/Electronics Technology, where precision and accuracy are critical, this model can help students master the technical skills needed for the field. Moreover, the model's emphasis on collaboration and communication aligns with the soft skills required in the modern workplace, preparing students not only for technical roles but also for leadership and entrepreneurial positions.

The implications of the Floating Facilitator Model extend beyond academic achievement. By fostering a more engaging and effective learning environment, this model can contribute to the development of a skilled workforce capable of driving innovation and entrepreneurship in the electrical/electronics sector. As students gain confidence in their technical abilities and problem-solving skills, they are better equipped to start their own businesses or contribute to existing enterprises. This entrepreneurial mindset is essential for economic development, particularly in regions where small and medium-sized enterprises (SMEs) play a significant role in job creation and economic growth.

Furthermore, the adoption of the Floating Facilitator Model in technical colleges can have a ripple effect on the broader economy (Chazdon *et al.,* 2017). As more students succeed in technical fields and pursue entrepreneurial ventures, the demand for locally produced electrical and electronic products and services is likely to increase. This, in turn, can stimulate economic activity, create jobs, and reduce dependency on imported goods. In the long term, the growth of the electrical/electronics industry, driven by skilled graduates, can contribute to technological advancement and infrastructure development, further strengthening the economy.

In conclusion, the Floating Facilitator Model represents a significant shift in instructional practices in technical education, with the potential to enhance students' achievement in

Electrical/Electronics Technology and support economic development through entrepreneurship. By providing a flexible and responsive learning environment, this model not only improves academic outcomes but also equips students with the skills and mindset needed to thrive in the modern economy. As technical colleges continue to adopt and refine this model, its impact on students, industries, and the economy will likely become increasingly evident. This study seeks to explore these impacts in depth, offering insights into how the Floating Facilitator Model can be leveraged to achieve both educational and economic goals.

Statement of the Research Problem

Despite the crucial role that technical education plays in equipping students with the necessary skills for the workforce, traditional teaching methods in technical colleges, particularly in Electrical/Electronics Technology, have often been inadequate in fostering deep understanding and practical expertise. These conventional approaches frequently fail to engage students actively, leading to suboptimal learning outcomes and a lack of readiness for the demands of the modern workforce (Luburić *et al.*, 2021). The resulting gap in skills not only affects students' academic achievement but also limits their potential for entrepreneurial ventures, which are critical for economic development. The Floating Facilitator Model, with its emphasis on personalized support and collaborative learning, offers a promising alternative to address these challenges (Hmelo- Silver *et al.* 2019). However, there is a need for empirical evidence on the effectiveness of this model in improving students' achievement in Electrical/Electronics Technology and its potential to foster entrepreneurship. This study seeks to fill this gap by examining the impact of the Floating Facilitator Model on students' learning outcomes and exploring its broader implications for entrepreneurship and economic development.

Purpose of the Study

1. Impact of floating facilitator model methods on achievement of students in electrical/electronics technology.
2. The influence of gender on students' achievement in electrical/electronics technology when taught using floating facilitator model.

Research Questions

1. Is there a difference in the mean achievement scores of students taught electrical/electronics technology using floating facilitator model and those taught using traditional method?
2. Is there a difference in the mean achievement scores of male and female students of different ability levels taught electrical/electronics technology using floating facilitator model and those taught using traditional method?

Hypotheses

The following hypotheses were tested at 0.05 level of significance.

Ho_1: There is no statistically significant difference in the mean achievement scores of students taught electrical/electronics technology using floating facilitator model and those taught using traditional method.

Ho_2: There is no statistically significance difference in the mean achievement scores of male and female students taught electrical/electronics technology using problem solving and discussion teaching methods

Methodology

The design of the study is quasi experimental group design. The study was carried out in Niger state Technical Colleges. The population of the study consists of all the 589 Technical colleges (TC II) electrical/electronics technology students in the state owned technical colleges in Niger State. A total of about 122 Technical Colleges (TC II) electrical/electronics technology students consisting of (70) male and (52) female students constituted the sample for the study. TC II students were used because contents scope electrical/electronics technology is in TC III curriculum. One instrument was used for data collection: The Electrical/electronics technology Achievement Test (EEAT) while the students' annual electrical/electronics technology achievement was obtained from the school management and will be used to classify the students into low, medium, and higher ability levels. The research instruments electrical/electronics technology achievement test (EEAT) was validated by two experts in department of Industrial and Technology Education, Federal University of Technology, Minna. The instrument was subjected to trial testing. It was administered on (20) TC II students of Government Technical College, Lafiagi Kwara State and Government Technical College, Ilorin, Kwara State. The choice of these schools is made on the assumption that it is comparable in terms of staff strength, population and administrative competence to the ones that are selected for the final study. The data obtained from the response of this subject in this test was used to calculate the reliability of the instrument, the reliability of the EEAT test. The reliability of the objective items was established at 0.85 Cronbach α (KR20) and the interrater consistency of the essay items was 0.87 (using Kendell). The instrument was administered directly to respondents. The researcher made arrangements with some class teachers and the research assistants before the post-test was conducted at the end of the forth week. The same EEAT used for the pretesting was administered to the subjects as the post-test. The same procedure and conditions used while conducting the pre-test was adopted. The research assistants marked and scored the scripts using the marking guide. The scores were collected and organized for data analysis.

Mean scores and standard deviations scores was used to analyze the data to provide answers for the research questions. The hypotheses will be tested at 0.05 level of significance using analysis of covariance (ANCOVA).

Results

Research Question 1:

What are the mean achievement scores of students taught electrical/electronics technology using floating facilitator model and those taught using conventional method?

Table 1: *Mean and Standard deviation of pretest and posttest scores of students taught electrical/electronics technology using floating facilitator model and those taught using conventional methods.*

Variable		Pretest		Posttest		
Methods of Teaching	N	$\bar{x}$	SD	$\bar{x}$	SD	Mean gain
Floating facilitator model (E_1)	69	9.16	4.29	17.80	7.05	8.64
Conventional Method (E_2)	53	8.66	2.06	15.04	2.53	6.38

Results in Table 1 show that the group taught electrical/electronics technology using floating facilitator model had a pretest mean of 9.16 with a standard deviation of 4.29 and a posttest mean of 17.80 with a standard deviation of 7.05. The difference between the pretest and posttest mean was 8.64. The group taught electrical/electronics technology using conventional method had a pretest means of 8.66 with a standard deviation of 2.06 and a posttest mean of 15.04 with

a standard deviation of 2.53. The difference between the pretest and posttest means was 6.38. However, for each of the groups, the posttest means were greater than the pretest means with the group taught using floating facilitator model having a higher mean gain. This is an indication that floating facilitator model have more effect on students' achievement in electrical/electronics technology than the conventional method.

Research Question 2:
What are the mean achievement scores of male and female students taught electrical/electronics technology using floating facilitator model?

Table 3: *Mean and Standard deviation of pretest and posttest scores of male and female students taught electrical/electronics technology using Floating facilitator model*

Variable		Pretest		Posttest		
Gender	**N**	$\bar{x}$	**SD**	$\bar{x}$	**SD**	**Mean gain**
Male	71	9.58	2.97	17.54	5.99	7.23
Female	51	8.06	3.98	15.29	5.06	

Result in Table 2 shows the influence of gender on students' achievement in electrical/electronics technology when taught using floating facilitator model. Result shows that the female students had a pretest mean of 8.06 with a standard deviation of 3.98 and a posttest mean of 15.29 with a standard deviation of 5.06. The difference between the pretest and posttest mean for the male students was 7.23. The male students had a pretest mean of 9.58 with a standard deviation of 2.97 and a posttest mean of 17.54 with a standard deviation of 5.99. The difference between the pretest and posttest mean was 7.96. However, for each of the groups (i.e. male and female), the posttest means were greater than the pretest means with the male students having a higher mean gain. This is an indication that gender may have some effects on students' achievement in electrical/electronics technology.

Hypothesis 1
There is no statistically significant difference in the mean achievement scores of students taught electrical/electronics technology using floating facilitator model and those taught using conventional method.

Table 3: *Analysis of Covariance (ANCOVA) of the significant difference in the mean achievement scores of students taught electrical/electronics technology using floating facilitator model and those taught using conventional method*

Source	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2140.882[a]	4	535.221	34.781	.000
Intercept	660.192	1	660.192	42.902	.000
Pretest	1734.827	1	1734.827	112.736	.000
Group	127.607	1	127.607	8.292	.005
Gender	7.932	1	7.932	.515	.474
Group * Gender	14.923	1	14.923	.970	.327
Error	1800.438	117	15.388		
Total	37553.000	122			

Corrected Total	3941.320	121

The result in Table 3 shows that the significant difference in the mean achievement scores of students taught electrical/electronics technology using floating facilitator model and those taught using conventional method. Result shows that with respect to the groups taught electrical/electronics technology using floating facilitator model and those taught using conventional method, an F-ratio of 8.29 was obtained with associated probability value of .005. Since the associated probability value of 0.01 was less than 0.05 set as level of significance, the null hypothesis (H_{01}) which stated that there is no significant difference in the mean achievement scores of students taught electrical/electronics technology using floating facilitator model and those taught using conventional method is rejected. Thus, inference drawn therefore is that there was a significant difference in the mean achievement scores of students taught electrical/electronics technology using floating facilitator model and those taught using conventional method with those taught using floating facilitator model having a higher mean gain. This shows that floating facilitator model has more effect on students' achievement in electrical/electronics technology than the conventional method.

Hypothesis 2

There is no statistically significance difference in the mean achievement scores of male and female students taught electrical/electronics technology using problem solving and conventional teaching methods

The result in Table 3 shows that with respect to the mean scores of male and female students taught electrical/electronics technology using floating facilitator model, an F-ratio of 0.515 was obtained with associated probability value of 0.47. Since the associated probability value of 0.47 was greater than 0.05 set as level of significance, the null hypothesis (H_{03}) which stated that there is no statistically significant difference in the mean achievement scores of male and female students in electrical/electronics technology is not rejected. Thus, inference drawn therefore is that the mean scores of male and female students did not differ significantly when taught electrical/electronics technology using floating facilitator model. This means that gender is not a significant factor in determining students' achievement in electrical/electronics technology.

Discussion of Results

The findings from Table 1 showed that students taught electrical/electronics technology with floating facilitator model recorded a posttest mean score of 17.80 with a standard deviation of 7.05. The posttest mean score for students taught electrical/electronics technology with conventional method was 15.04 with standard deviation of 2.53. This shows that floating facilitator model enhance achievement better than conventional method.

Following the statistical analyses in table 3, it was found that the difference in mean achievement scores for post-test was significant at 0.05 probability level. F-ratio of 8.29 was obtained with associated probability value of 0.01. Since the associated probability value 0.01 was less than 0.05 set as level of significance, we reject the null hypotheses ($H0_1$) which stated that there is no significant difference between the mean achievement scores of students taught electrical/electronics technology using floating facilitator model and those taught using conventional method. Thus, there is a statistically significant difference in the mean achievement scores of students taught electrical/electronics technology using floating facilitator model and those taught using conventional method.

These findings are similar to those of Festus and Ekpete (2012) who conducted a study on the influence of problem-solving techniques on students' performance and attitude towards chemistry. The result of the study showed that the calculated mean score of the experimental group (56.2) was higher than those of the control group (51.9). Orhan and Ruhan (2013) found that there was no significant difference in achievement of 7th grade students taught science using problem solving and those taught using traditional lecture based method. The difference can be attributed to factor like perception as pointed in the review literature.

The statistical analyses in Table 2 show that female subjects in problem-solving and conventional methods obtained higher mean scores (19.08 and 15.66 respectively) than their male counterparts (16.13 and 14.10 respectively). Further analyses show that the gender difference in the two groups was found not significant. F-ratio of 0.515 was obtained with associated probability value of 0.47. Since the associated probability value of 0.47 greater than 0.05 set as level of significance, the null hypotheses ($H0_2$) which stated that there is no statistically significant difference in the mean achievement scores of male and female students in electrical/electronics technology is not rejected. This means that gender is not a significant factor in determining students achievement in electrical/electronics technology. A closer look at the mean and mean gain scores table 4 show that the conventional teaching method is gender friendly in favour of the male students. Hence, the two methods have been found to be good teaching methods for teaching/learning of problematic topic like electrical/electronics technology.

Smith (2014) investigated gender as a factor in problem-solving in the use of grid map to study plant distribution in an abandoned school garden. The result of the analysis indicated no significant difference in the achievement of male and female students. Olagunju (2011) found that there was no significant difference in the achievement of male and female students in problem solving in mathematics, and science. On the contrary Bynne & Pope (2014) opined that boys have more positive science attitudes and achievement than girls. However, Catsambis (2015) and Ahiakwo (2009) reported that girls performed better than boys in science. These differences may be attributed to other factors such as teacher quality, environment and motivation as pointed in the background.

Conclusion

One of the important attributes of sciences is solving problems. Consequently, no science students can do without solving problems. The findings of this study served as a bases for making the following conclusions: floating facilitator and conventional methods of teaching enhance students' achievement in electrical/electronics technology in technical colleges. Consequent upon this, the study determined the impact of floating facilitator model on students' achievement in electrical/electronics technology in technical colleges. It was found that the use of floating facilitator model is more effective in improving students' achievement, gender and ability level of teaching and learning electrical/electronics technology than conventional method. It then therefore mean that floating facilitator model is a dependable option for teaching and learning in the technological development as it promotes active and efficient learning which can lead to the acquisition of necessary skills for employment

Recommendations

The following recommendations have been made based on the findings and conclusion of the study:

1. The study thus recommends the scientific approach to floating facilitator model because they motivate the learners and develop the spirit of exploration and discovery.

2. Seminars and in-service programs should be organized by delegations of education and the pedagogic offices for electrical/electronics technology teachers in the field to be acquainted with teaching of electrical/electronics technology using floating facilitator model methods.

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HARNESSING THE POTENTIALS OF AGRICULTURAL WASTE IN PRODUCTION OF COMPRESSED STABILISED EARTH BRICKS IN NIGERIA"

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Abstract
Agricultural waste are unwanted substances obtained from agricultural operations on crops forms, poultry and livestock production and farm processing facilities such as corn stalks, husks, seeds form fruits and vegetables. The waste is globally disposed on landfill causing pollution, global warming and others due to the activities of man. These harmful practices generate huge amount of carbon, thereby, threatening human and environmental health, with these environmental threats there are recent innovative advancement leading to the search for alternative natural materials that can help in mitigating the environmental threats such as global warming, greenhouse gases, carbon emission and ozone depletion using materials that are suitable and eco-friendly. In this regard, the utilisation of compressed stabilised earth bricks (CSEBs) is essential because it is made from natural raw materials such as clay and sand with cement as stabilisers in construction. Agricultural waste management and sustainable building materials are of great concern in Nigeria, with the environmental challenges, cost of cement and other building materials. This review explores the potentials of utilizing agricultural waste such as rice husk ash, eggshell powder, sugarcane bagasse ash. Sawdust ash, palm oil fuel ash and others in the production of CSEBs, examining existing literatures and highlighting innovative opportunities for Nigeria. The use of agricultural waste as partial replacement of cement or additives in CSEBs can improve their mechanical and physical properties, reduce environmental impact, reduce waste disposal cost and promote sustainable construction practices in Nigeria.

Keywords: Agricultural Waste, Production, Compressed Stabilised Earth Bricks,

Introduction
Agricultural waste are residues from growing and processing of raw agricultural products such as fruits, vegetables, meat, poultry, dairy products and crops. They are outputs of production and processing agricultural products which contains minerals that benefits man with less economic value than it collection cost, transportation and beneficial use Obi *et al.* (2016). They pose significant environmental and economic challenges in Nigeria. Currently, the demand for sustainable building materials is on the rise due to environmental issues such as global warming, carbon emission and others, this paper is to harnessed the potentials of agricultural waste in the production of CSEBs promoting eco-friendly construction practices and waste reduction. Karigidi (2021) stated that agricultural waste are unwanted substances obtained from agricultural operations on crops forms, poultry and livestock production and farm processing facilities such as corn stalks, husks, seeds form fruits and vegetables. Agricultural wastes that are hazardous includes pesticides remains, fertilizers and their plastics on-farm, medical waste like syringe globally disposed on landfills.

According to world bank 19% of waste are reused by recycling or composting while 11% of waste are disposed in sanitary landfills with gas collection system mostly in developed countries. In developing countries around the world 93% of waste are disposed by open dumping mostly burnt without proper channelling of emitted gases and fumes resulting in

environmental pollution, greenhouse gases exacerbating the impact of climate change. These harmful practices generate huge amount of carbon, thereby, threatening human and environmental health, the United Nations Environmental Programme (UNEP), in a report titled, "Toxic blaze: the cost of crop burning" stated that carbon produced through open burning is 460-1,500 times higher in its tendency to escalate global warming than the widely known carbon dioxide. Nowadays, there are innovative waste management techniques to reduce negative impact on the environment, human and animal health while promoting sustainable production and consumption.

The innovative technology helps in identifying the new ways to convert and recycle our waste materials into new products or resources, with the recent technological innovations which provides opportunities to design systems that will minimise environmental impact and promote sustainability through recycling of waste. These innovations are not only of environmental value but of economic value by creating renewable product, creating jobs, reducing waste and creating a sustainable economy. The recent innovative advancement has led to the search for alternative natural materials that can help in mitigating the environmental threats such as global warming, greenhouse gases, carbon emission and others using materials that are suitable and eco-friendly. In this regard, the utilisation of compressed stabilised earth bricks (CSEBs) is essential because it is made from natural raw materials such as clay and sand with cement as stabilisers in construction. Several researches have been carried out on the use of agricultural waste in the production of CSEBs due to their environmental friendliness, low carbon emission, low energy consumption and easily affordable in the remote areas to enhance local economy. Literature reviews shows that studies have been carried out regarding different suitable stabilisers for the production of improved CSEBs with desired properties, in this context agricultural waste such as rice husk, eggshell powder, palm oil fuel ash, sawdust ash, sugarcane bagasse ash, charcoal and others may also be suitable additives for sustainable construction practices.

Literature Review

The utilisation of agricultural waste in CSEBs offers environmental benefits by reducing environmental impacts such as global warming, ozone depletion, carbon emission, pollution and economic impacts such as reduction of waste disposal, reduction of production cost, conservation of natural resources and creation of job in rural communities. Studies have showed that agricultural waste materials such as rice husk, straw, corn cobs, sugarcane bagasse, coconut fiber, sawdust, palm kernel ash, eggshell powder and others have been successfully used as additives in replacing cement in CSEBs production. (Prusty *et al.* 2016). These alternative natural materials have improved the mechanical and physical properties of CSEBs like compressive strength, tensile strength, water absorption rate and workability for sustainable building practices. The utilisation of agricultural waste in partial replacement of cement has attracted science and technological innovative industries interest because of the benefits it offers of cost effectiveness, eco-friendly environment, economic impact and others as they represent 50% of the global agricultural biomass (Lozano and Lozano, 2018).

Small percentage of (AW) are used for panel processing, paper production and most are burned which destroyed the local ecological environment, therefore, the transformation of agricultural waste (AW) into sustainable low-energy construction materials may provide practical solution for nature, the environment and future generations (Liuzzi *et al.*, (2017). The innovative utilisation of agricultural waste is due to their high efficiency, thermal insulation properties, eco-friendly, tensile properties and good characteristics of biomass ash. In a study by Alsubari *et al*. (2018) the replacement of 7.5% rice husk ash (RHA) and earth increased the compressive

strength of concrete at 28 days with 4.1% higher than concrete with 100% cement. Agricultural waste like RHA are effective pozzolonic materials with silica composition to substitute cement, furthermore, RHA at 5% and 15% substituent of cement improved with high density, compressive strength and produced high performance sustainable cement mortar, increased flexural strength by 46.8% and 24% respectively. The study suggested that majority of agricultural waste with incineration process may serve as binders in concrete for sufficient engineering properties.

The performances of various agricultural waste ashes, such as rice husk ash, and palm oil fuel ash among others was investigated in concrete and the result showed great effect from these pozzolonic materials for improving the durability, lower chloride-ion permeability. It also revealed that rice husk ash in concrete reduce water absorption rate and permeability by 26% and 78% respectively. Tangchirapat *et al. (* 2007) investigated the curing time of concrete in partial replacement with palm oil fuel ash (POFA) which shows both initial and final setting time increased with the addition of POFA which depends on the fineness and degree of replacement, also large particles with high porosity of non-combusted palm fiber increased water-to-binder ratio of concrete, this led to high setting time while other researchers obtained similar behaviour with longer setting times for POFA concrete by using pozzolans like sawdust and fly ash, the cement setting time hydration is slower than the pozzolanic reaction between pozzolans and calcium hydroxide and the setting time also increased when cement was partially replaced with sawdust ash (SDA) and sugarcane bagasse ash (SCBA) .

The initial setting time of cement with SDA at 10-30% increased from 1hr 30min to 2hrs 05min compare with 1hr 26min for cement paste, while final setting was increased to 3hrs 56min to4hrs 20min and 3hrs 35min respectively. Udoeyo and Dashibil (2000) stated that with the replacement of cement at 20% SCBA, the initial and final setting time of cement increased by 7 and 24min respectively, compare to cement paste. He *et al.* (2020) opined that agro- waste can serve as alternative eco-friendly, efficient and sustainable pozzolans for cement industries. The incorporation of these residues as cementitious materials has proven that addition of waste was of great benefit to the environment and high performance to concrete properties. Rice husk is considered the most appropriate alternative material with similar characteristics to Portland cement and can effectively be used in construction. Based on the reviews, this paper is in the opinion that agricultural waste can be effectively utilised as additives in CSEBs production by improving their physical and mechanical properties, reducing environmental impact and promoting sustainable construction practices in Nigeria.

Avila *et al.* (2023) study revealed that eggshell composed of 95% calcium carbonate about 3% phosphorus and 3% magnesium and traces of sodium, potassium, zinc, manganese, iron and copper which can be use as binders in concrete to improve strength and durability for sustainable practices. While Langah and Saand (2020) stated that increase in eggshell powder decreases workability compare to the usual concrete mix with reduction in unit weight (density) with the compressive strength increasing sufficiently at the introduction of eggshell powder content up to 8.5% and 10.5% respectively at 7 and 28 days which showed that as the curing days increases the compressive strength increases. Gabol *et al.* (2019) analysed that adding various percentages of ESP in concrete improved the tensile strength up to 7.5% but at 10% ESP its tensile strength decreases but the compressive strength at 3 days mixed of various percentages of ESP showed continuous improvement as the quantity of binder exceed, compressive strength was increasing up to 7.5% but at 10% it decreases. It also showed increased in flexural strength in the various percentages for 3, 7 and 28days but decreases at 10% eggshell powder.

As the percentage of ESP increases, the workability of fresh concrete decreases but finally increases as it set. This study motivation is to develop a sustainable building material by utilizing agricultural waste as partial replacement of cement, with sustainable alternative natural materials from agricultural by-products such as eggshell powder, palm oil fuel ash, sugarcane bagasse ash, charcoal and others with the objective of creating sustainability through utilisation of improved environmental-friendly alternatives to cement. Yadav and Sharma (2023) revealed the effectiveness of using charcoal as by-products to manage organic waste and reduce emissions. The behaviour and suitability of charcoal in concrete based on the mechanical strength of concrete, suggest that both materials exert distinct effects on the properties of concrete, with the optimal replacement percentage variations. The presence of silica, calcium and alumina in biochar and charcoal make them effective in enhancing the durability and strength of cement which opens a potential application in the construction industry as supplementary cementitious materials.

Compressed stabilized earth bricks (CSEBs) are flexible in design, can be reused and recycled at the end of building life, they are community empowered, for the production process enables local communities to be involved in building their own homes and structures, fostering skills development and self-sufficiency. Lawrence and Anchanit (2019) reported that 5% constant proportion of cement and sand at different mix ratios had high compressive strength at 10% addition of sand, reduces water absorption rate at 20% due to the sand content in the mixes which proves that sand/moisture contents affects strength development and durability of the materials and have significant influence on the long-term performance of CSEB on bonding with mortar at the time of construction and prevent cohesion when the brick is dry and also prevent proper hydration of cement when the brick is very wet therefore, compaction of the mix can reduce the optimum water absorption rate from 12% to 10% with about 50% increase in compressive strength.

Abdullah *et al.* (2017) also analysed that parameters such as particle size of soil helps in identifying the composition of the soil within limit to produce high strength. It also shows that CSEBs mixed ratio plays a vital role in determining the soil, sand-cement strength and the properties of the soil can be the factor of producing the higher strength. The authors further stated that the quantity of gravel, sand, clay and silt of the soil must be suitable with the ratio of the mixture, without perfect mix ratio, the desired strength will not be achieved. Moreover, it can be affirmed that the degree of compaction pressure applied in the production of CSEBs greatly affects the compressive strength and water absorption rate. Also Lim *et al.* (2020) analyses that CSEBs have the potential of adoption for widespread use in construction due to it compressive strength that is equal to or better than common masonry units such as fired clay, bricks or cement blocks. Also CSEBs mixes can achieve in excess of 10 Mpa more than cement which makes it acceptable for load-bearing purposes in low-rise buildings, it has lower embodied energy and carbon emission, higher thermal conductivity than fired bricks and cement blocks which makes it suitable for use in tropical or hot climates with innovative potential such as cost effectiveness for sustainable buildings.

This research may offer a new perspective on the use of agricultural by-product in cement replacement which has the potentials for eco-friendly construction practices. According to Abdullah *et al*. (2017) the compressive strength of CSEBs become higher as their age increased from 7 to 28 days regardless of the degree of compaction, the compressive strength rises as the sand content is added more while reducing the laterite soil content for mixture ratio of 1:3:7 which will produce maximum strength at compaction ratio of 2500 Psi and a moderate strength

for mixture ratio of 1:1:9 with compaction of 1500 Psi. The authors further stated that sand and gravels are suitable to be used as additive in the soil to increase the quality of the sand and also improve the particle size distributions therefore, could affect the value of compressive strength and water absorption rate of CSEBs. In agriculture, these materials are called waste while to the scientific researchers and construction industries is an additive with great potentials of reducing energy demand during construction and the structures service life (Liuzzi et al., 2017). Rojas *et al.* (2019) observed that agricultural by-products such as rice husk, straw, coconut shell and flax have been used in construction for better thermal insulation in building, improved durability of the structures and reduce permeability of the cement matrix after exposure to acid attack. The cement will be partially replaced with agricultural waste because it contains fibres that shows a good stiffness, toughness balance, high-efficiency with thermal insulation properties, tensile property and has the characteristics of biomass ash. The utilization of agricultural waste in concrete increases its sustainability, cost effectiveness and environmental friendly nature compare to cement. Crop residue represents more than 50% of the global agricultural biomass, hence, transforming agricultural waste into sustainable low-energy construction materials could be a practical solution for nature, the environment and future generation. Moreover, agricultural waste-based-cement has good thermal insulation properties, can reduce waste disposal and thermal effect on urban constructions. According to Ginasekaran *et al.* (2013), Almeida *et al*. (2015) and Vo and Navard (2014) in Asia and Latin American countries, the investigation in agricultural industries division has a new range of waste, as pozzolans, regarded as inexhaustible sources of alternatives natural cementitious materials.
These agricultural waste materials accumulated at the landfills, bring series of environmental, technological and social issues due to unhealthful disposition and once activated within the range of 600-800^{o}C, according to their chemical and physical composition, they can achieve an excellent performance as supplementary cementitious materials to improve the performance of mortar and concretes, (Ferranddiz *et al*., 2014) which will promote efficiency and sustainable practices.

Environmental and Economic Benefits of Agricultural Waste

The utilisation of agricultural waste in CSEBs production will offer several benefits such as:

a. Reduction of carbon emission by replacement of cement with agricultural waste AW which significantly reduced carbon footprint in CSEBs production.
b. Reduction of waste disposal by converting or recycling from landfill and utilised into CSEBs production reducing waste disposed cost and environmental pollution.
c. Reducing production cost due to the availability of AW and inexpensive reducing production cost.
d. Conservation of natural resources by partially replacing conventional materials like cement with AW to reduce depletion of natural resources.
e. Job creation by the utilisation of AW in CSEBs production can create jobs opportunities in rural communities contributing to local economic development.

Agricultural waste recycling is very essential for environmental protection, energy production, and agricultural progress depends on AW recycling and utilization to increase economy and save environment. It promotes environmental awareness among scientific community as regards the possibility of reusing and recycling AW and the potential environmental risks of AW by promoting recycling and utilization strategies for reusing AW into valued-added products which will promote economic growth, job opportunities to youths, soil enrichment to farming communities and bountiful harvest without yield penalty for a sustainable agriculture, food and health security towards a circular economy (Koul *et al*., 2022). Several studies showed

the successful utilisation of AW in CSEBs production such as the case study of rice husk ash-based CSEBs in bangladash.

In a study investigated in bangladash by Paul *et al*. (2023), rice husk ash (RHA) was used as partial replacement of cement in CSEBs production. The aim of the study was to determine the sustainability of rice husk ash RHA as a replacement for the producing sustainable CSEBs. The study used three different ratios for cement 4%, 6% and 8% then five different ratios for RHA content 0%, 5%, 10%,15% and 20% which revealed that RHA improved the compressive strength, split tensile strength and flexural bending strength compared to the unsterilized specimen's due to the addition of stabilizers. The optimum RHA content was 5% for 4% cement content, where 6% and 8% cement was 10% RHA, the stabilized samples increased the durability, reduced water absorption rate and 4-8% cement with 5-10% RHA met the strength and durability requirements in various codes. Therefore, incorporating lower cement with 5-10% RHA was found to performed better than higher cement content indicating the suitability of RHA as partial replacement of cement. On this ground it is evident that CSEBs stabilized with RHA and cement can serve as sustainable building materials with environmental and economic impact.

In a study conducted by Krishna et al. (2024), sugarcane bagasse ash at 0%, 5%, 10%, 15%, 20% and 25% was used as partial replacement of cement. The study aimed at determining the strength and durability properties of concrete containing sugarcane bagasse ash in CSEBs production. The investigation revealed decreased in workability as SCBA percentage increased, increased in compressive strength for SCBA blended concrete at 5%,10%, 15% and 20% while 10% SCBA addition has high and better performance, increase in split tensile strength and flexural strength respectively at 7, 14 and 28 days curing age. Therefore, SCBA are effective pozzolonas for cement replacement due to their high silica concentration which makes it a potential pozzolonic material. This case study has implications in Nigeria, where rice husk is a readily available agricultural waste, the adoption of similar design and production methods for RHA and SCBA based-CSEBs in Nigeria can reduce cement consumption and the environmental impacts associated to it, the utilization of RHA and SCBA can reduce waste disposal costs and environmental hazards and finally it will promote sustainable and durable CSEBs for eco-friendly construction purposes.

Challenges and Limitations

Despite the environmental and economic benefits of using agricultural waste in CSEBs production, several challenges and limitations exist such as:

I. Availability and consistency of AW, the agricultural waste availability and consistency may vary depending on the location and seasons
II. Variability in the properties of waste, the agricultural waste materials have varying physical and chemical properties which affects the quality of CSEBs.
III. Scalability and feasibility of AW, production of AW-based CSEBs in large-scale may face logistics and economic challenges
IV. High water absorption rate of waste materials, some agricultural waste materials may have high water absorption rate which will affect the durability of the material depending on the choice of AW materials to use.
V. Low binding properties of AW materials, some agricultural waste material's may lack or have low binding properties requiring additional binders or additives.
VI. Public acceptance by people, the patronage and acceptance of AW-based CSEBs by builders, architects and building owner may be limited due to socialization.

VII. Processing of AW and storage, agricultural waste requires proper processing and storage to maintain quality.

It's crucial to mitigate these challenges and limitations for a successful adoption of agricultural waste-based CSEBs production for sustainable construction practices.

Conclusion

The utilization of agricultural waste in CSEBs production will offer a promising solution for sustainable eco-friendly construction, environmental friendliness and waste management in Nigeria. Harnessing the potentials of agricultural waste in Nigeria can reduce environmental impacts, reduce waste disposal costs, health hazards and promote eco- friendly sustainable construction practices to create a sustainable future with further research on the development needed to overcome the challenges and limitations associated with agricultural waste-based CSEBs production in Nigeria. There is need for public awareness campaigns on waste management, environmental and economic benefits of agricultural waste-based CSEBs with government encouraging research and development on CSEBs technology by incorporating agricultural waste to create sustainable building materials in Nigeria.

Recommendations

1. Nigeria government should incentivize research and development of CSEBs technology, incorporating agricultural waste to create sustainable building materials.
2. Encourage stakeholders should collaborate to establish a standardized and regulation for agricultural waste-based CSEBs production ensuring quality and safety.
3. Promote public awareness campaigns to be launched on the environmental and economic benefits of agricultural waste-based CSEBs.
4. Nigeria government should invest in-pilot projects and scale-up initiatives to demonstrate the feasibility and effectiveness of agricultural waste-based CSEBs.
5. Develop standards and guidelines for agricultural waste-based CSEBs production in Nigeria.

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IMPACT OF MULTIMEDIA ON THE ACADEMIC PERFORMANCE OF BASIC SCIENCE AND TECHNOLOGY STUDENTS IN JUNIOR SECONDARY SCHOOLS IN NIGER STATE

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Abstract
The study was carried out to determine Impact of Multimedia on the Academic Performance of Basic Science and Technology Students in Junior Secondary Schools in Niger State. Pre-test post-test quasi-experimental design was adopted. The population for the study is 22,226 junior secondary school basic science and technology students. One hundred and ninety-three students were purposively selected for the study. Intact classes were used for the two schools. This was divided in to two (2) groups (A and B). Data collection phase lasted for six weeks; pre-test was given before exposing the students to the treatment variable. Mean and standard deviation were used to answer all the research questions, while t-test statistics was used to test null hypotheses one and two. All hypotheses were tested at 0.05 (P=0.05). The analysis of the findings revealed among others that, multimedia instruction disc has significant impact on the academic performance of basic science and technology students. It was also found that, there is no significant difference in the academic performance of male and female students taught basic science and technology with multimedia instruction. The study revealed that, maintaining the use of multimedia instruction in teaching by the teachers of basic science and technology enhanced teaching and learning there by improving students' academic performance. It was recommended among others that, there is need for curriculum planners to emphasize the importance of using multimedia instruction when teaching basic science and technology by the teachers in secondary schools. Teachers in secondary schools should be encouraged by school administrators to use multimedia instruction disc when teaching basic science and technology.

Keywords: Basic science and technology, multimedia, performance

Introduction
Multimedia resources had been regarded as powerful aids that could enhance teaching and learning in various disciplines including language learning, science, mathematics, engineering, business, and others (Garrison, 2013). Such multimedia resources include: LCD projectors, laptops, desktops, CD-ROMs, videos, interactive whiteboards, and software pertinent to specific courses, and e-learning sites just to mention but a few, which are greatly utilized in instruction. According to Deliyannis and Karydis (2011), multimedia is an extremely wide area that includes the field of informatics, telecommunications, the audio-visual production sector, cinema, and digital. In that respect, the term "interactive multimedia" is used to describe a scientific and creative research field within "multimedia" that supports expression or communication through multimedia with the ability to influence and alter context (Mayer, 2012).

Nkweke et al. (2012) defined interactive multimedia materials as equipment and materials that the teacher and trainers use as alternative means of communication to transmit curriculum

content to the learner. In using interactive multimedia materials, two or more instructional materials are combined at the same time. Deliyannis & Karydis (2011) further defined the term "interactive multimedia" as a physical or digital system where multiple media or people have an effect on each other through their interactive behavior. Interactive Multimedia can be relevant in teaching various school subjects including basic science and technology. IMB involves the use of two or more different types of instructional media in a presentation (Nkweke et al., 2012).

A number of researchers such as (Ubogu 2013; Betcher & Lee 2017; Nkweke et al. 2012) had attested to the efficiency and effectiveness of interactive multimedia resources in the teaching and learning process. Interactive multimedia teaching has been believed to provide various techniques and methods for lesson planning and to assist classroom instruction with improved visualization and representation (Shephard, 2013; Teo & Chai, 2014). As such, educators also allow these sophisticated tools to permeate in their respective classrooms to enhance the teaching and learning process. Mayer (2012) asserted that multimedia instruction imbibes verbal dimensions such as printed and spoken text, and visual dimensions, such as pictures, graphs, illustrations, drawings, charts, photos, and animations. These interactive multimedia resources help increase students' awareness of learning concerns, thereby enhancing their understanding of the topic, fostering in-depth understanding which results in better performance. Interactive multimedia instruction had been viewed to have a positive impact compared to traditional lecture-based instruction (Jonassen & Reeves, 2011).
Here is the text with spaces added where necessary:

Basic Science and Technology is also a basic subject on which future technological development of students is built for those interested in vocational technical courses or engineering in higher institutions. According to the report of the Federal Ministry of Education (FME) (2013), Basic Science and Technology is an essential subject in the 9-year basic education programme. Its purpose, according to the report, is to contribute to the achievement of the national education goals by inculcation of technology literacy, exposure of students to the world of work to match their talents and interests for wise vocational choice, and inculcation of positive attitudes towards work as a source of human identity, livelihood, and power. Basic Science and Technology provides opportunities to students to use tools and machines used in industries. This helps to build good attitudes towards technology and the industry. The study of Basic Science and Technology helps to reduce ignorance about technology. The teaching of Basic Science and Technology, according to the report of the Nigerian Educational Research and Development Council (NERDC) (2012), became necessary due to technological development and increased national policy orientation towards vocational education development. The desired development in the Nigerian vocational education system can only be achieved through effective implementation of Basic Science and Technology at the secondary school level.

Basic Science and Technology is a practical-oriented and skills-required field of study and aims at equipping the students with essential technical skills. Datom (2015) described Basic Science and Technology as a core subject among the pre-vocational subjects in the junior secondary school syllabus that involves the academic and practical study of materials and sources of energy with the ultimate intention of applying knowledge from the study to provide a comfortable environment for man.

The potential benefits of interactive multimedia instruction cannot be underestimated in the contemporary world. Lawal and Ibrahim (2016) are of the opinion that interactive multimedia

instruction is one of the most influential of all the media for teaching. This has led to the use of conventional methods of teaching, which have not helped in any way to improve students' performance. For teachers to be able to pass knowledge to the students effectively and keep up with their counterparts in developed countries, he needs to integrate the use of interactive multimedia instruction in his teaching (Deliyannis & Karydis, 2011).

Statement of the Problem

Poor performance of junior secondary school students has been linked to many factors such as inappropriate admission policy into secondary school, negative attitudes of students to the subject, inadequate coverage of syllabus on the part of the teachers, and lack of adequate tools and equipment to teach Basic Science and Technology in junior secondary schools. Cardenas (2011) opined that the use of interactive multimedia instruction to teach will help to concretize abstract thought in the minds of the students compared to the use of conventional or traditional methods of teaching. Therefore, the study tends to examine the impact of interactive multimedia instruction on Basic Science and Technology students' academic performance in junior secondary schools of Niger State. Most people are very conversant with the traditional method of imparting knowledge to students in the classroom. This practice could be boring to the students after a while, and some of the topics taught to the students may look abstract to the students even when they are well taught by the teacher. Therefore, the absence of multimedia instruction in teaching Basic Science and Technology in junior secondary schools will not allow for optimal understanding, performance, and achievement among students of junior schools in Niger State.

Objectives of the Study

i. The impact of interactive multimedia instruction on academic performance of basic science and technology students;
ii. The impact of interactive multimedia instruction on the academic performance of male and female students in junior secondary schools in Niger State.

Research Questions

i. What is the impact of multimedia instruction on the academic performance of students taught Basic Science and Technology in junior secondary schools in Niger State?
ii. What is the impact of multimedia instruction on the academic performance of male and female students taught Basic Science and Technology in junior secondary schools in Niger State?

Hypotheses

The following hypotheses guided this research work:

i. There is no significant difference in the academic performance of students taught Basic Science and Technology using multimedia instruction teaching strategy and those taught using conventional methods of teaching.
ii. There is no significant difference in the academic performance of male and female students exposed to multimedia instruction teaching strategy.

Methodology

This study adopted the quasi-experimental design, pre-test post-test, control group design. The population of this study consists of the junior secondary school students in Minna. The major characteristics of the population comprise male and female students in Niger State secondary schools. In the selection of the schools for sampling, purposive sampling was employed. The schools were selected based on their population, availability of Basic Science and Technology teachers, and whether the subject (Basic Science and Technology) is offered in the schools.

The total number of students used for sampling is 193 students. The instrument, as formulated by the researcher, was validated by an expert in Industrial and Technology Education, Federal University of Technology, Minna. A pilot testing was conducted in Government Junior Secondary School, Paiko. The main aim was to determine the reliability coefficient of the items in the instrument (test items). The reliability of the instrument was determined by the statistical analysis of the data collected from the pilot study. The mean and standard deviation of the performance of students for the pre-test and post-test for the experimental group were computed to answer the research questions. Independent t-test statistics were used to test null hypotheses 1 and 2 at $P < 0.05$.

RESULTS

Research Question one: What is the impact of multimedia instruction on the academic performance of students taught basic science and technology in junior secondary schools?

Table1: Means and standard deviation of post-test scores of students taught Basic science and technology using multimedia instruction and those taught without.

Group	N	Mean	DF	Standard Dev.
Expt. Post-test	50	49.960	49	8.350
Control post-test	50	24.020	49	6.600

The result in Table1 indicates that post-test performance of students taught using multimedia instruction is better than that of students taught without it. This therefore, showed that multimedia instruction significantly improves students' academic performance.

Research Question Two: What is the impact of multimedia instruction on the performance of male and female students taught basic science and technology in Junior schools in Niger State?

Table2: Mean and standard deviation of posttest scores of male and female students under experimental group

Group	N	Mean	DF	Standard Dev.
Expt. Post-test males	25	49.680	24	8.854
Expt. Post-test Females	25	49.840	24	7.998

Table 2 presents the means and standard deviations of the post-test scores of male and female students taught Basic Science and Technology using multimedia instruction. The mean and standard deviation for male students were 49.6801 and 8.854, and that of the female students were 49.840 and 7.998. The result, therefore, indicated that no significant difference exists in the performance of male and female students taught using multimedia instruction. It means that multimedia instruction has an impact on the performance of male and female students in junior secondary schools in Niger State.

Test of Null Hypotheses

Hypotheses One: There is no significant difference in the academic performance of students who were taught basic science and technology with multimedia instruction and those taught using conventional method.

To test null hypothesis one, post-test scores of students taught Basic Science and Technology with multimedia instruction were compared with the post-test scores of students taught using the conventional method (lecture method) using t-test statistics at a 0.05% level of significance.

Table 3: Impact of multimedia instruction on Students' academic performance

Group	N	Mean	Std Dev.	DF	t-cal.	Sig.
Expt.	50	24.0200	6.60083			
				98	18.099	.000
Control	50	49.7600	8.35088			
P=0.05						

t= (98) =18.099P=.001<.05

From Table 3, the t-calculated was 18.099, which is greater than the t-critical (1.99) at a 5% level of significance (p = 0.05). The analysis therefore showed that multimedia instruction has a significant impact on the academic performance of Basic Science and Technology students. Therefore, the null hypothesis, which states that there is no significant difference in the academic performance of students who were taught Basic Science and Technology with multimedia instruction and those taught using the conventional method, was rejected.

Hypothesis two: There is no significant difference in the academic performance of male and female students taught basic science and technology.

To test null hypothesis two, post-test scores of male and female students exposed to multimedia instruction were compared using t-test analysis at 5% level of significant (p=0.05).

Table4: Impact of multimedia instruction on male and female Students' academic performance

Group	N	Mean	StdDev.	df	t-cal	Sig.
Male	25	49.6800	8.85400			
				24	0.60	.952
Female	25	49.8400	7.99833			
P=0.05						

t (24) =.60, P=.952>.05

Table 4 presents the t-test analysis of the difference between the academic performance of male and female Basic Science and Technology students taught using multimedia instruction. The analysis indicated that the t-calculated value of 0.60 was less than the t-critical value of 1.99 even at a 0.05 level of significance. This means that there is no significant difference between the academic performance of male and female students. The null hypothesis, which states that there is no significant difference in the academic performance of male and female students taught using multimedia instruction, was not retained.

Discussion of Results

The study revealed that multimedia instruction has a significant impact on the academic performance of Basic Science and Technology students. The result of hypothesis one revealed

that there is no significant difference in the academic performance of male and female students taught Basic Science and Technology with multimedia instruction. This is in line with the findings of Anulobi (2015), who discovered that the use of multimedia instruction in teaching enhances academic achievement.

This also agrees with the findings of Ogunleye (2010), who noted that multimedia instruction is used for enrichment, that is, as an added resource, similar to a film recording that is supposed to add value to a subject of study. He pressed further to say that it is also used for team teaching in the classroom and provides opportunities for all (male and female) students to learn. Also in support of these findings, Oshokoya (2014) conducted research on the effect of video-taped instruction on secondary school students' achievement in history. It had a mixed population of male and female students. The result confirmed that students taught with video-taped instruction performed better than those taught with the conventional method; it also revealed that gender was not a significant factor in students' achievement in history. It also revealed that the mean achievement scores of male and female students were greatly improved when video instruction was used in teaching them. This is in line with Ogommuoh and Nwewi (2013), who opined that students taught using video instruction performed significantly better than those taught using conventional/traditional methods. Owusu (2013) conducted research on the impact of the use of audio-visual aids to complement the traditional or conventional lecture method on the performance of Ghanaian senior high school physics students. The findings in this research study revealed that these senior high school students exhibited higher achievement than those in the control group. This finding is in line with Fillmore (2018), which opined that students learn better when audio-visual aids are used to teach them.

Oguz (2014) also conducted research on the effect of computer-based instruction on the achievement and problem-solving skills of science and technology students and found that there is a statistically significant increase in the achievements and problem-solving skills of the students in the experimental group that received treatment. This also agreed with Chukwu (2010), who observed that multimedia instruction can be considered a learning resource in that it can provide learners with access to knowledge and information in a more direct and concrete form, as well as provide physical models and improve academic performance.

Conclusion

From the results presented in Chapter Four, this study revealed that multimedia instruction has a significant impact on the academic performance of basic science and technology students. The study also revealed that there is no significant difference in the academic performance of male and female students taught basic science and technology with multimedia instruction. Results from the study made this conclusion to be drawn: that maintaining the use of multimedia instruction in teaching by the basic science and technology teachers will enhance teaching and learning, thereby improving students' academic performance.

Recommendations

i. The curriculum planners should emphasize the importance of using multimedia instruction to teach basic science and technology by the teachers of junior secondary schools.
ii. Teachers in junior secondary schools should be encouraged by the school administrators to use multimedia instruction when teaching basic science and technology, as it was found to be more effective than the lecture method.

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EFFECTS OF GUIDED-DISCOVERY INSTRUCTIONAL STRATEGY ON PRE-SERVICE TEACHERS' ACADEMIC ACHIEVEMENT IN NORTH-CENTRAL, NIGERIA.

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Abstract
The study investigated the effects of guided discovery and YouTube instructional strategies on pre-service teachers' academic achievement in North-central, Nigeria. A quasi-experimental research design was adopted for the study. A sample size of 153 pre-service Biology teachers from three colleges of education in north-central, Nigeria was used for the study. A multi-stage sampling technique was used to select the colleges of education used for the study. Biology Achievement Test (BIACT) was the instruments used for data collection. The instruments was validated by research experts from the FUT science education department,with a coefficient of 0.89 (BIACT) and Kuder-Richardson formula 20 (K-R20) was used to determine the reliability of BIACT. Two research questions and two research hypotheses were generated for the study. Mean and standard deviation were used to analyze the research questions while ANOVA was used analyzed hypotheses. Results from the findings among others showed that the pre-service teachers who were taught invertebrates diversity using guided discovery and YouTube instructional strategies (experimental groups) had better achievement scores than those taught with lecture method. Also, there was no significant difference in the mean achievement scores of male and female pre-service teachers taught invertebrates diversity. It was recommended that Biology lecturers should use guided discovery and YouTube instructional strategies as teaching strategies in teaching of Biology, especially invertebrates' diversity in most of our colleges of education.

Keys words: Guided-discovery, YouTube, Achievement.

Introduction
The classroom environment is continually changing in structure and context, reflecting the ever-changing dynamics of both the nature of students and teachers personalities. This is as a result of different teaching methods used in the classrooms. There are different teaching methods used in delivering instructions to students in all levels of education, be it in tertiary institutions like Colleges of Education, Polytechnics or at University. The inadequacies of teaching methodologies can have profound effects on students' academic achievement and retention. One key issue lies in the mismatch between teaching styles and individual learning preferences. Students have diverse ways of processing information, and when teaching methods favour a particular style, it can leave some learners at a disadvantage. For instance, if a curriculum heavily relies on auditory learning, students who thrive in visual or kinaesthetic learning environments may struggle to grasp and retain concepts.

Additionally, out-dated teaching methodologies may fail to incorporate advancements in educational research and technology. In a rapidly evolving world, traditional approaches that rely solely on lectures and rote memorization can become ineffective. Students today often

benefit from interactive and experiential learning, which encourages critical thinking and problem-solving skills (Al-Rawi, 2018).

It is in line with this that, the NCE Minimum Benchmark Standard (2015) specify that biology courses at NCE level shall be taught by careful selection or combination of the following teaching strategies namely; lecture method, practical, project method, field trips and excursions, games and simulations, team teaching, tutorial, concept mapping and, supervised projects of students, guided discovery method, excursion to bio-technological centres, seminar, and online or eLearning. Therefore, by adopting one or two of these teaching methods, they can enhance the performance of students.

Guided Discovery Instructional Strategy is one of the teaching methods mentioned above. Dajal, *et al.* (2019) defined it as an approach to teaching in which students are guided by the teacher to find facts by themselves. Guided Discovery is an instructional strategy that employs exploration, manipulation and experimentation to find out new ideas. It is regarded as convergent thinking (Alabi & Lasisi, 2015). Guided-Discovery strategy of teaching involves the following steps; establishing the goals, identifying students attitudes (such as prior knowledge, interest and prefer way of learning), selecting learning material (specimen) that should be learnt, choosing topic and elaborating or explaining the material (specimen) to the students. With this kind of approach, teachers provide opportunities for students to gather information, compare, categorize, analyse, integrate and organize and make their conclusions. Students do not just want to achieve the objectives in the form of learning outcomes, but also can shape the learning process.

Also, another learning strategy that be will be used in this study is the YouTube. The YouTube has evolved as an effective, educative platform altering and demoralizing the educational landscape. With its attractive videos educators and learners (students) now leave unprecedented chances to inspire learning. Hurley *et al.*, (2005) are credited with the founding of the YouTube platform that can be deployed in the classroom as an instructional media. The YouTube address online is www.youtube.com. YouTube is a video sharing service or application that allows users to upload and download videos, view, rate and share, add to playlists, make video comments and can be subscribed to by other users. It is currently one of the biggest websites for online video content and the third most popular website after Google and Facebook (Holland, 2016). Therefore, by adopting Guided-Discovery and YouTube Instructions as strategies for teaching and learning in the classroom, it could enhance students' achievement in Biological concept in Colleges of Education in North-Central Nigeria.

Broaddus *et al.* (2019) defined achievement as the extent to which a student, teacher or an institution has attained their short-term educational goals. Achievement can be attained through the readiness and dedication of the students to the course they are undergoing. In support of this, Sobowale (2016) stated out rightly that student achievement is exhibited in the way they partake in instructional processes. These include their contributions in class activities reading, writing, asking and answering question among others. There are also numerous factors that signify academic achievement, some of these factors are curricular-based criteria namely grades or academic achievement test (Bhat, & Khanadi, 2015). Thus, YouTube videos accompanied by discovery learning can improve students' performances in terms of procedural knowledge rather than factual and conceptual knowledge. It is of importance to adopt Guided Discovery Instructional Strategy and YouTube Instructional Strategy in teaching and learning in the classroom, it could enhance students' retention of biological concept.

Gender differences in biology will be investigated in this study, having considering the different variables in this study, the researcher's opinion that gender effect on biology will continue to be a topical issue. It is hopeful that the findings from this study's will throw more light on the above subject, especially when using Guided-Discovery and YouTube Instructional Strategies in teaching on Learning Outcomes on Invertebrates Diversity in teaching Biology students in Colleges of Education in North-Central States.

Statement of the Research Problem

Despite the importance attached to Biology in National policy on education FRN (2010), students record poor achievement in the 2018 and 2022 Senior Secondary School Certificate Examination, where by in 2019, 33.9% candidates had credits in Biology, 2020 (28.6%) and in 2021 (33.9%) had a credit in Biology. Following this assertion the researcher projected among other factors to be teaching method. In spite of application of various interactive method of teaching to improve the teaching and learning of biology, the trend persisted. As a result the researcher sought to investigate effect of guided discovery and YouTube instructional strategies on pre-service teachers' academic achievement and retention in North-central, Nigeria.

Aim and Objectives of the Study

The study strived to achieve the following specific objectives by determining the:

i. determine whether Guided-Discovery Instructional Strategy, YouTube Instructional Strategy and Lecture Method affects NCE 1 Pre-service Biology teachers' achievement scores taught Invertebrates diversity in North-Central, Nigeria.
ii. find out the effects of Guided-Discovery Instructional Strategy ,YouTube Instructional Strategy and Lecture Method on NCE 1 Pre-service Biology teachers' achievement scores in Invertebrates diversity based on gender in North-Central, Nigeria.

Research Questions

From the above objectives the following corresponding research questions were raised:

1. What is the difference in the Mean ($\bar{X}$) achievement scores of NCE 1 Pre-service Biology teachers' taught invertebrates' diversity using Guided-Discovery Instructional Strategy, YouTube Instructional Strategy and Lecture Method among colleges of Education in North-Central, Nigeria?
2. What is the difference in the Mean ($\bar{X}$) achievement scores of male and female NCE 1 Pre-service Biology teachers' taught invertebrates' diversity using Guided-Discovery Instructional Strategy, YouTube Instructional Strategy and Lecture Method among colleges of Education in North-Central, Nigeria?

Research Hypotheses

For the purpose of the research study, the following null hypotheses were formulated and tested at 0.05 level of significant

H_{O1}: There is no significant difference in the achievement scores of NCE 1 Pre-service Biology teachers' taught invertebrates' diversity using Guided-Discovery Instructional Strategy, YouTube Instructional Strategy and Lecture Method among colleges of Education in North-Central, Nigeria.

H_{O2}: There is no significant difference in the achievement scores of male and female NCE 1 Pre-service Biology teachers taught invertebrates diversity using Guided-Discovery

Instructional, Guided-Discovery Instructional Strategy and those taught without using Lecture Method among colleges of Education in North-central, Nigeria.

Methodology

The research design adopted for this study is the quasi-experimental design (the pre-test, post test, post-post-test, non-equivalent, non-randomized experimental and control groups design). The population of the study comprises pre-service teachers in North-central, Nigeria, and target population was NCE 1 pre-service Biology teachers. Intact class of 153 pre-service Biology teachers (male = 60, female =93) were used for the study from three randomly selected colleges of education in North-central states, Nigeria. A multi-stage sampling technique was used to select the colleges of education used for the study. The test instruments used for data collection named Biology Achievement Test (BIACT); while the treatment instruments were Guided-discovery, YouTube Instructional Strategies and Lecture Method). The BIACT was validated by research experts from the FUT science education department, with a coefficient of 0.89, Kuder-Richardson formula 20 (K-R20) was used to determine the reliability of BIACT. The BIACT comprises of 40 multiple choice objective questions. All the three groups were given Pretest before the treatment and after treatment posttest were given. Experimental group one was exposed to the use of Guided-discovery Instructional Strategy, experimental group two was exposed to YouTube Instructional Strategy while Control group was exposed to Lecture Method (LM). Mean and standard deviation were used to analyze the research questions while ANOVA was used to analyzed hypotheses. Conclusion, it was established that there was significant difference in the achievement scores among the groups.

Analysis of Results

Research Question One: What is the difference in the Mean ($\bar{X}$) achievement scores of NCE 1 Pre-service Biology teachers' taught invertebrates' diversity using Guided-Discovery Instructional Strategy, YouTube Instructional Strategy and Lecture Method among colleges of Education in North-Central, Nigeria?

Table 1: Mean and Standard Deviation of Pre-test and Post-test Mean Scores of Pre-service Biology teachers' Taught with Guided Discovery, YouTube Instructional Strategies and Lecture Method.

Group	N	Pretest		Posttest		Mean ($\bar{X}$) Gain	Mean ($\bar{X}$) Difference	
		$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	I-J	
Guided-Discovery	54	9.37	2.38	23.46	3.46	14.09	Y-G	0.67
YouTube	48	9.54	2.45	24.44	6.14	14.90	G-C	3.50
Lecture Strategy	51	9.49	2.39	20.22	5.33	10.73	Y-C	4.17

Table 1 shows the Mean and Standard Deviation analysis of Pre-test and Post-test scores of the two experimental groups and the control group on achievement in Invertebrates Diversity. The table revealed the mean and standard deviation scores of the pre-test and post-test of experimental group one (Guided-Discovery) are $\bar{X}$ = 9.37, SD = 2.38, and the Post-test mean and standard deviation scores are $\bar{X}$ = 23.46, SD = 3.46 respectively, which signifies a mean gain of $\bar{X}$ = 14.09. The mean and standard deviation scores of the Pre -test and Post-test of

experimental group two (YouTube) are $\bar{X}$ = 9.54, SD = 2.45, and the Post-test mean and standard deviation scores are $\bar{X}$ = 24.44, SD = 6.14, respectively, which indicates a mean gain of $\bar{X}$ = 14.90. While the mean and standard deviation scores of the Pre-test and Post-test of Lecture Method are $\bar{X}$ = 9.49, SD = 2.39 and $\bar{X}$ =20.22, SD= 5.33 respectively, with a mean gain of $\bar{X}$ = 10.73. The results revealed that experimental groups one, two and the control group had mean gain of 14.09, 14.90 and 10.73 respectively. The difference between the mean scores of the two experimental groups was $\bar{X}$ = 0.67, between the YouTube and the Lecture Strategy group is $\bar{X}$ = 4.17 and between Guided-Discovery and the Control group is $\bar{X}$ = 3.5. This implies that there was difference in the mean scores of the experimental and control groups, with YouTube having the highest mean score, followed by Guided Discovery group and lastly by the Lecture Strategy group. This result is in favour of the two experimental groups with experimental group two (YouTube) having the highest mean gain.

Research Question Two: What is the difference in the Mean ($\bar{X}$) achievement scores of male and female NCE 1 Pre-service Biology teachers' taught Invertebrates' diversity using Guided-Discovery, YouTube Instructional Strategies and those taught with Lecture Method among colleges of Education in North-central, Nigeria?

Table 2: Mean and Standard Deviation of Male and Female Pre-service Biology Teachers' Taught with Guided Discovery, YouTube Instructional Strategies and Lecture Method.

GROUPS	Gender				
Guided-Discovery	Male	29	23.89	3.479	
	Female	25	23.04	3.458	0.85
	Total	54	23.46	3.463	
YouTube	Male	19	24.68	5.860	
	Female	29	24.28	6.414	0.40
	Total	48	24.44	6.140	
CLM	Male	12	20.08	6.273	
	Female	39	20.26	5.092	0.18
	Total	51	20.22	5.327	
Total	Male	58	23.36	5.190	
	Female	95	22.27	5.398	1.09
	Total	53	22.69	5.329	

Table 2 describes the Post-test mean and standard deviation of male and female students taught Invertebrates' diversity with Guided Discovery, YouTube Instructional Strategies and Lecture Method. It shows that males in the Guided-Discovery group had $\bar{X}$ = 23.89, SD = 3.48; females had $\bar{X}$ = 23.04, SD = 3.46 respectively, indicating a difference of 0.85. The YouTube male students had $\bar{X}$ = 24.68, SD = 5.86 while the females had $\bar{X}$ = 24.28, SD = 6.41 respectively, showing a difference of 0.40. While the Conventional Lecture Strategy, the males had $\bar{X}$ = 20.08, SD = 6.27, and females had $\bar{X}$ = 20.26, SD = 5.09 respectively, revealing a difference mean score of 1.09. Hence there is difference in the mean scores of male and female NCE 1 pre-service teachers taught Invertebrate Diversity with Guided-Instruction, YouTube and Lecture Instructional strategies.

Testing of Hypotheses

Hypotheses One (HO_1): There is no significant difference in the achievement scores of NCE 1 Pre-service Biology teachers' taught invertebrates' diversity using Guided-Discovery

Instructional Strategy, YouTube Instructional Strategy and Lecture Method among colleges of Education in North-Central, Nigeria.

Table 3: Post-test ANOVA Analysis of Post-test (Achievement) Scores of pre-service Teachers taught using Guided-Discovery, YouTube Instructional Strategies and Lecture Method.

Source	Type III Sum of Squares	Df	Mean Square	Fcal	Sig.	Partial Eta Squared
Corrected Model	491.075[a]	2	245.538	9.627	.000	.114
Intercept	78694.603	1	78694.603	3085.364	.000	.954
Group	**491.075**	**2**	**245.538**	**9.627**	**.000**	.114
Error	3825.866	150	25.506			
Total	83061.000	153				
Corrected Total	4316.941	152				

P< 0.05

Table 3 reports the ANOVA results of the post-test scores of pre-service students taught invertebrates' diversity with Guided-Discovery, YouTube Instructional Strategies and Lecture method. From the results, it revealed that F (2, 150) = 9.627, p= 0.00, which is less than 0.05 level of significance. The results revealed that the Guided-Discovery, YouTube and Lecture instructional Strategies produced a significant difference effect on the post-test achievement scores of pre-service teachers taught invertebrates' diversity in the North-central States. This clearly indicates that there is significant difference in the post-test mean scores of pre-service teachers taught invertebrates' diversity with Guided-Discovery, YouTube and Lecture instructional Strategies. This implies that a statistical significant difference exists among the three groups. The results of the analysis indicate that hypothesis one was rejected on the basis that the main effect (treatment) was significant. Since it was established that there was a significant difference in the post-test scores of the groups, Sidak post-hoc test analysis was done to identify the direction of the difference among the treatment groups.

HO2:There is no significant difference in the achievement scores of male and female NCE 1 Pre-service Biology teachers' taught Invertebrates' diversity with Guided-Discovery, YouTube and Lecture instructional strategies among colleges of Education in North-central, Nigeria?

Table 4: ANOVA Results of Gender Difference in the mean achievement scores NCE 1 Pre-service Biology teachers' taught with Guided-Discovery, YouTube and Lecture

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	503.061[a]	5	100.612	3.878	.002	.117
Intercept	68689.897	1	68689.897	2647.544	.000	.947
Gender	**4.375**	**1**	**4.375**	**.169**	**.682**	**.001**
Group	405.282	2	202.641	7.810	.001	.096
Gender * Group	5.745	2	2.873	.111	.895	.002
Error	3813.881	147	25.945			
Total	83061.000	153				

Corrected Total	4316.941	152

Table 4: reports the ANOVA results of the gender differences in performance of students taught invertebrates diversity with Guided-Discovery, YouTube and Lecture Instructional Strategies. From the results, F (1,147) = .169, p = .682, which is greater than 0.05 level of significance. This indicates that there was no significant difference in the performance of male and female students taught invertebrates' diversity with Guided-Discovery, YouTube and Lecture Instructional Strategies.

Discussion of the Findings

There was significant difference in the mean achievement scores of students taught biology using Guided-discovery, YouTube strategies and lecture method. This is in agreement with the findings of Tofi, Achor, and Eje, (2023), these researchers concluded from their investigations that students taught using innovative teaching method as Guided-discovery, YouTube strategies and lecture method performed better than those taught using expository method in terms of achievements.

The was no significant difference in the achievement scores of male and female students' taught Invertebrates' diversity using Guided-Discovery Instructional Strategy, YouTube Instructional Strategy and Lecture Strategy. This is in support of Olorode and Jimoh, (2016), Sakariyau, 2016 and Frederick-Jonah, Akporehwe, & King, (2020).

Recommendations

As result of the above findings, it is recommended that:

1) Biology lecturers in colleges of education should adopt the use of Guided-Discovery and YouTube Instructional Strategies in teaching as it is more effective strategies compared to the Lecture Method.
2) Workshop seminars, symposia and conferences should be organized periodically to acquaint new biology lecturers with recent research findings that would lead to effective and meaningful teaching and learning.
3) Government and college administrators' should prioritize investments in ICT facilities and infrastructures to enable a successful technology-enabled instruction and environment using the YouTube Instructional Classroom.

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INTEGRATING CULTURE INTO MATHEMATICS CLASSROOM: THE ROLE OF ETHNO-MATHEMATICS INSTRUCTIONAL STRATEGY

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Abstract
The integration of culture into the mathematics classroom represents a significant pedagogical shift that acknowledges the diverse backgrounds of students and the rich tapestry of knowledge that various cultures contribute to the field of mathematics. Ethno mathematics refers to the study of the relationship between mathematics and culture, emphasizing that mathematical practices are not solely the product of Western civilization but are instead a global phenomenon that encompasses a multitude of cultural perspectives. This paper aims to elucidate the significance of ethno mathematics in fostering innovative pedagogical approaches within the mathematics classroom, thereby enhancing student engagement and promoting a more inclusive learning environment.

Keywords: Culture, Ethno-Mathematics, Innovative Pedagogy and Mathematics Classroom

Introduction

Mathematics is a field of study that discovers and organises methods, theories and theorem that are developed and proven for empirical sciences. Mathematics is the craft of creating new knowledge from old, using deductive knowledge and logic (Abaniel, 2021).Mathematics is also called the science that draws necessary conclusions (Kurumeh, 2004). Mathematics which also describes the structure of order and relation evolving from century (Dictionary Britannica, 2004), is pivotal to almost all science related courses, which includes, physics, engineering, computer science and so on(Gambari,2006).Obviously no student intending to study any discipline, can do without mathematics. The Federal Ministry of Education taking cognisance of the importance of mathematics, made mathematics one of the core subjects, to be offered by all learners from Primary to Secondary school levels (FRN, 2004)

The importance of mathematics cannot be overemphasized, this is because mathematics provide an official way of building mental discipline, encourages logical reasoning and mental rigours. Mathematics provide healthy brain function, while also improving problem solving skills, the study of mathematics can help develop skills of posing hypotheses, design experiment and help in data analysis (Badmus, 2002). Mathematics education is concerned with the practice of teaching and learning of mathematics, as a way of solving problems involving learning the algorithm and formulas necessary for computation, Masarwe et'al (2012). Mathematics education also called the pedagogy of mathematics refers to the study of how people learn and teach mathematics meaningfully. Mathematics pedagogy is primarily concerned with the tools, method and approaches that facilitate the study of mathematics encompassing a variety of different concepts.

Culture refers to the idea, customs and social behaviours of a particular group of people or society. It is the characteristics or features, of the everyday existence shared by a group of people (Capua, 2021). It refers to their norms, values, and symbols which are used to identify them, providing a framework within which they live and work. A mathematics classroom, on

the other hand refers to a learning environment, where students engage in the study of mathematics (Farokhah, 2017). It is where teachers use various assessment tasks, to elicit evidence of students understanding, and guide instructional adjustments (Principles for mathematics at dpi.wi.gov). An effective mathematics classroom use clear methods that make mathematics easy to understand and interesting for students. This involves the use of interactive lessons aimed at keeping students engaged, hence encouraging them to learn how mathematics works using practical examples. Integrating culture into the mathematics classroom requires the teacher to intentionally want to bridge the gap by intersecting culture and mathematics, thereby helping learners learn about their values and culture as an asset to learning mathematics.

Innovative pedagogy refers to instructional strategies or instructional approaches that positively impact students learning, behaviours and attitudes and are capable of ensuring, that all students achieve the defined course, or programme learning outcome, necessary to demonstrate the expected graduate attributes (Maharaj et al, 2019).Innovative pedagogy fosters solving a real problem in a new, simple way to promote learning (Adolphus, 2011). Ethno mathematics as an example of innovative pedagogy, involves critical thinking, active learning, and problem based learning (PBL). Ethno mathematics is the study of mathematics in relation to the culture of the people. It is also considered as the science of number, manipulation and calculation as it is embedded in the culture of the people. (Abonyi, 2006). (Rosa &Orey, 2011) define ethno mathematics by breaking it, into three Greek words, ethno, mathema, and tics. Ethno means a member of a group within a cultural environment identified by their cultural traditions, codes, symbols, myths and specific ways used to reason and to infer. 'Mathema' means to explain and understand the world in order to transcend, manage, and cope with reality, so that the member of the cultural group can survive and thrive. And 'tics' refers to techniques such as counting, ordering, sorting, measuring, weighing, ciphering, classifying, inferring and modelling**".**

Ethno mathematics as an instructional strategy aims at creating meaningful learning. It possesses the potential to create, different learning atmosphere in each region, thereby allowing social inequality, as well as cultural differences (Soyemi, 2023). (Machaba&Dhlami, 2021) agrees that ethno mathematics instructional strategy is an innovation in mathematics learning and can be used to teach mathematics in formal classes. Considering ethno mathematics as an innovative pedagogical strategy, in the mathematics classroom, restores a sense of pleasure and involvements and can increase creativity in learning mathematics (Prahmana & D'Ambrosio, 2020). Integrating culture into the mathematics classroom help both the teacher and the learner to understand that, mathematics is an expression of human culture, thereby making the learning of mathematics to start from the real socio-cultural concept and reality of students (Risidyanti & Prahmana, 2021). Ethno mathematics is usually manifested is some cultural artefacts such as, mats, clay pots, clay bed, local drums, and local spoons. These cultural artefacts have imbedded in them some geometrical concepts such as straight line, angle, perpendicular and parallel lines.

Ethno Mathematics as an Innovative Pedagogical Strategy

Ethno mathematics compasses a broad spectrum of mathematical practices that arise from various cultural contexts illustrating how different societies utilize mathematical concepts, to solve practical problems. For instance indigenous community often employ unique counting system, geometric patterns in art and spatial reasoning in navigation, which reflect their cultural heritage and lived experiences (D'Ambroisio, 2016). By recognizing these diverse mathematical practices, educators can create a more nuanced understanding of mathematics

that transcends the traditional Eurocentric narrative (Fouze& Amit, 2021). This approach will not only validate the mathematical knowledge of learners from diverse backgrounds, but also enrich the overall curriculum, as it incorporates a variety of perspective which challenges the regular mathematics instructional strategy.

Integrating culture into the mathematics classroom makes ethno-mathematics a key to innovative pedagogy because it necessitates the adoption of innovative pedagogical strategies that promotes active learning and critical thinking amongst others. To do this effectively educators should involve the use of culturally relevant examples and problems that resonates with the students experiences (Mongari,2020). For example teachers can incorporate traditional games, crafts or architectural designs from various cultures to illustrate mathematical concepts such as symmetry, mensuration, and probability. More so collaborative learning activities encourage learners to share their mathematical practices, with a view to fostering a community and belonging within the classroom (Eraikhumen, 2003). This enhances students mathematics engagements and by extension their achievement. Another aspect is that ethno mathematics, applies problem based learning (PBL) as a tool for engaging students in real world projects that require mathematical reasoning and cultural understanding. For example a project that involves designing a community garden, can incorporate mathematical concepts such as area, perimeter, and geometry, while also allowing students to explore the cultural significance of various plants, and gardening techniques within their communities. This innovative pedagogical approach reinforces mathematical skills as well as, cultivates a sense of social responsibility and cultural awareness among learners (Kurumeh, 2004).

According to (Pauline, 2023) who worked on the use of ethno mathematics module in teaching geometry, reported that ethno mathematics approach is the most effective teaching method, which links geometry teaching to the cultural environment of the learners. This means studying the concept of the cultural group, and integrating it, into the curriculum which resulted in higher achievement in geometry but (Aikpitiyan & Erhaikurmen, 2017) asserted that despite its effectiveness ethno mathematics is rarely used in the classroom. (Pauline, 2023) further stated that, the ethno mathematics module is one of the learning materials that help learners study independently, and construct their own knowledge and learning experiences.

Lucky et al., (2017) stated that ethno mathematics has been proven by researchers to be one of the most effective and innovative pedagogical strategy. He found out that ethno mathematics approach enhances understanding and efficient learning, resulting in higher achievement of students in mathematics; his research was carried out in Edo state, Nigeria. Also Mongari (2002) conceived that Ethno mathematics, as a pedagogical approach of teaching and learning mathematics, builds on the students previous knowledge, background and the role the environment play in terms of contents, method, and past and present experiences. (Taylor&Illuno, 2023) maintained that students who received instruction through an ethno mathematics approach, which involved using traditional and local shapes to teach conic, sections, demonstrated higher levels of academic performance compared to students who were taught using a conventional instructional strategy.

The Role of Teacher Development for the Successful Integration of Ethno mathematics into the Mathematics Classroom

It is important that educators receive adequate professional development programs, focused on enhancing teachers understanding of ethno mathematics, and its pedagogical implications, these programs would equip teachers with the necessary knowledge and skills, as well as providing them with practical strategies for incorporating culturally

relevant content into their lessons. This innovative pedagogical approach, can foster collaborative network among educators, aid sharing of resource and experience, and promote best practices, which in turn could lead to a culture of continuous improvement and innovation in teaching (Sonyebari, 2020). These roles include but not limited to the following;

1. The teachers themselves should ensure they understand, and appreciate the ethno mathematics instructional strategy if their teaching must be valued.
2. Teachers must continually upgrade their knowledge of ethno mathematics instructional strategy; they must also work on their perception and remove every form of bias.
3. Teacher development institutions, should equip teachers with such abilities that make them serve as a link between the formal concepts and practice in culture and the regular mathematics curriculum, this helps to aid students understanding of the material since it is directly linked to their culture.
4. Teachers are to be provided with sufficient and appropriate geometrical concepts as a way to make mathematics more accessible, engaging and relevant with a view to improving learner's academic achievement (Madusise, 2015).

Challenges for Integration of Ethno mathematics into the Mathematics Classroom

In spite the numerous benefits of ethno mathematics, as a key to innovative pedagogy, several challenges also abound which includes:

1. The prevailing perception that mathematics is a universal language, which could lead to marginalization of culturally specific mathematical practices.
2. Educators encounter resistance from stakeholders who are accustomed to conventional teaching method and curriculum. To overcome the challenges, it is paramount that these stake holders be involved, (including parents, administrators and the wider community,) in an open dialogue aimed at highlighting the value of a culturally responsive mathematics education, this would bring about a deep understanding of the cultural contexts from which these practices originates, thereby fostering an all-inclusive environment which honours the contributions of all learners.
3. The inability to understand the historical and social context of different mathematical systems. Ethno mathematics requires a critical and reflective attitude towards the origin, meaning, and implications of mathematical concepts and practices (Patrick, 2023).
4. A wrong assumption that culture and mathematics are intimately and dialectically connected this could lead to incomplete understanding of the language of mathematics.

Effective Strategy for Integration of Ethno mathematics into the Mathematics Classroom

The following are part of the strategies, that could be used to ensure full integration, of ethno mathematics into the mathematics classroom;

1. Teachers should ensure they prepare a culturally friendly lesson plan; this means that every mathematics lesson should be given an indigenous perspective, implying that both learners and teachers must be familiar with same.
2. Teachers can also demonstrate ethno mathematics from different cultures, hence showing learners the cultural difference in teaching and learning mathematics, with a view to ensuring that learners imbibe the knowledge of same concepts, but with different cultural representations.
3. Another effective strategy for the integration of ethno mathematics into the mathematics classroom is, to use a combination of different hands on and minds on activities, involving other learning strategies such as explicit instruction, cooperative learning, visual strategies and strategic questioning. All these can help enhance the ethno mathematics instructional strategy, rather than using it alone, in isolation.

Conclusion

The integration of ethno mathematics into the mathematics classroom, offers a transformative approach to pedagogy, which recognizes and values the diverse cultural background of learners. It embraces the rich mathematical practices, which exist within various cultures, helping educators to create a more engaging learning environment, fostering critical and creative thinking, which promotes a deeper understanding of mathematical concepts. It is imperative that teachers receive the necessary support and resources to implements these innovative strategies effectively. Hence the incorporation of ethno mathematics will not only enrich the mathematics curriculum, but also prepare learners to navigate the increasingly, interconnected and multicultural world, which enhances their autonomy and capacity for meaningful participation in the society.

Ethno mathematics is a thriving field of study, there is no need denying its significance for teaching geometry and mathematics in general. Its role is to serve as an intercultural and cross disciplinary field despite some of the challenges which includes resistance, poor awareness and unfriendly circumstances such as classroom size amongst others. Ethno mathematics is based on studies in a number of areas of mathematics which includes; anthropology, Ethnography, cultural Studies, cognitive sciences, history and social dynamics. An effective strategy for implementing ethno mathematics begins from recognizing the beauty of it and analysing its use in the teaching of geometry (Prahmana & D'Ambroisio, 2020).

Recommendations

The following measures are strongly recommended, for the smooth running of the course of ethno mathematics, where it already existed, and its effective implementation in a situation where it is to be introduced;

1. Seminars and workshops should be conducted for existing mathematics teachers on how to use ethno mathematics instructional strategy.
2. Ethno mathematics should be embedded as a course of study in the teachers training curriculum, this would help pre-service mathematics teachers to be equipped for the task ahead, by making them fully prepared upon graduation.
3. Curriculum planners should include ethno mathematics strategy in the mathematics curriculum, during compilation or review of the existing curriculum.
4. The government, school administrators, and Policy makers should adhere to the prescribed teacher- learner ratio. This is to help prevent overcrowding as an overcrowded class does not support the ethno mathematics strategy. The government could also help by employing more teachers where necessary.
5. Teachers should be properly motivated and incentivized.

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MOTIVATIONAL FACTORS FOR SUSTAINABLE IRISH POTATO PRODUCTION: LEVERAGING EMERGING TECHNOLOGIES TO ENHANCE FARMERS' ACCESS TO INFORMATION NEEDS IN PLATEAU STATE, NIGERIA

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Abstract
Irish potato is a key contributor to global food and nutrition security. Sustainability in Irish potato production focuses on meeting current cultivation needs while preserving and enhancing resources for future use, thus promoting long-term food security. Access to information needs is vital for farmers, enabling them to obtain the necessary information to satisfy their agricultural needs. It is essential for improving farm practices, maximising profits, and enhancing livelihoods. Effective information access is especially crucial for sustainable Irish potato production, helping farmers use sustainable techniques, manage resources efficiently, and ensure healthy crop production over generations. The objectives of this study include to: identify the motivational factors that influence farmers to adopt sustainable Irish potato production in Plateau State, Nigeria; examine the role of emerging technologies (such as precision agriculture, social media, and mobile apps) in enhancing farmers' access to information needs and improving their productivity and to identify the key information needs of Irish potato farmers in Plateau State, Nigeria, and how these needs can be met through emerging technologies such as access to real-time information on best practices, weather forecasts, market prices, and pest management strategies, which are crucial for optimizing productivity and minimizing environmental impact. The study will adopt a literature review and make recommendations on strategies to integrate emerging technologies to enhance farmers' access to information needed to boost sustainable irish potato production in Plateau State Nigeria to improve food security and job opportunities.

Keywords: Access to information needs, emerging technology, farmers information needs, motivational factors and sustainable irish potato production

Introduction
The Irish potato (Solanum tuberosum) is a key contributor to global food and nutrition security, ranking fourth in human consumption after maize, wheat, and rice (F.A.O, 2023). Today, Plateau State account for over eighty per cent (80%) of Nigeria's Irish potato production. (Obi-Egbedi and Gulak, 2020). Irish potatoes offer numerous benefits, including serving as a staple food, a source of income when cultivated commercially (cash crops), and creating job opportunities. Nutritionally, they are rich in antioxidants, vitamins (B1, B2, B3, B6 which are very useful in maintaining brain and nervous system health, and C to repair the wear and tear

of the body cells), minerals (potassium, calcium, iron, magnesium, phosphorus, and sodium), and fibre, making them valuable for maintaining health, lowering blood pressure, and reducing cholesterol levels (Akinfewa, 2021).

However, Irish potato production in Plateau State faces challenges such as climate variability, pest and disease management, access to quality inputs, knowledge gaps, infrastructure, market access, financial constraints, and limited technological advancements (Adama, 2023).

Sustainability in agriculture, particularly in Irish potato production, involves using farming techniques that ensure healthy crop production for future generations while minimizing negative impacts on environmental, economic, and social aspects. Sustainable practices are crucial for the long-term sustainability of Irish potato production, including conserving water, reducing pesticide use, promoting biodiversity, and preventing soil erosion (Tijjani & Khairulmazmi, 2020).

Access to accurate and timely information is essential for achieving sustainability, and farmers can access information through extension workers, libraries, radio, television, and information and communication technologies (Ogbonna and Anunobi, 2022). Addressing challenges and adopting sustainable practices will ensure the long-term sustainability of Irish potato production in Plateau State and promote food security. The difficulty experienced by farmers in accessing relevant information hinders sustainability, leading to reduced productivity and output. Information is a vital resource for sustainable Irish potato production, alongside land, labour, capital, and skills. Farmers need agricultural information to improve farming practices, make informed decisions, and increase farm income. Effective access to information is crucial for sustainable Irish potato production, helping farmers use sustainable techniques, manage resources efficiently, and ensure healthy crop production over generations. For instance, information on soil care, irrigation management, and crop rotation is essential for maintaining soil health and conserving water (Garrido & Wyber, 2019).

The Objectives of the Study

The aim and objectives of this study is to enhance farmers' access to information needs for the sustainability of irish potato production through leveraging emerging technologies in Plateau State, Nigeria. The specific objectives are to:

1. identify the motivational factors that influence farmers to adopt sustainable Irish potato production in Plateau State, Nigeria;
2. examine the role of emerging technologies in enhancing farmers' access to information needs and improving their productivity;
3. identify the key information needs of Irish potato farmers in Plateau State, Nigeria, and how these needs can be met through emerging technologies and
4. strategies to improve farmers' access to information needs through integrating emerging technologies to boost sustainable irish potato production in Plateau State Nigeria.

Literature Review

Farmers' Motivational Factors for Adoption of Sustainable Irish Potatoes Production

Feliciano (2022) reported that, a wide range of agricultural practices that are considered sustainable consist of water conservation, input reduction, soil conservation, biodiversity conservation, adoption of renewable energy, organic farming and climate change mitigation and adaptation practices. The motivational factors that enable farmers to adopt these sustainable agricultural practices are economic factors (costs, technology, market demands);

institutional factors (regulations and land tenure); farmers' sources of information; farmers' perceptions on sustainability; farm characteristics and farmers' perceptions on climate change and climate change risks. Farmers adopt sustainable agricultural practices due to various factors, including economic, institutional, social, and environmental considerations (Feliciano, 2022; Piñeiro *et al.,* 2020: Selahkwe *et al.,* 2021).

Economic motivations include Cost reduction and efficiency; market demands and premium prices for sustainable products; access to technology, such as water re-utilisation and Combined Heat and Power (CHP); Increased profitability through minimized input costs and optimized resource allocation; Farm gate price and revenue. Also, the implementation of biodiversity conservation practices and their 'co-benefits' (Feliciano, 2022).

Institutional factors such as regulations and land tenure. Regulations are general rules or specific actions imposed by government agencies or private entities to enhance environmental and economic outcomes through improved practices (Piñeiro *et al.,* 2020). Institutional factors influencing sustainable practice adoption include Regulations and land tenure; access to credits and extension services, training on farm records, fertilizer use and planting and weeding techniques. Having access to credits helps the farmers to conduct field operations on time because of being able to pay for agricultural services and inputs needed in potato production, government support and policies influence positively potato production.

Social factors motivating sustainable practice adoption include Farmers' sources of information; Access to relevant and reliable information is considered crucial for farmers' adoption of agronomic innovations including sustainable agricultural practices (Dessart *et al.,* 2019). Informational sources and participation in knowledge networks on the adoption of sustainable agricultural practices; farmers' perceptions of sustainability and environmental consciousness; family size and availability of cheap labour; farmers' years of experience and educational level; access to information and knowledge networks. Dessart *et al.,* (2019) found that farmers' awareness of water quality, soil erosion, and the impact of sustainable management practices on the environment often leads to the adoption of sustainable management. Environmental factors driving sustainable practice adoption include: Climate change and water scarcity; soil conservation and erosion prevention; biodiversity conservation and wildlife corridors. Overall, farmers' adoption of sustainable agricultural practices is influenced by a complex interplay of economic, institutional, social, and environmental factors. The extension services help to equip the farmers with improved technologies and innovations that improve production efficiency leading to high yields. The knowledge gained from extension agents led the farmers to adopt improved technologies and management practices which have resulted in improvements in potato yield and production. More so, Selahkwe *et al*,. (2021) highlighted the farmers' motivational factors as follows; number of follow-ups after training, farmers' years of experience positively and significantly motivate farmers to adopt improved technologies, farmers with higher educational levels adopt new technology quickly than those with low education level, information access channels, rural residents with higher education level are more likely to value the government information department and Internet, follow-up and access to extension facilities after training, years of potatoes farming experience, access to quality seeds and improved seed from Non-Governmental.

The Role of Emerging Technologies in Enhancing Farmers' Access to Information Needs
Precision agriculture (PA) is a modern technology to optimize agricultural practices, resulting in increased productivity while reducing costs and environmental impact. Khose *et al*. (2023) posited that PA is an application of principles and technologies such as data collection,

Precision farming starts with data collection, gathering information on soil characteristics, moisture levels, nutrient content, crop health, and weather patterns. This data is collected through various technologies, including soil sensors, drones, satellites, weather stations, and ground-based sensors; Data analysis, the collected data is processed and analysed using sophisticated AI-ML algorithms and advanced software. This analysis reveals patterns, trends, and correlations, enabling farmers to make data-driven decisions; Site-Specific management, based on the analysed data, farmers can adopt site-specific management practices, adjusting irrigation schedules, nutrient applications, and pest control measures according to their unique needs of each area; Automation and precision equipment, precision farming relies on advanced machinery and equipment equipped with GPS and other technologies. These tools enable precise navigation, planting, fertilization, and harvesting, reducing human error and optimizing resource utilization. It is an innovative technology that comprises the application of several Hi-tech tools like Geographical Information System (GIS), Global Positioning System, Remote Sensing, Variable Rate Technology, Decision Support System, and Farmer (Nithinkumar *et al*., 2023).

Remote sensing; Satellite imagery and aerial drones provide real-time data on crop health, growth, and stress levels. Multispectral, thermal, and hyperspectral imaging can detect early signs of pest infestations, diseases, and nutrient deficiencies, and help to identify water-stressed areas, enabling prompt action (Caballero *et al*., 2019).

Global positioning system (GPS); GPS technology enables precise mapping of agricultural fields and provides accurate location information for agricultural machinery. This facilitates controlled traffic farming, where the same paths are followed repeatedly, minimizing soil compaction.

Geographic information systems (GIS); GIS integrates various data layers, including satellite imagery, weather data, soil maps, and yield maps. By visualizing this data spatially, farmers gain valuable insights into field variability and can make informed decisions accordingly.

Sensors and Internet of Things (IoT); Soil moisture sensors, water quality sensors, weather stations, and crop monitoring devices continuously collect data on environmental conditions. This information aids in optimizing irrigation schedules, predicting optimal planting times, and adjusting nutrient applications. The information collected from these sensors will help to develop different prediction models, which helps farm management preciously.

Machine Learning and Artificial Intelligence (AI)

Precision farming, leveraging AI, ML, and IoT technologies, optimizes agricultural practices by enhancing water management through soil moisture monitoring and efficient irrigation systems (Khose *et al.,* 2023), improving nutrient management through soil testing and real-time sensing (Shekhar *et al*., 2021a; 2021b), revolutionizing pest and disease management through remote sensing and targeted interventions (Khose *et al.,* 2023), and promoting crop monitoring and yield prediction through satellite imagery and advanced models (Ahmad *et al*., 2020), ultimately leading to reduced chemical usage, soil conservation, biodiversity preservation, water conservation, and lower greenhouse gas emissions (Mekonnen *et al*., 2019). **Smart agriculture** employs methods that differ from traditional ones, such as controlled irrigation and targeted, accurate application of herbicides and fertilizers, to increase production, decrease environmental impact, and enhance efficiency and profitability (Dhanaraju *et al*., 2022). Artificial intelligence, big data, cloud and edge computing, smart sensors, Internet of

Things (IoT) technology, robots, drones, and artificial intelligence are the primary digital technologies enabling the development and implementation of smart agricultural systems.

Cell phones and smart mobile phones are becoming the most important tools for farmers to access agricultural-related information. Smartphones provide easy access to weather information and market data, removing technological barriers and offering user-friendly applications for operating hardware, accessing sensor data, real-time IoT solutions, cloud services, and farm management applications at affordable prices. These applications and websites can aid small-scale farmers in communication, information access, expense tracking, yield management, and farm management, ultimately leading to better decision-making, increased productivity, and higher profitability (Dhillon & Moncur, 2023).

Mobile applications according to Kamal and Bablu (2023) offer enhanced access to information, market linkages, financial services, resource management, and extension services, which collectively empower smallholder farmers and catalyse agricultural growth. Increased Access to Information such as access to real-time weather updates, up-to-date crop prices, best farming practices, and pest and disease management. Leveraging mobile applications on a smartphone with an internet connection provides access to real-time weather updates. The provision of real-time weather updates is one of the most crucial features of agricultural mobile applications, weather plays a crucial role in farming, determining the timing of planting, irrigation schedules, and the overall health of crops. Accurate forecasts enable farmers to plan planting, irrigation, and harvesting, mitigating climate-related risks; mobile applications furnish farmers with up-to-date crop prices from various markets, empowering them to make informed decisions about when and where to sell their produce. Farmers access market rates, negotiate fair deals, and maximize earnings, enhancing economic stability; The best farming practices and innovative techniques are now readily accessible through these mobile applications. Best farming practices, interactive tutorials, videos, and expert insights promote sustainable, efficient, and environmentally friendly methodologies; Pest and disease management is a constant challenge for smallholder farmers, as outbreaks can devastate entire harvests. Mobile applications have addressed this concern by providing farmers with timely and accurate information on pest identification, prevention, and control measures. Timely information on identification, prevention, and control measures protects crops and minimizes losses, farmers can make well-informed decisions to enhance productivity and achieve better crop yields. These advancements not only drive economic growth for farmers but also contribute to sustainable and resilient agriculture, supporting food security and economic development in rural communities (Maginga *et al.*, 2022).

Financial Inclusion such as mobile banking and digital payment solutions, access to credit for essential inputs, increased financial security and stability, reduction of transaction costs; Resource Management such as farm management and resource tracking tools, optimal resource allocation and efficiency, reduced resource wastage and environmental impact, higher productivity and reduced expenses; and Extension Services for dissemination of information via text, audio, and video content, remote support and guidance for farmers, adoption of sustainable farming practices, improved productivity and income levels.

Farmers Information Needs

Irish potato farmers need access to various types of information to improve their farming practices and increase productivity as mentioned by Begna (2022): Kumar *et al*. (2023) and Indira *et al*. (2023) these include: farmers needs information on variety selection, Participatory Variety Selection (PVS) for improved crop adoption and food security; Sustainable agriculture,

farmers need information on key principles and practices for environmental stewardship, social responsibility, and economic viability; Quality seeds, farmers need information on how to access high-quality, disease-resistant seeds for better crop performance and higher productivity; Pest and disease management or monitoring to reduce crops loss, accurate information for early detection and ecological-based management; Soil health and fertility management, farmer need soil health data to manage fertilization and irrigation effectivity, information on how to maintaining soil health through testing, nutrient management, and conservation agriculture; Post-harvest handling and storage information, storage technologies and management practices to reduce losses; Climate change and weather information to forecasts planting and harvest, adaptation strategies using accurate climate data and seasonal forecasts; Market information and access to understand pricing trends and sell produce at the best rate, timely market information for informed decision-making and improved market performance.

Strategies to Improve Farmers' Access to Information Needs with Emerging Technologies.

The following are strategies to improve farmers' access to information needs through emerging technologies these include:

- Stakeholders in agriculture should research to identify farmers' information needs and equip them with timely information on the best internet tools to adopt for sustainable farming and agriculture information delivery.
- Educating and training farmers on modern agricultural technologies is crucial; this includes teaching them how to utilize mobile apps, websites, and digital tools, and developing user-friendly interfaces with follow-up support to ensure effective and sustainable adoption.
- Organizing ICT and agricultural information literacy training for farmers will equip them to harness the potential of internet-based information services.
- Providing online agricultural advisory and consultancy services in libraries and information services centres offers a valuable platform to reach farmers.
- The government should prioritize infrastructure investment, such as improved internet connectivity, to enhance access to internet-based services.
- The government should formulate policies offering incentives for technology adoption in agriculture, including providing low-cost smartphones/tablets to farmers and establishing public-access telecenters where farmers can access information at a low-cost.
- Developing local digital platforms, apps, and services for farmers and fostering partnerships between government, telecom providers, agri-tech companies, and non-governmental organizations can facilitate the distribution of agricultural knowledge.

Conclusion

Sustainable Irish potato production relies on access to quality, timely, accurate, and relevant agricultural information. Farmers are motivated to adopt sustainable farming practices when they see a clear economic benefit from their production efforts, as well as support from systems such as government incentives and extension services. Additionally, sustainable practices like soil health management, pest control, and efficient water use, along with the use of modern technologies and improved disease-resistant potato seed varieties, also encourage adoption.

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UTILIZING ARTIFICIAL INTELLIGENCE TOOLS TO ENHANCE SUSTAINABLE LIBRARY AND INFORMATION SCIENCE TEACHING PRACTICES AMONG LIBRARY AND INFORMATION SCIENCE EDUCATORS IN FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

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Abstract
This study investigated the integration of AI tools to improve sustainable teaching practices among Library and Information Science (LIS) educators at Federal University of Technology (FUT), Minna. To carry out this research, purposive sampling was used to gather the necessary data. Four research questions were formulated for the study. Total enumeration was used to adopt the total population of Twenty (20) LIS academic staff in FUT, Minna. A close ended electronic questionnaire was developed which was used to collect data for this study to assess the effectiveness of AI tools in enhancing instructional methods, resource management, and student engagement. The data gathered from the questionnaire were analyzed using descriptive statistics of percentages and charts. Data collected from LIS faculty members reveals that AI tools significantly contribute to the optimization of course delivery, personalized learning experiences, and efficient resource allocation. The findings underscore the potential of AI technologies to support sustainable teaching practices, addressing both pedagogical and environmental concerns in higher education. This research provides actionable insights for LIS educators seeking to adopt AI-driven strategies for advancing teaching practices in alignment with sustainable development goals.

Keywords: artificial intelligence, teaching practices, educators, library and information science.

Introduction
Artificial intelligence (AI) is the term used to describe how technology, particularly computer systems, mimic human intelligence processes. Applications of artificial intelligence include expert systems, machine learning, speech recognition, and natural language processing (NLP). Poutre(2024) stated that, AI systems typically work by taking in enormous amounts of labeled training data, examining it for correlations and patterns, and then utilizing these patterns to predict future states.

The use of AI has grown in many different business domains and scientific domains. Some of the most notable examples are listed below: Industry and commerce, healthcare, banking and finance, law, media and entertainment, journalism, software development, IT, security, manufacturing, transportation, and education. According to Lin (2022), there are numerous ways artificial intelligence (AI) can be used in education - teachers' time can be better used for other tasks by having some of the grading process automated. The author further noted that, AI technologies may also assess how well students are performing and modify to suit their

individual needs, enabling more individualized instruction that allows students to work at their own speed. The job of educators may change if AI tutors help students stay on course and modify their learning style.

According to Xue and Wang (2022), educational establishments worldwide have incorporated contemporary technologies in the last fifteen years to enhance the learning environment for instructors and students alike. This means that the shift from blackboard teaching to interactive online classes with smartboards has been notable, with the worldwide pandemic speeding up progress. Automation of tedious jobs and streamlining of procedures in sectors like marketing and healthcare have made headlines due to AI adoption. Educators in any field, from primary school teachers to university professors, can benefit greatly from artificial intelligence. Finding the ideal AI assistant can be revolutionary, as educators are always juggling a lot of jobs.

There is no longer any question about the fact that technology and other advances in our society have had a profound and enormous impact on library and information science (LIS) education around the world. To put it another way, Abubakar (2021) noted that, there have been significant changes to LIS education, particularly in the previous several decades, leading to alterations in all of its structures. These kinds of shifts are global, widespread, and profound. Additionally, the field of LIS is now viewed as an interdisciplinary field of study that has integrated many new and related areas such as information science, computer science, information system, knowledge management, information architecture, digitization, content management, and archives related areas. Therefore, it is crucial to emphasize that expanding and altering LIS programs to fit the new, changing environment—especially in the domain of ICTs and AI—is now inevitable.

Statement of the Problem

Although the use of Artificial Intelligence (AI) tools in educational contexts has the potential to revolutionize teaching methods, their application in Library and Information Science (LIS) education has not yet reached its full potential. The adoption and implementation of sustainable teaching approaches that capitalize on contemporary technological breakthroughs presents challenges for LIS educators at FUT Minna. The issue is that, even though AI tools have the potential to improve sustainability and efficacy of instruction, the LIS department lacks a thorough grasp of and experience with these tools in real settings. Abubakar (2021)explained that, this disparity makes it more difficult to create creative teaching methods and maximize learning results in the discipline of library and information science. In order to solve this problem, it is necessary to investigate the ways in which LIS educators may support and enhance sustainable teaching techniques by leveraging AI tools.

Literature Review

A transformative era for classroom teachers has begun with the introduction of Artificial Intelligence (AI), which has opened up a new world of possibilities in the teaching and educational sectors. This advancement in technology brings with it a set of AI-driven technologies that improve the delivery of instructional materials while also streamlining administrative duties Elgohary & Al-Dossary (2022). AI technologies for educators have a wide range of uses, from making interesting and interactive presentations to producing accurate assessment questions and real-time feedback. By providing them with supplementary resources to enhance conventional teaching materials, these technologies aim to assist classroom teachers. Teachers can adapt their methods to each student by integrating AI, making sure that every learner gets the support and individualized instruction they need to succeed.

According to Lin (2022), Artificial intelligence (AI) technologies also make it easier to create critical thinking exercises and challenging questions that push students' comprehension limits and encourage a deeper engagement with the material. Furthermore, they also make it possible to automate repetitive tasks like assignment grading, which frees up teachers to concentrate more on teaching and less on paperwork.

Several special aspects of AI tools can support teachers in their instructional duties. A few of these AI capabilities as listed by Edutopia (2024) include:

1. Simplified workspace: Search for an AI teaching assistant program that offers a single location to store all of your resources, such as lesson plans, educational materials, student information, and all AI-generated content, for convenient access.
2. Features for collaboration: Select capabilities such as real-time editing, ideating, commenting, and file sharing that facilitate live collaboration and foster teamwork and communication.
3. Tools for organization: To assist you with work prioritization and classification, look for AI-powered solutions with strong organizational features like tagging and filtering.
4. Features for time management: Make sure the AI tool has time-tracking, progress-tracking, and deadline reminders so you can increase productivity and concentrate on the important things.
5. Composing and recording features: To easily produce, edit, and distribute work products, use programs with integrated writing and documenting features, such as note-taking, editing, and pre-built templates.
6. Artificial Intelligence Generation: Use generative AI techniques to produce interesting lectures, presentations, and activity ideas that will boost teaching creativity and effectiveness.

Top 10 AI Tools for Educators to Use

Edutopia (2024) listed the top ten AI tools for educators' use as,

1. **ClickUp**

   Ideal for managing, producing, and collaborating as a team. Educators may avoid the hassles of managing several work management, collaboration, and communication tools by using ClickUp, an all-in-one productivity platform. The software Click Up for Education is great for handling academic and administrative responsibilities in one interface, like monitoring students' information and developing curricula. Additional Clickup features include,

   - Quick responses: Obtain lesson plans, student information, and study materials quickly without having to go through papers on the ClickUp site by hand.
   - Organizing and planning: Enhanced organizational skills allow you to organize classes, manage assignments, make to-do lists, grade assignments on time, and share papers with students.
   - Automated updates: Avoid wasting time on manual tracking by receiving automated progress reports on chores like grading documents and submitting assignments.
   - Project synopses: Provide thorough project summaries that include goals, schedules, and deadlines for efficient planning.
   - Writing support: Get AI-powered writing support to produce detailed lesson plans and rich tables containing student data, come up with ideas for classroom activities, and correct spelling errors to boost productivity.

2. Twee

Most effective for understanding YouTube videos and producing instructional materials. One well-liked AI tool for instructors to use in lesson planning is Twee. It can be used for other courses as well, even though its primary purpose is to support English teachers. Twee can assist with reading comprehension, writing prompts, vocabulary development, speaking practice, listening exercises, and grammar exercises thanks to its artificial intelligence capabilities.

With Twee, instructional materials including letters, stories, dialogues, multiple-choice questions, true/false questions, and articles can be created. Time-constrained educators may construct interesting English classes quickly with Twee's special YouTube video tool. The top qualities of Twee include;

- Write content for many subjects, such as articles, stories, and dialogues.
- Create activities, summaries, and questions straight from YouTube videos.
- Arrange lesson plans and provide them to students in PDF format.

3. Lumen5

Using artificial intelligence, Lumen5 is an internet application for creating videos from written content. It is a great tool for educators and professors who, when slideshows fall flat, need to quickly produce polished yet interesting movies. Lumen5 provides tools to resize and compress videos, combine clips, add text to videos, and more. It can be used by educators to make instructional materials for pupils, crucial presentations, and notices for the school. The greatest things of Lumen5 are as follows,

- Turn text into interesting videos without the need for complicated video editing tools
- Use a sizable collection of royalty-free photos, films, and music to improve the visuals `in your content
- Adjust the generated video by making changes to the text, graphics, audio, and branding aspects.

4. Canva

Educators wishing to create dynamic presentations, lesson plans, visual aids, and more can utilize Canva, a user-friendly and free AI graphic design platform. It contains one of the greatest resource libraries, which includes gifs, movies, animations, and music in addition to templates, infographics, and posters. Canva effortlessly shares and reviews student work straight through your learning management system (LMS) by integrating with popular classroom technologies like Google Classroom and Microsoft Teams (Coursera, 2024). Among Canva's greatest features are the following,

- Select from thousands of pre-made templates to save time browsing
- It can be connected with Google Classroom to share work with others.

5. Audio Pen

Excellent for writing instructional materials. Taking notes and creating content is made easier with AudioPen, an easy-to-use AI voice-to-text tool. It's an excellent tool for teachers because it can copy meetings, lectures, and thoughts, which lessens their labor. It even improves readability by getting rid of repeats and stutters. Non-native English speakers may now access education without worrying about making grammatical errors and express themselves in English while on the road because it is compatible with computers and smartphones. (Simplilearn, 2024). The greatest benefits of AudioPen are as follows,

- Record everything, including emails, lesson plans, lecture notes, and student feedback
- The premium edition allows for quickly creation of succinct summaries of extensive recordings, up to 15 minutes.

- Convert spoken narratives into many languages, record research notes with ease while on the go, and transcribe meetings.

6. OpenAI ChatGPT

Ideal for conducting research and producing content. Many educational uses are possible for OpenAI's potent ChatGPT (Generative Pre-trained Transformer) AI model. For educators, it's the perfect AI tool. With the free edition of ChatGPT, tests, quizzes, and lesson plans are suited to certain subjects, student needs, and learning preferences. It has been one of the most talked-about AI technologies for educators and students since its launch in 2022. Along with creating debate subjects and writing prompts, you can also translate languages—a huge benefit for non-native speakers—and come up with lesson plans for classroom instruction. Teaching with AI is a comprehensive resource provided by OpenAI. This tutorial was created specifically with educators in mind to assist them in using ChatGPT into their teaching environments. It provides teachers with examples, logical justifications, and suggested suggestions for lesson planning. Simplilearn (2024). Among the best features of OpenAI ChatGPT are,

- Provide educational resources with a well-written prompt
- Adjust format and content complexity as necessary.
- Simplify time-consuming chores that repeat themselves, such as grading and making tables with different data.

7. **Slidesgo**

Ideal for producing educational materials with a visual aid. Slidesgo offers a number of other helpful tools in addition to free Google Slides and PowerPoint templates. These templates are excellent for making presentations or slides for research, planners, notebooks, lessons, meetings, newsletters, thesis defenses, or project proposals. They are available for a variety of industries, including business, marketing, technology, medicine, and even the education department. The "AI icebreaker generator," a tool provided by Slidesgo to educators, is excellent for introducing lessons to students through interactive exercises. One of Slidesgo's biggest benefits is that you can customize classroom templates by adding your own branding, colors, and content.

- Apply AI to supplied content analysis to make content and design recommendations.
- Use Slidego's "AI presentation maker" tool to select the topic, tone, and style; AI will take care of the rest.
- This saves time and effort when creating content from scratch.

8. Microsoft Copilot

Ideal for customizing written content. Microsoft Copilot is an AI application that makes it easy to organize lessons, assign homework, and provide learning resources. The application, which is a Microsoft product, functions similarly to OpenAI's ChatGPT in that it leverages artificial intelligence to perform tasks automatically and produce content in response to your commands. This product facilitates the creation of specialized student feedback, instructional materials, and other resources. One of Microsoft Copilot's biggest advantages is its ability to personalize information for each learner based on their unique learning preferences and needs.

9. Quizizz

Ideal for adaptability and innovation. With the help of Quizizz, a game-based learning platform, teachers and students can engage in fun activities instead of tedious evaluations and reviews. Instructors can utilize this AI tool for free to prepare for tests, provide live lecture, assign homework, conduct individual and group practice, create slides, and more. It is possible

to construct interactive tests with leaderboards, avatars, and real-time feedback by utilizing Quizizz AI. Students can use their own devices to complete the quizzes, which come in a variety of question types like multiple-choice, polls, open-ended, and even image-based questions. Coursera (2024) The best features of Quizizz are;

- Make tests with more than fifteen different question kinds; modify the level of difficulty; proofread for errors; and even create new questions.
- Use the tool for in-class or remote learning activities on any web-enabled device.
- Increase student involvement with gamified features like Team Mode, Leaderboards, and Power-Ups.

10. Claude

Ideal for cutting down on time spent on tedious chores. Human values and social norms are intended to be of concern to Claude. Because of this, it's the perfect AI tool for educators. Instructors and Claude can work together to clarify difficult subjects, develop lesson plans, make interesting exercises, evaluate papers, respond to inquiries, and even come up with original material in response to prompts. Reviewing essays and short answer answers from students can be assisted by Claude. Though it can't give you the final scores, Claude can help you identify areas that need improvement. It may offer helpful criticism on how to raise student achievement. Translation of materials, summarizing of articles and research papers, and poetry writing are some of Claude's strongest traits.

How AI Can Enhance the Work of Educators

Personalized learning: Using AI-driven data, teachers may create customized learning experiences that offer insightful information about student performance and learning patterns. AI is able to rapidly modify student learning materials based on this data. Personalized learning experiences that take into account each student's learning style, learning limitations, and strengths can then be created by teachers using this information. (Stryker & Kavlakoglu, 2024) Efficiency and productivity: Increased productivity is another benefit of AI as noted by Patrizio (2024). Among the many clerical duties that educators have to perform are interacting with students and their families, marking tests, and giving feedback. Teachers could discover that they spend more time on these administrative duties than they do in instructing and interacting with students. By automating or streamlining these processes, artificial intelligence (AI) solutions free up more time for teachers to spend with their students.

Content creation and augmentation: Instructors can select from a variety of educational resources by using AI-powered platforms. Especially with generative AI, educators may generate lectures, exercises, quizzes, conversation starters, and presentations with just a brief keyword-based suggestion Gatlin, 2023).

Computerized Lesson Plans: Instructors are always looking for ways to make class planning more organized and efficient. Due to this endeavor, lesson planning platforms have been created with the intention of reducing the difficulties teachers encounter when creating and adjusting extensive lesson plans. This platform efficiently expedites the planning process by developing an automated approach for lesson plan generation, allowing teachers to save valuable time. Gatlin, 2023).

Improving the adoption and effective use of AI tools among LIS (Library and Information Science) educators at FUT Minna can be achieved through a combination of strategies:

1. Training and Professional Development: Provide workshops and specialized training on AI tools. This could involve webinars, in-person instruction, and courses covering

the fundamentals as well as more complex aspects of the AI technologies pertinent to LIS.

2. Value Demonstration: Provide real-world examples of how AI tools might improve instruction, research, and library administration. Their advantages can be demonstrated by case studies and success stories from other universities.
3. Integration into Curriculum: Include AI technologies in the LIS curriculum so that teachers can learn how to use them in their lesson plans and homework.
   Provide continuous technical support and resources, including FAQs, manuals, and troubleshooting assistance. Having a committed support staff or a person to contact with questions about AI might allay worries.
5. Promote Collaboration: Create a cooperative atmosphere where teachers can exchange best practices and their experiences with AI tools. Establishing discussion boards, communities of practice, or forums can help in knowledge sharing.
6. Feedback Mechanism: Put in place a method for getting teachers' opinions about the AI technologies. Utilize these comments to address any issues that come up and to make improvements.
7. Pilot Programs: To introduce AI technologies in a controlled way, begin with pilot programs. This enables experimentation and modification in response to preliminary findings and teacher input.
8. Promote incentives: Give educators who actively engage with and effectively use AI tools incentives like grants, recognition, or professional development credits.
9. Leadership Support: Make sure that institutional leadership promotes the use of AI and is in favor of its integration. Support from the top ranks can supply the tools and credibility required for adoption initiatives.

Problems with Artificial Intelligence in Education

There must be Pros and Cons for everything in this world to be in balance, and artificial intelligence is no different. The most frequent difficulties in incorporating AI into LIS teaching methodologies according to Du Boulay (2016), are as follows;

i. Endangering Teachers' Job Security
   The threats to teachers' job security are at the top of the list. Though this hasn't happened yet, it's a worry that the development and application of AI may affect the demand for specific educational job categories. With AI continuing to automate more parts of the educational process, there might be less need for human educators, which could result in increased productivity as well as possible job losses.

ii. Dehumanized educational experience
   The potential for AI to dehumanize learning is one of the main drawbacks for educators. Students might not receive the nuanced instruction that a human teacher can provide if AI algorithms are in charge of creating the content and setting the lesson's pace. Furthermore, bias can be reinforced by AI algorithms, which means that they might not be able to offer a diverse, inclusive curriculum that is adapted to each student's needs.

iii. Expensive for Teachers to Adopt
   The fact that implementing AI in the classroom might be expensive for instructors is another drawback. Not every educational organization, including schools, has a set amount set aside just for purchasing AI tools and technology. Furthermore, it might be too expensive right now to introduce AI in schools on a large scale. It might be costly and difficult to maintain if the teacher is the one paying for it.

iv. Technology over Dependence
Teachers and students run the risk of becoming overly dependent on technology as schools rely more and more on AI-powered solutions. Long-term, this reliance may lead to the disregard for crucial conventional teaching techniques as well as the failure to foster critical thinking and problem-solving abilities.

Methodology

This study employed a descriptive survey research design. The population of the study is made up of 20 academic staff in Library and Information Science Department, FUT, Minna. Total enumeration was used to adopt the total population of Twenty (20) LIS academic staff in FUT, Minna. A close ended electronic questionnaire was developed which was used to collect data from LIS academic staff. The data gathered from the questionnaire were analyzed using descriptive statistics of percentages and charts.

Results

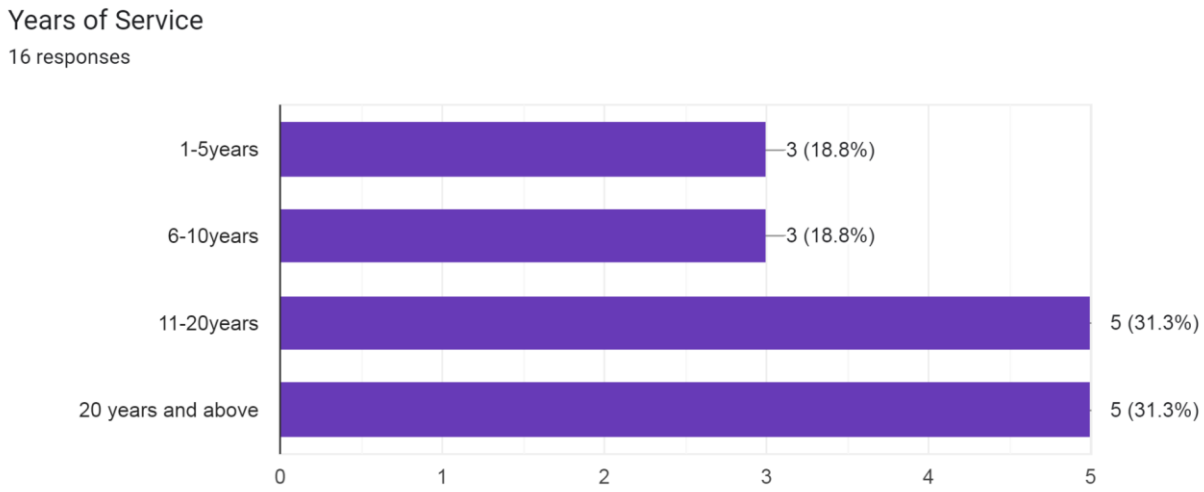
Table 1.1 Response rate

Table 1.2 Response rate of Respondents

	Total Number (F%)	Response Rate (F%)
LIS Academic Staff	20 (100%)	16 (80%)

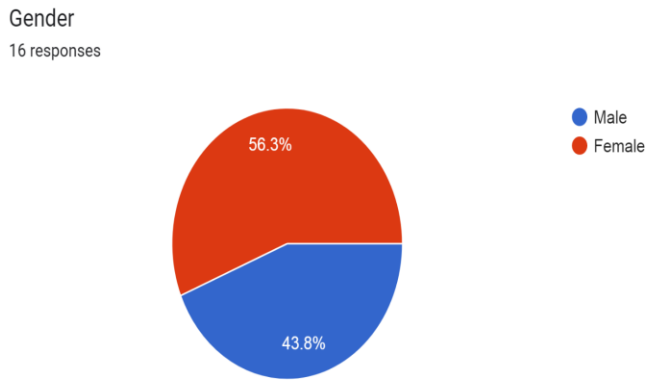
Demographic results

Figure 1.1 Depicting the years of service of the respondents



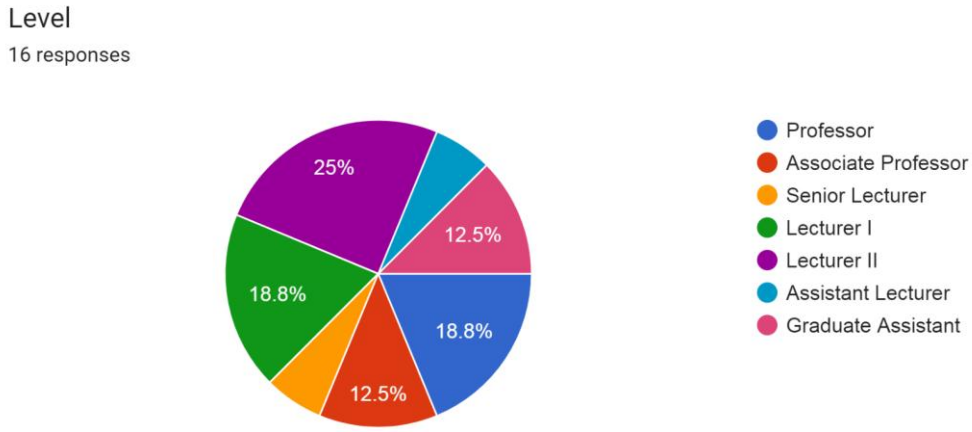
From the figure 1.1, 3 (18.8%) of LIS educators have 1-5 years teaching experience, 3(18.8%) have 6-10 years teaching experience, 5 (31.3%) have 11-20 years teaching experience, while, 5 (31.3%) have 20 years and above teaching experience. This accounts for the wealth of knoelwedge and experience in the department.

Figure 1.2 Depicting the Gender distribution of the respondents



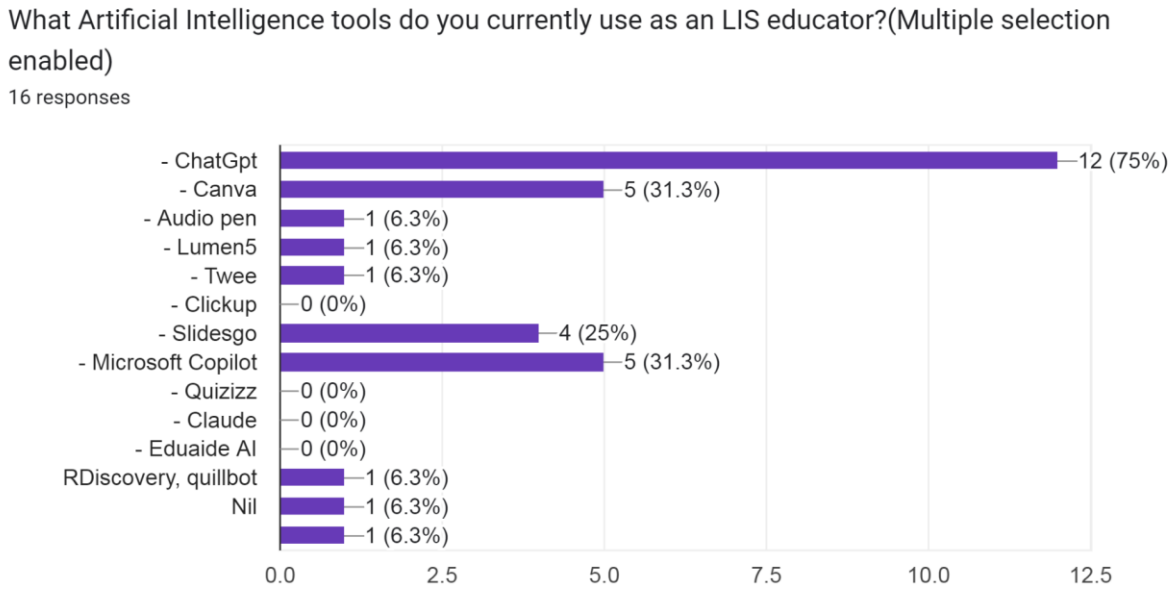
From the figure 1.2, 9 (56.3%) of the respondents are female, while, 7 (43.8%) of the respondents are male.

Figure 1.3 Depicting the professional level of the Respondents



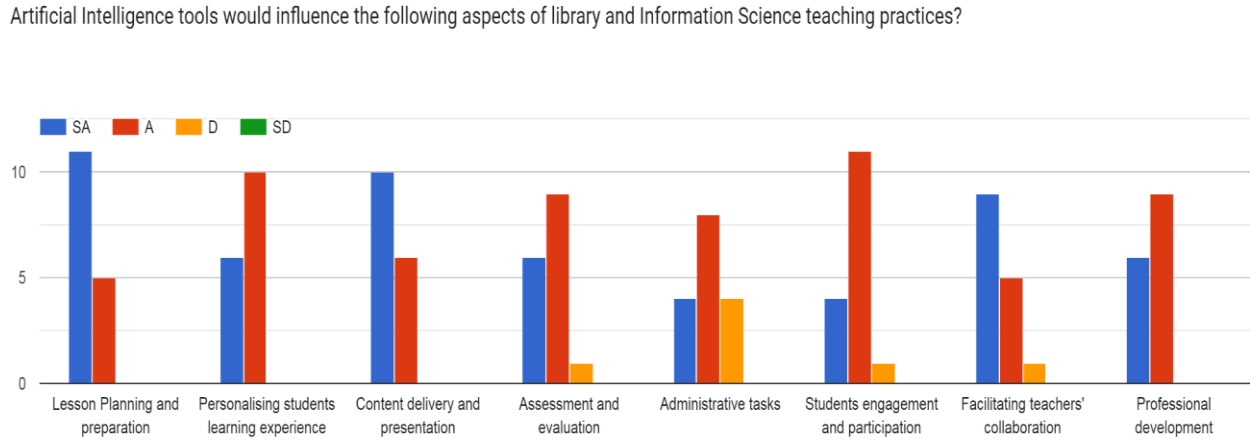
From the Figure1.3, 3 (18.8%) of the respondents were Professors, 2 (2.5%) were Associate Professors, 3(18.8%) were Lecturer I, while, 4 (25%) were Lecturer II

Figure 1.4 Depicting responses for types of AI tools currently used by the respondents



The Figure 1.4 showed ChatGpt as the AI tool mostly used by LIS educators with 12(75%), followed by canva and microsoft copilot with 5(31.3%) each, slidesgo had 4 (25%) , Audio pen, Lumen and Twee all had 1(6.3%). Clickup, Quizizz, claude, and Eduaide AI had 0% while R discovery and quillbot both had 1 (6.3%) respectively.

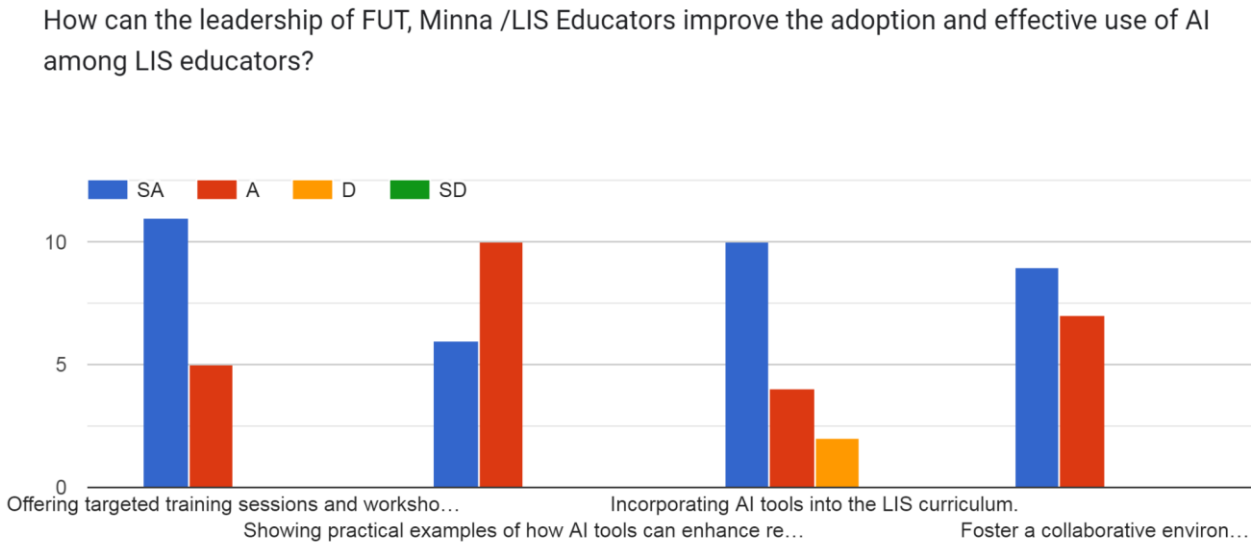
Figure 1.5 depicting the Influence of AI on different aspects LIS teaching practices.



The result in Figure 1.5 shows 68.75% of the respondents strongly agreed that artificial intelligence tools will influence lesson planning and preparation and 31.23% agreed to same. 37.5% of the respondent strongly agreed that personalising students learning experience would be influenced by AI and 62.5% agreed to same. 62.5% of the respondents strongly agreed that AI would influence content delivery and presentation while, 37.5% agreed to same. 37.5% of the respondents agreed that assessment and evaluation would be influenced by AI, 56.25% agreed while 6.25% disagreed to same. 25% of the respondents agreed that AI would influence administrative task, 50% agreed and 25% disagreed. 25% of the respondents strongly agreed that AI would influence student engagement and participation, 68.75% strongly agreed and 6.25% disagreed to same. 56.25% of the respondents strongly agreed that AI would influence teachers' collaboration, 31.25% agreed and 6.25% disagreed. 37.5% of the respondents

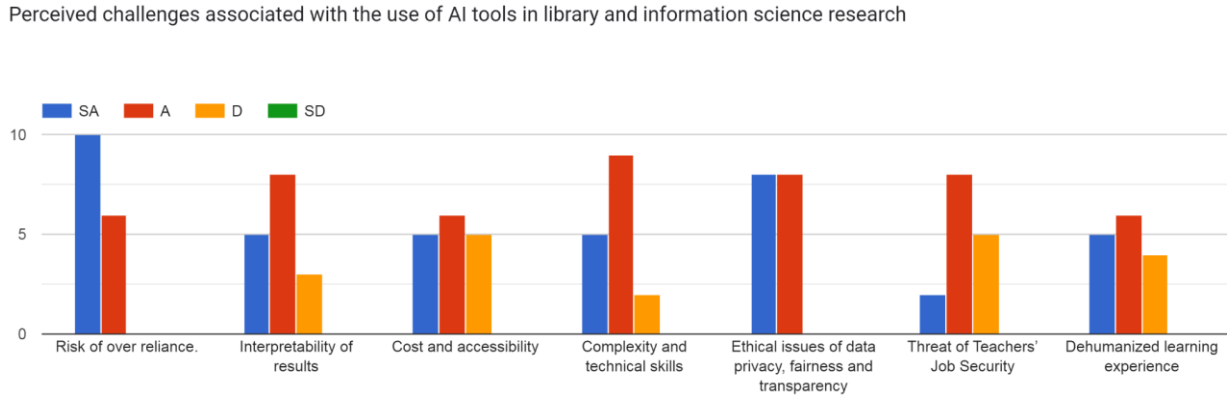
strongly agreed that AI would influence professional development and 56.25% agreed to same. From the forgoing result, it can be deduced that there is more agreement to the positive influence that AI makes to the teaching practices of LIS Staff in FUT, Minna.

Figure 1.6 Depicting how the leadership of FUT,Minna /LIS educators improve the adoption and effective use of AI among LIS educators.



From the above result, 68.75% of the respondents strongly agreed that offering targetted training sessions and workshops can improve adoption and use of AI, 31.25% agreed to same. 37.5% of the respondents strongly agreed that showing practical examples of how AI tools can enhance research and teaching practices can improve AI adoption and 62.5% agreed to same. 62.5% of the respondents strongly agreed that incorporating AI tools into LIS curriculum can improve AI adoption and use, 25% agreed while 12.5% disagreed to same. 56.25% of the respondents strongly agreed that fostering a collaborative environment can improve AI adoption and use while 43.75% agreed to same. This result proves that the school's authority/ leaderdership of LIS educators have a very important role to play in the adoption and effective use of AI by LIS educators.

Figure 1.7 Depicting percieved challenges associated with the use of AI tools by LIS educators.



From the result above, 62.5% of the respondents strongly agreed that risk of over reliance is a challenge in the use of AI tools while, 37.5% agreed to same . 31.25% of the respondents

strongly agreed that interpretability of results is a challenge in the use of AI tools, 50% agreed and 18.75% disagreed to same. 31.25% of the respondents strongly agreed that cost and accessibility is a challenge in the use of AI tools, 37.5% agreed while, 31.25% to disagreed to same. 31.25% of the respondents strongly agreed that, complexity and technical skills is a challenge in the use of AI tools, 56.25% agreed while, 12.5% disagreed to same. 50% of the respondents strongly agreed that ethical issues are a challenge in the use of AI tools and 50% agreed to same. 75% of the respondents strongly agreed that threat of teachers' job security is a challenge in the use of AI tools, 50% agreed while, 31.25% disagreed to same. 31.25% of the respondents strongly agreed that dehumanised learning experience is challenge in the use of AI tools, 37.5% agreed and 25% disagreed. This shows that as with anything, challenges also abound in the adoption of AI tools but in all, moderation and control of use is the key.

Recommendations

The Federal University of Technology, Minna authorities ought to devise tactics that will enable LIS instructors at FUT Minna to become more accustomed to using AI technologies and make efficient use of them in their work.

In co-teaching situations, teachers and AI must work together to provide advice, interpretation, and a deeper level of engagement with the topic. AI systems can help with instruction, evaluation, and real-time feedback and tutoring. Teachers will always play a crucial role as mentors, motivators, and learning facilitators. AI cannot replace the human connection, empathy, social and emotional intelligence, and capacity to nurture creativity and critical thinking that teachers bring to the classroom.

Artificial intelligence (AI) should be utilized sparingly and project a positive image so that students don't become over dependent on it.

Conclusion

In conclusion, instructors face both opportunities and challenges as a result of AI's growing presence in education. Teachers may use AI to enhance student performance and advance equity in the classroom by adopting a proactive approach towards this technology. This will allow educators to maintain the special role that teachers play in helping students grow, develop, and learn. For this reason, integrating AI-powered EdTech tools into instructors' lesson plans is still essential.

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EFFECTS OF ARTIFICIAL INTELLIGENCE (AI) ON STUDENTS' ACADEMIC ACHIEVEMENT IN BASIC SCIENCE AND TECHNOLOGY

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Abstract
The study investigated the effects of Artificial Intelligence (AI) on students' academic achievement in Basic science and technology in Junior Secondary Schools. Two research questions and two hypotheses guided the study. The study was conducted in Minna metropolis, Niger State. Quasi-experimental design was adopted for the study. A multi-stage sampling technique was used for the study. The sample size for the study consisted of 109 students. The study compared Web-based instructional medium to the use of conventional lecture method on identification, uses and functions of different types of woodwork and metalwork machines. Basic Science and Technology Achievement Test (BSTAT) was the main instrument used for data collection. BSTAT consisted of standardized questions adopted from the past NECO Basic technology past question papers and require no face validation. Meanwhile, content validity of BSTAT was established by five experts. The reliability coefficient for BSTAT yielded 0.88 using Kuder Richardson 20 formula. Research questions were analyzed using Mean and Standard deviation while the null hypotheses were tested at .05 level of significance using ANCOVA and t-test statistics. The findings of the study indicated that AI was more effective in helping students to improve on their academic achievement and that no significant difference was observed in the achievement of both male and female students, Based on the findings of the study, it was recommended among others that junior secondary school teachers should make use of web-based instruction for teaching basic science and technology.

Keywords: Artificial Intelligence, Students' Academic Achievement, Basic Science and Technology and Gender

Introduction
Artificial intelligence (AI) applications in education are becoming more popular and have gotten a lot of press in recent years. AI is a leap across creative and innovative thinking in various fields, including mathematics education. The current study indicates various research of AI in different context (Hwang, et al., 2020). The use of AI can enhance our abilities in living a life covered in increasingly sophisticated technology. According to Cleminson (2020), based on the development of computer technology, AI continues to expand and innovate. AI enables students to develop and enhance more mathematical skills and cognitive skills in learning. Popenici and Kerr (2017) the role of technology in higher learning is to enhance human thinking and augment the educational process. AI helps students in finding answers faster and easier. All information about the lesson can be easily accessed by students using this innovative intelligence software. In this generation, students are more inclined to learn and explore new knowledge on their own, so this powerful tool of AI can help students to explore more without waiting for an educator. Cope et al. (2020) indicate, however, the role of AI will never 'take over' the duty of educator in any way. Furthermore, the deployment of these technologies for teaching, learning, student assistance, and administration faces various hurdles (Popenici & Kerr, 2017).
Basic science and technology is a composite or cluster of subject or a course of study in the revised 9-Year Basic Education Curriculum whose implementation has just commenced in

September 2014 at the Primary and Junior Secondary School (JSS) levels of the 9-3-4 system of education being practised in Nigeria (Federal Ministry of Education, 2009). It is a product of the restructuring and integration of 4 Primary and JSS levels Basic Education Curriculum namely: Basic science, Basic Technology, Physical and health education, and Computer Science / Information technology. In the context of this study Basic Technology would be more emphasized. The integration of these curricula became necessary based on the recommendations of the Presidential Summit on Education (2010) to reduce the number of subjects offered in Primary and Junior Secondary Schools; feedback from the implementation of the curricular in schools that identified duplication of concepts as the major cause of curriculum overload; and the need to encourage innovative teaching and learning approaches and techniques that promote creativity and critical thinking in learners among others. For that reason, efforts were made to reduce content overload, repetition or duplications within and across subjects with little attention to the depth, appropriateness of the curricula contents (Jgbokwe, 2015).

According to Federal Ministry of Education (2009) the Basic Science and technology Curriculum (BSTC) is expected to enable the learners: develop interest in science and technology; acquire basic knowledge and skills in science and technology; applied scientific and technological knowledge and skills to meet contemporary societal needs; take advantage of the numerous career opportunities provided by science and technology; become prepared for further studies in science and technology; avoid drug abuse and related vices; and be safety and security conscious. Thematic approach to content organization was adopted in developing BSTC (Igbokwe, 2015). In thematic approach, the topics in each theme are spirally sequenced; from simple to complex across the 9 years of schooling in order to sustain the interest of learners and promote meaningful learning and skills. The contents of the curriculum are enriched with real-life examples and further promotes guided inquiry and activity based teaching and learning (Igbokwe, 2015). Web-based instruction holds promising implications for both teacher and students in providing the needed rich learning- environments for enhancing students' achievement especially with the use of blended learning approach.

According to Thrasher, Coleman and Atkinson (2012), blended learning is a method of instructional delivery that includes a mix of web-based instruction, streaming video conferencing, face-to-face classroom time, distance learning through television or video or other combinations of electronic and traditional educational models. It is otherwise known as distributed or hybrid learning. It can be implemented in a combination of ways, it always accommodates a separation of geographical locations for part (or all) of the instruction and focuses on leaner-to-leaner as well as instructor-to- leaner interaction. A typical model for blended learning might involve an initial face-to- face orientation followed by a period of online classes and then a face-to-face wrap-up class. A web-based instruction using blended learning approach as earlier stated would be adopted in the context of this study for increasing students' academic achievements in basic science and technology.

The use of web-based instruction focuses more on "learning" than "teaching". UNESCO (2005) pointed out that the shift to student-centred learning emerged based on cognitive learning research. Cognitive learning theories focus more on what goes on inside the learner's mind during learning process (Brenda, 1998). For that reason, the underlining premise for the use of web-based instruction in the context of this study is based cognitive theory. Emphasis in cognitive theory holds the perspective that students actively process information and learning takes place through the efforts of students as they organize, store and then find relationship and scripts (Darabi & Nelson, 2004).

Academic achievement according to Abd-El-Aziz (2013) connotes attainment in a school subject as symbolized by a score or mark on an achievement tes. Ziz

(2013) further explains that academic achievement depends on several factors among which are the instructional methods, learning environment and the learner. e rain oes not pay attention to boring things. What makes Web-based Instruction a specia me lum is that they add complementary, multisensory events designed to improve students understanding of concepts. This helps maintain students' attention which may in turn improves cognitive achievement. As a consequence, basic science and technology teachers should strive to make use of appropriate web-based instructional environment for the purpose of improving students' academic achievement.

Because of discrepancies in students' academic achievement in basic science and technology in our schools, researches have been carried out in a bid to identify factors responsible for it. Such studies are that of Uwaifo and Edigin (2011) on evaluation of basic technology instruction in Nigerian secondary schools. Abd-El-Aziz and Jimoh (2016) also assess the items used in the Basic Education Certificate Examination (BECE) multiple choice questions for Basic technology in the year 2011 to 2013 in Oyo state. Poor academic achievement of students in basic technology have been a source of concern to well-meaning individuals in Nigeria. This is so, because of its relevance in promoting good quality learning that constitute the base for future learning in a bid to build a worthwhile technological base in which economy is knowledge-driven. There is therefore the need for a serious improvement in upper basic level students' academic achievement in basic science and technology with a specific attention and or emphasis on basic technology as pre-vocational base on which future vocational choices are made. This could be done through effective instructional approach as entailed in web-based instruction.

The prevalent method of teaching as it could be seen in the practice by most basic science and technology teachers today is lecture method. This method according to Abd-El-Aziz (2013) is saddled with many limitations such as its teacher-centred and as such renders students passive as well as encouraging route memorization of facts; and its inability to provide a variety of activities for instruction in technology education among others. Persistent use of this method over the years has shown no improvement in the students' academic achievement in basic science and technology. A special teaching approach which is student-centred as entailed in web-based instruction may be more efficacious in enhancing students' achievements in basic science and technology This instructional approach could be useful in a classroom setting that consists of male and female students.

In this regard, gender issue is becoming an important factor capable of influencing students' academic achievement when exposed to an instructional approach (Ezeliora, 2007; Anagbogu & Ezeliora, 2007). Gender simply refers to classification of human into male and female. Researches on gender related issues have so far provide a mixed results. For instance in Nigeria, Anagbogu and Ezeliora (2007) exposed students to different scientific trainings based on cognitive, affective and psychomotor skills and found that girls scored significantly higher than boys. In the same manner, the findings of a study by McNeese (2003) in Brunei revealed that female students outperform male students in science. Meanwhile, Abidoye (2015) and Annetta, Mangrum, Holmes, Collazo and Cheng (2009) reported that gender has no effect on academic performance of students in Geography and physics respectively. On the note of these accounts, it would be appropriate and important for demographic details of students to be taking into consideration in the context of this study.

Statement of the Study

Discrepancies in the factors identified by the researchers as responsible for poor students' academic achievement in basic science and technology have become a source of concern to well-meaning Nigerians and demand for further researches. Observations have equally shown that the prevalent method of teaching adopted by most basic science and technology teachers today is lecture method. This method is teacher-centred and saddled with many limitations as it renders students passive, encourages route memorization of facts and unable to provide variety of activities for instruction in technology education. Persistent use of this method over the years has shown little or no improvement in the students' academic achievement in basic science and technology. Background to the study however establishes that students' learning could be better enhanced in a web- based instruction environment. Exploring the influence of this web-based instruction on students' academic achievement in basic science and technology is therefore desirable. This study therefore investigate the effects of artificial intelligence on students' academic achievement in basic science and technology. Gender may equally affect the way a method enhances knowledge or skill acquisition and as such underscores the need to investigate the effect of artificial intelligence on students' gender academic achievement in basic science and technology.

Purpose of the Study

The main purpose of this study was to investigate the effects of artificial intelligence on students' achievement in basic science and technology. Specifically the study sought to:

i. Determine the effect of artificial intelligence package on the mean achievement scores of junior secondary school students in basic science and technology compared to those taught the same basic science and technology using the conventional lecture method.
ii. Determine the difference between the mean achievement scores of male and female students taught basic science and technology using the Artificial intelligence.

Research Questions

The following research questions were equally raised to guide the study:

i. What is the mean achievement score of junior secondary school students taught basic science and technology using the artificial intelligence to those taught the same basic science and technology using the conventional lecture method.
ii. What is the mean achievement scores of male and female students taught basic science and technology using the artificial intelligence package?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

Ho_1: There is no significance difference in the mean achievement score of junior secondary school students taught basic science and technology using the artificial intelligence to those taught the same basic science and technology using the conventional lecture method.

Ho_2: There is no significance difference in the mean achievement scores of male and female students taught basic science and technology using the artificial intelligence package.

Research Methods

A quasi-experimental design using non-randomized, non-equivalent, pretest, posttest experimental group design was adopted for this study. The population for the study consisted of 2,550 students from educational zone "A" junior secondary school two (JSS II), otherwise known as Upper Basic II students in Minna metropolis. The sample size for the study consisted of 109 Upper basic II students. Multi stage sampling technique was used for the study. In the first stage, simple random sampling technique was used for selecting three co-education junior secondary schools. In the second stage, purposive sampling technique was used to select seven junior secondary schools with well-equipped computer and internet facilities with little or no interrupted internet network. Thirdly, simple random sampling technique was used to select two junior secondary' schools out of seven. Lastly, simple random sampling technique was used to allocate one of the two schools to experimental and the other one to control group by balloting. Intact class in each of the two schools was used for the study. The instrument used for data collection in the study was Basic Science and Technology Achievement Test (BSTAT) adopted from the past NECO basic technology past questions for Junior Secondary School levels otherwise referred to as Upper basic level. BSTAT consisted of twenty multiple choice items with four options (A-D). The items in BST AT consisted of standardized questions adopted from the past NECO h technology past question papers and require no face validation Meanwhile validity of BSTAT was established by giving BSTAT and its table of specifically to five experts to check the spread of the items' conformity with the concepts covered. Modifications were made based on their comments. The instrument was trial tested using twenty students from a similar junior secondary school in Abuja Metropolis. The reliability co-efficient of BSTAT using Kuder Richardson 20 formula was 0.88.Two lesson plans were developed for the purpose of this study. One of the lesson plans was developed to guide web-based instruction and the other one for conventional lecture lesson. The pre-test was administered on both experimental and control groups to draw a base line for data generated before the commencement of the study. Experimental group was taught in the computer laboratory on a direct linkage with the relevant website(s) for the needed information. Teacher makes used of Liquid Crystal Display (LCD) projector to take a lead in facilitating the classroom activities on basic science and technology contents presented to the students. The teacher presents information and displays relevant video clips and animations of the contents by direct connection to the web and asked the students to do the same on the web. Each student worked or was allocated to a workstation for the classroom activities. Web-based instruction was compare to conventional lecture method on identification, uses and or functions of different types of woodwork and metalwork machines. In the control group, teacher wrote the topic on the chalkboard and introduced the lesson by asking questions based on the previous lesson. He stated the specific learning objective(s) of the lessons; discussed and demonstrated the content of the lesson while the students listened to the teacher writes down the necessary information in their note books and are allowed to ask questions on areas of the topic which is not clear to them. Teacher asked few questions and randomly picked students to answer them. Teacher recognized and praised the correct responses and guided wrong responses to correct answers. The study lasted four weeks and BSTAT was reshuffled and administered immediately at the completion of treatment as posttest to measure the achievement of the sample students in each group. The data collected were analyzed using mean and standard deviation to answer research questions while Analysis of (ANCOVA) and t-test were used to test the hypotheses.

Results

Table 1: Mean Scores of Students' Academic Achievement in Basic Science and Technology based on the Modes of Instruction

Academic Achievement

		Pretest		Post-test		
Group	N	Mean	SD	Mean	SD	Mean Gain
Experimental	52	6.270	4.5334	18.550	11.6374	12.280
Control	57	7.050	4.6254	13.300	7.9288	8.250

Table 1 reveals that students taught with web-based instruction had a pre-test mean score of 6.270, post-test mean score of 18.550 and mean gain of 12.280. On the other hand, student taught using conventional lecture method had a pre-test mean score of 7.050, post-test mean score of 13.300 and mean gain of 8.250. This shows that using web-based instruction produces better result.

Table 2: Mean Scores on the Effect of Gender on Students' Academic Achievement in Basic Science and Technology when taught using Web-based Instruction

Academic Achievement						
		Pretest		Post-test		
Group	N	Mean	SD	Mean	SD	Mean Gain
Male	23	6.35	4.732	20.75	10.350	14.40
Female	29	6.19	4.225	16.35	9.928	10.16

Table 2 reveals that male students taught with web-based instruction had pre-test mean score of 6.35, post-test score of 20.75, and mean gain of 14.40. Female students who were equally taught with web-based instruction alongside with their male counterparts had a pre-test mean score of 6.190, post-test score of 16.350, and mean gain of 10.16 This shows that males have a higher mean score than female.

Table 3: Summary of Analysis of Covariance (ANCOVA) of Students' cognitive achievement scores in Auto-Mechanics based on Modes of Instruction

Source	Type III sum of squares	*df*	Mean square	F	Sig of F
Correct Model	71.360[a]	2	23.787	9.561	0.000
Intercept	3649.742	1	3649.742	1 17.963	0.000
Pretest	743.232	1	74.232	2.399	0.126
Groups	64.642	1	64.642	5.563*	0.000
Error	2134.840	107	5.810		
Total	107545.825	109			
Corrected Total	1654.350	108			

*Significance at Sig of F less than 0.05

Table 3 shows the F-calculated value for the effect of instruction on the academic achievement of students in Experimental group and Control group. The F-cal value for the group is 5.563 with a significance of F at .000 which is less than 05. The results indicated that there is a significant difference between the mean scores of Experimental group and Control group in the academic achievement of students in Basic science and technology. Therefore, the null hypothesis of no significant difference in the mean achievement score of junior secondary school students taught basic science and technology using the 'Artificial intelligence and those taught the same basic science and technology using conventional lecture method is rejected.

Thus, there is a significant difference significant difference in the mean achievement score of junior secondary school students taught basic science and technology using the 'Artificial intelligence and those taught the same basic science and technology using conventional lecture method.

Table 4: Summary of t-test Analysis of the Mean Achievement Scores of Male and Female students taught basic science and technology using artificial intelligence.

Variable	N	*Df*	X	SD	t-value	P-value
Males	23		20.750	10.350		
Females	29	50	16.355	9.928	0.758^{NS}	1.96

NS=Not Significant at P>0.05

Table 4 shows that the calculated t-value is 0.758 while the critical t-value is l 96 at .05 alpha level of significance. This implies that the null hypothesis that there is no significant difference in the mean achievement scores of male and female students taught basic science and technology using the Artificial intelligence is not rejected. Hence, there is no significant difference in the mean achievement scores of male and female students taught basic science and technology using the artificial intelligence.

Summary of Findings

The summary of findings of the study includes:

i. Students taught with web-based instruction produce higher mean score than those taught with conventional lecture method
ii. Male students performed better than female students when taught web-based instruction.
iii. There is significant difference between the mean scores of students taught with web-based instruction and those taught using conventional lecture method.
iv. There is no significant difference between the mean scores of male and female students taught with web-based instruction.

Discussion of the Results

Data obtained from this study indicated that students in the experimental group obtained a higher post-test mean score than those in the control group. The difference between the mean scores was statistically significant as shown in Table 3. The results of this study agree with earlier studies by Kaur and Kaur (2012), Giizeller and Akin (2012) and Thrasher, Coleman and Atkinson (2012). These studies revealed that web-based instruction is effective in the recall of learnt materials.

Also, the findings of this study regarding the achievement of male and female students in basic science and technology show that males were ahead of female by a difference of 4.24, but it was found to be statistically significant in the test of hypothesis. This is in line with the studies by Abidoye (2015), Gambari, Yussuf and Balogun (2012) and Annetta, Mangrum, Holmes, Collazo and Cheng (2009). These researchers did not establish any significant difference in the achievement of male and female students when taught using different methods and technique. The lack of significant difference in the achievement of male and female in basic science and technology arises probably from the fact that the web-based instruction is not gender biased. Rather, with the effective application of web-based instruction, good results can be achieved by both male and female.

Conclusions

On the basis of the findings emanating from this study, web-based instruction was found to be more effective than the conventional lecturing method on students' achievement in basic science and technology. The mean score of the students taught with AI was found to be significantly higher than those taught with conventional teaching method. It can be confirmed from the findings of this study that the teaching method had a significant effect on students academic achievement in basic science and technology. One can therefore conclude that understanding ol basic science and technology can be enhanced by incorporating AI into basic science and technology teaching and learning.

Also, males had a mean score higher than the female students, the difference in the mean scores was not statistically significant. I he result indicated that both males and females benefitted equally when exposed to this AI instructional medium. Hence, if well utilized, AI could serve as an effective approach to achieving the desired learning outcomes especially when equal treatment are required for both male and female students.

Recommendations

i. The use of AI was found to be effective in promoting academic achievement in basic science and technology, junior secondary school teachers should therefore be encouraged to make use of web-based instruction for teaching basic science and technology.
ii. Seminars, conferences and workshops should be organized to sensitize and train teachers on the use of web-based instruction for teaching and learning.
iii. Government should provide computer facilities, projectors, and good internet network connectivity in schools so that the learners can learn at their own pace on the web.
iv. Curriculum planners should incorporate the use of web-based instruction as part of instructional medium for teaching basic technology in the next review of the curriculum.
v. Teachers of basic science and technology should provide equal opportunities for male and female students to learn as both can achieve similar results with the use of appropriate instructional medium. Thus, the use of AI which is prone to gender biased when used effectively should be employed.

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TRANSFORMING TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING IN NIGERIA THROUGH AI AND NEW TECHNOLOGIES: A STRATEGIC FRAMEWORK FOR ENHANCING LEARNER ENGAGEMENT AND EMPLOYABILITY

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Abstract

This paper explores the potential of transforming Technical and Vocational Education and Training (TVET) in Nigeria through the integration of artificial intelligence (AI) and emerging technologies to enhance learner engagement and employability. It highlights the significant challenges facing the TVET sector, including outdated curricula, inadequate infrastructure, limited industry linkages, and insufficient teacher training. The paper presents a strategic framework focused on curriculum modernization, teacher development, infrastructure investment, and stronger partnerships between TVET institutions and industries. The integration of AI is emphasized as a key enabler for creating personalized learning experiences and bridging the gap between education and industry demands. In conclusion, the paper underscores the importance of adopting new technologies to align TVET with the evolving needs of Nigeria's workforce. It was recommended among others that the government should prioritize investment in infrastructure, such as high-speed internet and modern equipment, to support AI integration in TVET institutions.

Key words: Technical and Vocational Education and Training, Artificial Intelligence, Learner Engagement, Employability, Curriculum Modernization

Introduction

Technical and Vocational Education and Training (TVET) in Nigeria has long been recognized as a crucial component of the country's educational framework, playing a significant role in equipping individuals with the practical skills necessary for economic productivity. TVET is designed to provide learners with the technical know-how required to meet the demands of various industries, particularly in sectors where skilled labor is essential. The Nigerian educational system acknowledges the importance of TVET, with institutions dedicated to imparting vocational skills in areas such as manufacturing, construction, and information technology. These institutions, ranging from vocational/skill acquisition centers technical colleges, have the mandate to produce graduates capable of contributing to the nation's industrial and economic development (Uduafemhe, Raymond, Usman, & Idris, 2018; Uwaifo, 2009).

The Nigerian government has historically emphasized the need to strengthen TVET as a means to reduce unemployment and foster economic growth. Policies and programs have been introduced to enhance the quality and reach of vocational education, including the establishment of the National Board for Technical Education (NBTE), which oversees the curriculum and standards of TVET institutions across the country. Despite these efforts (Uduafemhe, 2015), the TVET system in Nigeria has faced numerous challenges, including

inadequate funding, outdated curricula, and a disconnect between training programs and the actual needs of the labor market. These issues have hindered the ability of TVET institutions to produce graduates who are truly equipped to thrive in Nigeria's evolving economic landscape.

The current state of TVET in Nigeria is characterized by both significant challenges and emerging opportunities. One of the primary challenges is the outdated curriculum that many TVET institutions continue to use. The curriculum often fails to align with modern industry requirements, leaving graduates underprepared for the realities of the workforce. Additionally, the lack of adequate infrastructure and teaching resources further exacerbates the situation, making it difficult for institutions to deliver quality education. Uduafemhe et al, (2018), hinted that in many cases, students are trained on obsolete equipment, and teachers lack access to continuous professional development, leading to a skills gap between what is taught and what is needed in the industry.

Another major challenge is the perception of TVET as a less prestigious educational pathway compared to university education. This societal bias has led to lower enrollment rates in TVET programs, particularly among young people who view vocational training as a last resort rather than a viable career path. Moreover, the absence of strong industry linkages means that many TVET graduates struggle to find employment, as they lack the practical experience and industry connections that are crucial in today's job market (Adamu, 2021).

However, despite these challenges, there are significant opportunities for revitalizing TVET in Nigeria. The growing recognition of the importance of vocational skills in driving economic development has led to increased government and private sector interest in supporting TVET initiatives. Additionally, the advent of new technologies presents a unique opportunity to modernize TVET programs and make them more relevant to the needs of the 21st-century economy. By integrating digital tools and emerging technologies such as artificial intelligence (AI) into the curriculum, TVET institutions can enhance the learning experience and better prepare students for the demands of the modern workplace (Uduafemhe, Ewim, & Karfe, 2023; UNESCO, 2019).

The Role of AI and New Technologies in Education Globally

Globally, the role of artificial intelligence (AI) and new technologies in education has been transformative, offering unprecedented opportunities to enhance teaching and learning. AI, in particular, has the potential to revolutionize education by providing personalized learning experiences, automating administrative tasks, and offering data-driven insights that can improve educational outcomes. In many countries, AI is being used to tailor educational content to individual learners, ensuring that students receive the support they need based on their unique strengths and weaknesses (Uduafemhe, Ewim, & Karfe, 2023; Holmes et al., 2019). This personalized approach not only enhances learning outcomes but also increases student engagement by making education more relevant and accessible.

Furthermore, new technologies such as virtual reality (VR) and augmented reality (AR) are being integrated into educational programs to create immersive learning environments. These technologies allow students to engage with complex concepts in a hands-on manner, improving their understanding and retention of information. In the context of TVET, VR and AR can be particularly useful in simulating real-world scenarios, enabling students to gain practical experience without the risks associated with traditional hands-on training (Freina & Ott, 2015).

In addition to improving the learning experience, AI and new technologies also have the potential to bridge the gap between education and industry. By incorporating AI-driven tools that simulate industry-specific tasks, TVET institutions can ensure that their graduates are better prepared to meet the demands of employers. Moreover, the use of data analytics can help institutions track the progress of their students and make informed decisions about curriculum development and resource allocation, ultimately leading to a more effective and efficient education system (Luckin et al., 2016).

The Current State of TVET in Nigeria

Historical Overview of TVET in Nigeria

The roots of Technical and Vocational Education and Training (TVET) in Nigeria can be traced back to the pre-colonial era when traditional apprenticeship systems were prevalent. These informal systems of skills acquisition were integral to various trades, including blacksmithing, weaving, and pottery. However, formal TVET began to take shape during the colonial period, with the establishment of technical schools aimed at producing a skilled labor force to support colonial administration and industries (Umaru et al., 2015).

After Nigeria gained independence in 1960, the importance of TVET was further recognized, leading to the establishment of more technical colleges and vocational centers across the country. The 1977 National Policy on Education marked a significant milestone, as it emphasized the need for vocational and technical education to drive the nation's industrial and economic development (Federal Republic of Nigeria, 2013). Subsequent educational reforms continued to prioritize TVET, leading to the creation of specialized institutions such as polytechnics and colleges of technology.

Government Policies and Initiatives in TVET

Over the years, the Nigerian government has implemented various policies and initiatives to strengthen the TVET sector. The introduction of the 6-3-3-4 educational system in 1982 was one such initiative, aimed at integrating vocational training into the secondary school curriculum (Ekpenyong & Edokpolor, 2015). The National Board for Technical Education (NBTE) was established to oversee the regulation and standardization of TVET programs in the country, ensuring that curricula align with national development goals (Uduafemhe and Raymond, 2019).

In recent years, the government has launched several initiatives to address the challenges facing TVET. The National Skills Development Policy, introduced in 2018, seeks to enhance the quality and relevance of TVET by promoting public-private partnerships, improving infrastructure, and updating curricula to reflect industry needs (Federal Ministry of Education, 2018). Additionally, initiatives like the Youth Employment and Social Support Operation (YESSO) and the N-Power program have been introduced to provide skills training and employment opportunities for Nigerian youth, further highlighting the government's commitment to revitalizing the TVET sector.

Challenges Facing TVET in Nigeria

Inadequate Infrastructure and Resources

One of the most significant challenges facing TVET in Nigeria is the inadequate infrastructure and resources available in many institutions. Many technical colleges and vocational centers are poorly equipped, with outdated tools and machinery that do not meet current industry standards. This lack of modern facilities severely limits the ability of students to gain practical, hands-on experience, which is essential for developing the skills required by employers (Okoye

& Arimonu, 2016). Additionally, the scarcity of learning materials and resources further exacerbates the problem, leading to suboptimal learning outcomes.

Limited Industry Linkages and Outdated Curriculum

Another critical challenge is the limited linkages between TVET institutions and industries. The curricula in many TVET programs are outdated and do not align with the rapidly changing needs of the labor market. As a result, graduates often find themselves ill-equipped for the demands of modern industries, leading to high levels of unemployment and underemployment among TVET graduates (Oviawe, 2018). The lack of collaboration between TVET institutions and industries also means that students miss out on opportunities for internships, apprenticeships, and on-the-job training, which are crucial for gaining real-world experience.

Insufficient Teacher Training and Development

The quality of instruction in TVET institutions is another area of concern. Many teachers in TVET programs lack the necessary qualifications and training to effectively deliver technical and vocational education. In some cases, instructors are not familiar with the latest technologies and industry practices, making it difficult for them to provide students with relevant and up-to-date knowledge (Okwelle & Deebom, 2017). The lack of continuous professional development opportunities for TVET instructors further compounds this issue, leading to a workforce that is not fully prepared to meet the demands of the evolving labor market.

Opportunities for Improvement

Growing Demand for Skilled Labor in Nigeria

Despite the challenges facing TVET in Nigeria, there are several opportunities for improvement. One of the most significant is the growing demand for skilled labor in various sectors of the Nigerian economy. As industries continue to expand and diversify, there is an increasing need for workers with specialized technical skills. This demand presents an opportunity for TVET institutions to revamp their programs and align them more closely with industry needs, thereby enhancing the employability of their graduates (Raymond, Uduafemhe, Alome, & Ogumah, 2018; Ayonmike, Okwelle, & Okeke, 2015).

Emerging Technologies as Enablers of Educational Transformation

The rise of emerging technologies also offers a unique opportunity for transforming TVET in Nigeria. Technologies such as artificial intelligence, virtual reality, and digital platforms can be leveraged to enhance the delivery of technical and vocational education. These technologies can be used to create more interactive and engaging learning environments, provide students with access to up-to-date information and resources, and facilitate remote learning in areas where access to education is limited (Daniel, 2015). By embracing these technologies, TVET institutions in Nigeria can improve the quality of education they offer and better prepare students for the demands of the modern workforce.

Strategic Framework for Transforming TVET in Nigeria

Defining a Clear Vision for the Future of TVET in Nigeria

The strategic framework for transforming Technical and Vocational Education and Training (TVET) in Nigeria must be grounded in a clear and forward-looking vision that aligns with the nation's broader economic and social development goals. The vision for TVET in Nigeria should be to create a dynamic, inclusive, and innovative education system that equips learners with the technical skills, knowledge, and competencies necessary to thrive in a rapidly changing global economy. This vision should emphasize the integration of cutting-edge technologies, particularly artificial intelligence (AI) and digital tools, to ensure that TVET

graduates are well-prepared to meet the demands of the 21st-century workforce. By focusing on innovation and inclusivity, the vision should also aim to make TVET accessible to all segments of society, including marginalized and underserved populations, thereby contributing to equitable economic growth and social cohesion.

Setting Objectives for Learner Engagement and Employability

To operationalize this vision, the strategic framework must set clear objectives that focus on enhancing learner engagement and employability. Key objectives should include increasing the relevance of TVET curricula to industry needs, fostering a culture of continuous learning and adaptability among students, and improving the quality of teaching and learning through the integration of AI and other emerging technologies. Another critical objective should be to establish strong linkages between TVET institutions and industries, ensuring that students have access to real-world experiences and job placement opportunities. Additionally, the framework should aim to increase the employability of TVET graduates by equipping them with not only technical skills but also soft skills and digital literacy, which are increasingly important in today's job market.

Key Components of the Framework

Curriculum Development and Modernization with AI Integration

A key component of the strategic framework is the modernization of TVET curricula to include AI and other emerging technologies. This requires a comprehensive review of existing curricula to identify gaps and areas for improvement. The integration of AI can enhance the personalization of learning experiences, enabling students to learn at their own pace and receive tailored feedback that addresses their specific needs. Moreover, AI can be used to create adaptive learning environments that respond to the evolving demands of industries, ensuring that students are always learning relevant and up-to-date skills. This modernization process should be guided by input from industry stakeholders to ensure that the curricula align with the needs of employers and prepare students for the future of work.

Teacher Training and Professional Development in Emerging Technologies

For the successful implementation of AI and other technologies in TVET, it is essential to invest in the training and professional development of teachers. Instructors must be equipped with the skills and knowledge to effectively integrate these technologies into their teaching practices. This can be achieved through targeted professional development programs that focus on the use of AI tools, digital literacy, and innovative teaching methodologies. Additionally, creating a community of practice among TVET educators can facilitate the sharing of best practices and support continuous improvement in teaching quality. By empowering teachers with the necessary skills, the framework can ensure that the adoption of new technologies leads to meaningful improvements in student learning outcomes.

Infrastructure Development and Resource Allocation

Another critical component of the framework is the development of infrastructure and the allocation of resources to support the integration of AI and digital tools in TVET. This includes the provision of modern equipment, high-speed internet access, and digital learning platforms that facilitate the use of AI in the classroom. Investment in infrastructure should be prioritized in both urban and rural areas to ensure equitable access to high-quality TVET. Additionally, resource allocation should be guided by a needs-based approach, with a focus on providing adequate funding for the maintenance and upgrade of facilities and the procurement of cutting-edge technology. By building robust infrastructure, the framework can create an enabling environment for the effective delivery of modernized TVET programs.

Industry Partnerships and Collaboration for Real-World Relevance

The final component of the framework is the establishment of strong partnerships between TVET institutions and industries. Collaboration with industry stakeholders is essential for ensuring that TVET programs are aligned with the needs of the labor market and provide students with practical, real-world experience. These partnerships can take the form of internships, apprenticeships, and joint curriculum development initiatives. Additionally, industries can play a role in providing training for instructors and offering input on the latest technological trends and skill requirements. By fostering these collaborations, the framework can enhance the relevance of TVET programs and improve the employability of graduates.

Implementation Strategies

Phased Implementation Plan

The implementation of the strategic framework should be carried out in phases to ensure a smooth transition and to allow for adjustments based on feedback and lessons learned. The initial phase should focus on pilot projects in selected TVET institutions, where new curricula and technologies can be tested and refined. Subsequent phases should involve the gradual scaling up of successful initiatives, with a focus on capacity building and resource mobilization. This phased approach allows for a more manageable and sustainable implementation process.

Monitoring and Evaluation Mechanisms

To ensure the effectiveness of the strategic framework, robust monitoring and evaluation mechanisms must be put in place. These mechanisms should track progress against key performance indicators, such as student engagement, employability rates, and the integration of AI in curricula. Regular evaluations should be conducted to assess the impact of the framework and to identify areas for improvement. By continuously monitoring and evaluating the implementation process, the framework can be adjusted as needed to achieve its objectives.

Policy Recommendations and Government Involvement

Finally, the successful transformation of TVET in Nigeria will require strong policy support and government involvement. The framework should include specific policy recommendations that address issues such as funding, regulatory oversight, and the promotion of public-private partnerships. The government should play a central role in coordinating the efforts of various stakeholders, including TVET institutions, industries, and development partners. Additionally, policies should be put in place to incentivize the adoption of AI and other technologies in TVET, such as tax breaks or grants for institutions that invest in digital infrastructure. By providing a supportive policy environment, the government can help to drive the transformation of TVET and ensure that it meets the needs of Nigeria's evolving economy.

Conclusion

In summary, Technical and Vocational Education and Training (TVET) in Nigeria faces significant challenges, including outdated curricula, limited industry linkages, insufficient teacher training, and inadequate infrastructure. However, the integration of artificial intelligence (AI) and emerging technologies presents a unique opportunity to modernize TVET and enhance learner engagement and employability. By adopting AI-driven learning tools and updating the curriculum to meet industry demands, TVET institutions can better prepare students for the modern workforce. The growing demand for skilled labor in Nigeria, coupled with the potential of new technologies, sets the stage for a transformation in TVET that aligns education with the needs of the 21st-century economy.

The strategic framework outlined in this paper provides a clear vision for the future of TVET in Nigeria, focusing on modernizing curricula, investing in teacher development, building infrastructure, and fostering industry partnerships. These components are essential to revitalizing TVET and ensuring that it plays a pivotal role in Nigeria's economic and social development. To achieve this transformation, a phased implementation plan, robust monitoring and evaluation mechanisms, and strong government support will be necessary. With these measures in place, TVET in Nigeria can become a dynamic, inclusive, and innovative system that equips learners with the skills and knowledge necessary to thrive in an ever-evolving global economy.

Recommendations

Based on the proposed strategic framework, the following recommendations are crucial for transforming Technical and Vocational Education and Training (TVET) in Nigeria, ensuring enhanced learner engagement and employability through the integration of AI and new technologies:

1. Modernize TVET curricula with input from industry stakeholders to align education with modern workplace demands.
2. Provide targeted professional development opportunities for teachers to effectively integrate AI and digital tools into teaching.
3. Prioritize investment in infrastructure, such as high-speed internet and modern equipment, to support AI integration in TVET institutions.
4. Establish strong linkages between TVET institutions and industries to provide students with practical experience and job market readiness.
5. Implement the strategic framework in phases, with continuous monitoring and evaluation to assess effectiveness and make adjustments.
6. Ensure government plays a central role by formulating policies that incentivize AI adoption and promote public-private partnerships for TVET transformation.

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EMERGING TECHNOLOGY AND INNOVATIVE PEDAGOGY FOR ENTREPRENEURSHIP EDUCATION IN THE DIGITAL AGE

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Abstract

The digital age demands a transformative approach to entrepreneurship education, one that foster adaptability, creativity and innovation , this paper explores innovative pedagogies that redefine entrepreneurship education, preparing students for success in a rapidly changing world, examining the cutting- edge methods such as gamification, simulation, micro learning, and project-based learning which emphasize e experiential learning, collaboration and digital literacy , this research highlights the effectiveness of these approaches in developing entrepreneurship mindset, skills, and competences, this also discuss the integration of emerging technologies like AI, blockchain, adaptive learning, gamification and IOT enabling immersive and interactive learning experiences. The findings of this study provide insights for educators and policy makers seeking a create new generation of entrepreneurs equipped to thrive in the digital economy, by embracing innovative pedagogies, which will unlock the full potential of entrepreneurship education, driving innovation economic growth, and societal impact. This research contributes to the development of a framework for entrepreneurship education in the digital age, ensuring that future entrepreneurs are prepared to navigate and shape the ever- evolving business language.

Keywords: Emerging Technology, Innovative Pedagogy, Entrepreneurship Education, Digital Age.

Introduction

In the digital age, the landscape of education has undergone a transformative shift with emerging technologies and innovative pedagogical approaches creating new opportunities for entrepreneurs to thrive. the convergence of digitalization, global connectivity and the growing emphasizes the entrepreneurship within the education realm which has given rise to a dynamic field known as entrepreneurship'' where the boundaries between education, technology and entrepreneurship are blurred, (Zhang, 2021; Hashim, *et al*., 2021)

Academics will agree or reluctantly admit that the change in education, particularly when issues of curricula and pedagogy is in question, is hard-fought battle, rarely won by innovators. Still like most institutions, traditional higher education finds it difficult to comprehend.

Digital technologies are powerful tools for supporting learning, which include technology characteristics namely their capacity to build, record, manage, represent, communicate data and information respectively. In the realm of education, a teacher is an individual who strives for excellence, constantly seeking innovative approaches in the field of teaching. This also aligns with the understanding and subsequent development of instructional methods in the present era, known as the 21st Century or modern period. Implementing teaching pedagogy as an innovative technique in teacher education prompts the teacher to pose a multitude of inquiries prior to, during, and subsequent to the teaching endeavor.

Integration of emerging technologies of interdisciplinary approach to solve complex problems, mirroring real-world scenarios , focusing on sustainability and environmental sciences that we

enable students to become environmentally conscious citizens and contribute to a sustainable future; Collaboration and global connectivity and partnerships will expose students to diverse perspectives and enhance their understanding of the global scientific community; Ethical considerations and scientific literacy that will enable students to critically evaluate the impacts of scientific advancements on individuals, communities, and society as a whole. In the realm of education, a teacher is an individual who strives for excellence, constantly seeking innovative approaches in the field of teaching. This also aligns with the understanding and subsequent development of instructional methods in the present era, known as the 21st Century or modern period. Implementing teaching pedagogy as an innovative technique in teacher education prompts the teacher to pose a multitude of inquiries prior to, during, and subsequent to the teaching endeavor.

The term "*Edupreneur*" combines the more common words "*Educator"* and *"Entrepreneur*." Literature and skilled population are the foundation stone of a growing economy. The term `Edupreneur means is a person who ventures into educational sector and starts an educational institute of his/ her on own. Edupreneurship refers to the application of entrepreneurial principles in the field of education (Sri Nurhayati Leni Kristiyanti 2024). Edupreneurs identify gaps in the educational system and develop innovative solutions to address these needs. Edupreneurs bring a fresh perspective to traditional educational practices, fostering innovation and creativity. They often focus on developing tools and resources that enhance teaching efficiency and effectiveness, such as digital platforms, learning management systems, and organizational tool,

Additionally, it evaluates the real-world impact of the teachers' pedagogical competencies and children learnings outcomes, offering valuable implications for educational practice and policy. By bridging the gap between educational entrepreneurship practice and policy, also educational entrepreneurship and practical teaching tools.

Edupreneurs are one of the most important stewards of learning as an economic resource. Among the various entities that serve the vitally important but often under-appreciated third sector of education, they are the most likely to have the agility, flexibility, and creativity needed to meet rapidly evolving learning needs across our global economy.

The successful educator helps break down the boundaries, opening up the movement of learning from one to many, from localized to global, from the past and present into the future. Edupreneurs aim to make this shift in the context of a market that will recognize and reward them for the value they create. Learners who trust they will be transformed through new knowledge, skills, and behaviour gladly compensate the edupreneur who can provide the transformation. Edupreneurship also known as 'Educational Entrepreneurship' is a consequential category of entrepreneurship which arose due to the market opportunity in educational sector.

Pedagogical reforms are essentials to enhance teaching and learning practices in Nigeria's education system. They aim to improve the quality of education by adopting innovative teaching methods, enhancing teachers training programs, updating curricula to meet current needs, incorporating technology in classrooms, and promoting learner-centered approaches. These reforms are crucial as they provide opportunities for students to develop critical thinking, problem-solving, and lifelong learning skills. The use of teaching pedagogy as an innovative technique in teacher education is related to the reflective teachers' endeavor to elevate their

teaching to a standard level, while considering the reflective consequences. Jasper 2003, Juliet (2024)

The rise of entrepreneurship in the digital age brings about rapid advancements in digital technologies have revolutionized the way we approach education, transforming both the delivery and the content of learning (Srivastava, 2023). The proliferation of online and virtual learning platforms, the integration of artificial intelligence and augmented reality into pedagogical tools and the increasing emphasize on data given decision -making have all contributed to the emergence on the new educational paradigm (Srivastava,2023), the shift has open a new avenues for entrepreneurial minded individuals to leverage technology and innovation to address pressing educational challenges giving rise to the concept of entrepreneurship

In the realm of education, a teacher is an individual who strives for excellence, constantly seeking innovative approaches in the field of teaching. This also aligns with the understanding and subsequent development of instructional methods in the present era, known as the 21st Century or modern period. Implementing teaching pedagogy as an innovative technique in teacher education prompts the teacher to pose a multitude of inquiries prior to, during, and subsequent to the teaching endeavor.

The integration of emerging technologies in teaching and learning process is no longer a choice but a need for educators considering the level of infusion of technology on education particularly as it relates to the changing learning environment, demand for flexibility in methodology, and the need to enhance creativity and innovations in learning.

The future transformation of science education involvement is poised to revolutionize the way students learn and engage with scientific concepts. Through inquiry-based learning, integration of emerging technologies, interdisciplinary approaches, and a focus on sustainability, students will be better prepared to navigate and contribute to an ever-evolving scientific landscape. entrepreneurship, may be defined as the "successful exploitation of ideas, into new products, processes, services or business practices.

According to Mezieobi, Fubara, and Mezieobi (2015), educational research and development have shown various novel teaching strategies that can be applied equally effectively. The following instructional models were listed: individualized instruction, computer assisted instruction (CAI), mastery learning, programmed instruction, flexible scheduling, team teaching, advance organizer, concept mapping, future wheel instructional model, modular instruction, enter-educate instructional model, and micro teaching. Among these, micro teaching is likely the most popular in the Nigerian educational system.

In the face of these emerging technologies and innovative education, there is absolute need to acquit the school players with the knowledge of these technologies, sufficiently and adequately supply the relevant educational resources both in quality and quantity and most importantly ensure its application in Nigerian schools. In all honesty, practical teaching of entrepreneurial courses or trade just like other courses of study requires complete awareness, and usage of the emerging technologies and satisfactory provision of educational resources which could be human and non-human. This study therefore aims to explore the intersection of emerging technologies, innovative pedagogies in the context of edupreneurship education, highlighting the potential for this synergy to foster a new generation of digitally savvy and socially conscious entrepreneurs.

Research Questions

1. What skills are most important for entrepreneurship education?
2. What are the most effective emerging technologies in enhancing entrepreneurial mindsets and skills?
3. What innovative Pedagogy is most effective for entrepreneurship education?
4. What are the challenges of integrating emerging technologies on student's entrepreneurial education?

Review literature

Emerging Technologies play a vast role in the educational process. The application of emerging technologies in education is changing learners' experiences both inside and beyond the classrooms. (Edeh, M.O 2019) stated that there is an evolving relationship between education and technology, and the evolving pedagogies have also taken advantage of newly designed or emerging technologies.

Oliveira et al., (2019) carried out a review literature on emergent technologies from the field of science education. The study shows that emergent technological artifacts such as computer simulations, virtual labs, mobile devices, robots, games, and digital photography and drawing are increasing the experience of learners.

Berland and Wilensky (2015) conducted a study on four urban middle school classrooms comparing the effectiveness of curricular units in supporting students' complex systems and computational thinking. The result shows that, students using the physical system were more likely to interpret situations from a bottom-up ("agent") perspective, and students using the virtual system were more likely to employ a top-down ("aggregate") perspective. Edgar, Jesus and Babara (2017) conducted a study on "Emerging technologies in education: A systematic review of the literature published between 2006 and 2016". The result shows that Education Technology are contextual and evolving and it improves the critical thinking and problem-solving skills of students.

Corinne (2018) conducted a study on "emerging technologies in higher education and the workplace: An assessment". The study shows that digital revolution poses a double challenge to higher education: in the methods and practices of learning and of teaching.

Emerging technologies are those innovative changes that were introduced in education to facilitate goal achievement. Obviously, they are electronically driven facilities that foster teaching/learning effectiveness. In consonance with above avowals, Ukonu (2020) posited that emerging technologies are electronic devices ploughed into the educational enterprise which involves computer-based classroom interactions, video conferencing, zoom e-mail and entire social media applications. To give credence to the above assertion, Digital learning network (2019) viewed emerging technology as an overhauling of teaching/learning barriers thus making the experience more accommodating to both the teacher and the learner. It is a way of energizing teachers to create a learner-friendly atmosphere that the present generation requires. It makes education stress-free, more accessible, and quicker.

In support of the above declarations, Onyema (2019) recognized emerging technologies as synonymous with Information Computer Technology (ICT) by describing the ICT as an essential tool in teaching/learning situations which has unlocked the key of digitalizing classroom facilities. This is made possible through replacing the chalk/marker board with digital white boards which are of various forms like the use of smartphones, flipped classroom

and so on. Flipped classroom is a device that enables the students to listen to the lectures at home and divert the period for classroom behaviour to other relevant exercises thus enhancing performances. Other e-learning devices are as follows: (1) tablets, these are mini computers that do not require keyboard or mouse to input data, it makes use of touch screen as input device; (2) interactive white boards, which is also referred to as smart boards, this makes it easy to show-case pictures, diagrams or any other learning materials to the students, images so projected could be moved about and/or operated according the teacher's desire to put the message across to the students; (3) e-reader, this is the kind of device that have a large compilation of thousands of books in a converged form otherwise called digital form. It provides a wide range of reading materials and makes personal study habit; (4) gamification, this is a series of games which is intended to impart desired knowledge and skills; (5) mobile phones (Omemu, 2020) this is the type of smartphone that is widely used by the students due to its moderate price when compared to other smartphones. It is used for whatsApp, radio, television, YouTube, tweeter etc.

In line with the following expressions, that e-learning which the emerging technologies denote include but not limited to: (1) Synchronous online learning--this is an online fact to face teaching/learning process which is made possible through the use of webinars', video conferencing etc. It gives room for asking questions and getting instant answers through chats sessions and raise hand symbols. (2) Adaptive e-learning-this is a kind of e-learning that creates a scenario for the learner to be proactive because the subject matter is attuned to the needs, aims and objectives of the learner. (3) Linear e-learning---this is a kind of e-learning that involves the instructor and the learner; the learner is passive because there is no opportunity for interactive session because it is cup and jug type of learning; example is the teaching on air. (4) Interactive online learning--just as the name suggests, it is a participatory online teaching/learning behaviours which fosters progressive performance; the instructor and the learners are active during the session. (5) Collaborative online learning---this is a kind of online group discussion class which could be between students themselves or teachers and students; it calls for collective participation and sharing of ideas, skills or knowledge with an anchor man (Uwaezuoke, 2020).

Apparently, emerging technologies is an innovation ploughed into education to tackle some teaching and learning challenges both on the part of the teachers and the learners as well. It is for this reason that Eimuhi and Aiwuyo (2022) posited that emerging technologies is set out to modify teaching/learning efficacy as it is very accommodating, fosters exploration, promotes positive teaching/learning outcomes among students and enhances teachers' job performances to a desirable level. As an innovation in education, emerging technologies should start from the basement which is the secondary education so as to enable the learners master and internalize various aspects of it and exhaust all the benefits therefrom for qualitative, functional and innovative education.

Methodology

The study employed descriptive survey research design. The population of the study consists of all the teachers. Stratified random sampling technique was used to select 1,200 teachers and higher education institutions for the study. The instrument was self-designed and entitled "Emerging Technologies and Innovative pedagogy for Edupreneurship Education in the digital age Questionnaire" (ETIPEDAQ). The instrument has two sections; A and B. Section A was used to demographic information from the teachers, example Age, Gender, Educational Level, Year of teaching Experience and Subject taught while Section B was used to draw Emerging technologies, Innovative Pedagogy, Entrepreneurship Education and Open-Ended Questions

The instrument has 3 items in each section. The response is familiar, not familiar non familiar and somewhat familiar type which involves all the participants to get the percentage for each question. 50% benchmark of the percentage score indicates the awareness while below 50% is applicable to the unawareness of the digital devices. Face and content validity were ensured. Test-retest method was used to determine the reliability of the instrument. The scores obtained were subjected to Cronbach Alpha Correlation Coefficient which gave rise to 0.79. Simple percentage was used to answer the research questions. The administration of the instrument was carried out by the researcher and five trained research assistants, out of 1004 questionnaire copies distributed, 980 were retrieved and used for data analysis

Results

Research Question One: What skills are most important for entrepreneurship education?

Table 1: Mean and Percentages of Skills for Entrepreneurship Education

Skills	Number	Percentage
Communication	79	6.58
Creativity	478	39.84
Critical thinking	643	53.58
Total	1,200	100.00

From Table 1, it is observed that Critical thinking with 53.58% is the most important skill needed for entrepreneurship education followed by Creativity (39.83%) while Communication has the lowest importance (6.58%). It can be concluded that critical thinking and creativity are essential for entrepreneurship education in our schools.

Research Question Two: What are the most effective emerging technologies in enhancing entrepreneurial mindsets and skills?

Table 2: Mean and Percentages of effective emerging technologies in enhancing entrepreneurial mindsets and skills

Emerging Technologies	Number	Percentage
Virtual Reality (VR)	548	45.67
Blockchain Technology	181	15.08
Augumented Reality (AR)	471	39.25
Total	1,200	100.00

From Table 2, it is observed that Virtual Reality with 45.67% is the most effective emerging technology in enhancing entrepreneurial mindsets and skills, followed by Augumented Reality (39.25%) while Blockchain Technology (15.08%) is the least effective emerging technology in enhancing entrepreneurial mindset and skills. It can be concluded that Virtual Reality and Augumented Reality are effective technologies in enhancing entrepreneurial mindset and skills.

Research Question Three: What innovative Pedagogy is most effective for entrepreneurship education?

Table 3: Mean and Percentages of Innovative Pedagogy for effective entrepreneurship education

Innovative Pedagogy	Number	Percentage
Gamification	182	15.17
Project-based learning	516	43.00
Problem-based learning	502	41.83
Total	1,200	100.00

From Table 3, it is observed that project-based learning (43.00%) is the most effective innovative pedagogy for entrepreneurship education, followed by problem-based learning (41.83%) and the least effective innovative pedagogy for entrepreneurship education is gamification (15.17%). It can therefore be concluded that project-based and problem-based learning are effective innovative pedagogy for entrepreneurship education in our schools.

Research Question Four: What are the challenges of integrating emerging technologies on student's entrepreneurial education?

Table 4: Mean and Percentages of challenges of integrating emerging technologies on student's entrepreneurial education

Innovative Pedagogy	Number	Percentage
Lack of resources	652	54.33
Limited time	411	34.25
Resistance from students	137	11.42
Total	1,200	100.00

From Table 4, it is observed that lack of resources (54.33%) is the most challenging factor against integrating emerging technologies into students' entrepreneurship education, followed by limited time (34.25%) and the least challenges is resistance from the students (11.42%). It can therefore be concluded that limited resources and time are the major challenges facing during integration of emerging technologies into students' entrepreneurship education in our schools.

Conclusion

This study investigated the skills, emerging technologies, innovative pedagogies required for effective integration of technology into entrepreneurship education as well as the challenges encountered during the process. This research concludes that creativity and critical thinking skills are required for effective integration of technology into entrepreneurship education. It also found that Virtual Reality and Augumented Reality are emerging technologies that enhances the integration. Also, problem-based and project-based learning are innovative pedagogies required for proper integration of technology into entrepreneurship education. Lastly, lack of resources and limited time are the major challenges that hinders the integration of emerging technologies into students' entrepreneurship education in our schools.

Recommendation

Based on the outcome of this study, the following recommendations were made:

1. Creativity and critical thinking skills should be inculcated in the students to ensure proper integration of emerging technology in their entrepreneurship education.

2. Virtual Reality and Augumented Reality should be used by teachers to motivate the students during integration of emerging technology into their entrepreneurship education.
3. Problem-based and project-based learning which are innovative pedagogies should be encouraged for proper integration of technology into entrepreneurship education.
4. Adequate time and resources should be allocated by the educational stakeholders to ensure effective integration of technology into entrepreneurship education.

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DEVELOPMENT AND EVALUATION OF COMPUTER AIDED CONCEPT CARTOONS FOR TEACHING COMPUTER SCIENCE AT JUNIOR SECONDARY SCHOOLS IN BIDA, NIGER STATE, NIGERIA

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Abstract
This study aimed at evaluating the development of Computer Aided Concept Cartoons for teaching Computer Science at Junior Secondary Schools in Bida, Niger State. Three research questions and two null hypotheses guided the research, which used a quasi-experimental design. The population comprised 22,876 students, with 265 participants (148 males, 117 females) selected through multistage and random sampling from two out of 16 schools. The instrument was face-validated by experts and had a reliability coefficient of 0.82, determined using Kuder-Richardson formula 20. Data were analyzed using mean, standard deviation, and t-test at a 0.05 significance level. Results revealed that Computer Aided Concept Cartoons positively impacted students' achievement in learning Computer Science, with male students achieving higher mean scores than females. The study recommends employment of qualified teachers, proper utilization of instructional resources, and the use of appropriate evaluation techniques for student performance.

Keywords: Development, Evaluation, Concept Cartoons, Computer and Junior secondary schools.

Introduction

As technology continues to advance, it affects every aspect of human life making it crucial for educational systems to stay updated and relevant (Olaodejo, 2021). It means that education must adapt and respond effectively to help students meet the changing needs of 21st-century employment. According to a study conducted by World Economic Forum (2018), technological advancements such as automation, artificial intelligence and robotics are expected to significantly transform the labour market resulting in the displacement of certain job roles while creating new ones. The study emphasizes the need for education systems to equip students with the skills necessary to thrive in the digital age, this include critical thinking, creativity and adaptability. Additionally, Olaodejo (2021) further reiterated the impact of technology integration on educational outcomes was explored found out that when properly integrated into the curriculum technology can enhance student engagement, motivation, and achievement. He emphasizes the importance of teachers being skilled in using technology effectively and integrating it purposefully into their instructional practices.

There are many technological tools available that can empower teachers and help today's students learn essential content and skills efficiently and effectively (Gorra, *et al.*, 2020). These tools can also be effective in helping to engage students in the learning process and motivate them to attain heights in academic and career pursuit, (Gorra, *et al.*, 2020). Similarly, Zakariyyau (2023), in his study found out some factors responsible for the poor performances of students in schools and concluded that the critical factor is the instructional methods employed in the teaching process. Stephenson and Warwick (2022) added that there are many accounts of the sort of ideas that learners have about the world around them.

Computer Aided Concept Cartoons guides increases student motivation as the computerized program as the student sees it. Despite the way computer studies is taught to students in classes, it appears they are faced with some problems of teaching and learning in those schools. Such problems have often resulted into poor academic performances by students in computer science by both the male and female gender. Supporting this, Yalams and Enoch (2021) in a study of comparative analysis of students` performance in Computer Science at both primary and higher level of learning revealed astonishing poor academic performances. Poor academic performances of students in computer science generally have attracted the attention of educationist and researchers for quite some time as a major problem of teaching and learning. Similarly, Ezeliora (2021) asserted that Computer Science studies have recorded a poor academic performance of students in various courses or subjects in almost all levels of educational system over the years. There is no doubt that the situation needs urgent attention. Similarly, Ishola (2021), in his study on factors responsible for the poor performances of students in schools concluded that the critical factor is the instructional methods employed in the teaching process. Instructional methods are the methods or procedures used by the teachers to deliver the lesson to the students (learners).The desire to solve these widely acknowledged problems of teaching and learning computer studies in our junior secondary schools necessitated the development and evaluation of Computer Aided Concept Cartoons for teaching computer science at junior secondary schools in Bida, Niger State. The development of computer-aided concept cartoons using the Waterfall Model follows a systematic and sequential approach.

The Waterfall Model is a traditional software development methodology that follows a linear and sequential approach to project management (Kabapinar, 2017). The Waterfall Model provides a structured framework that facilitates a step-by-step progression from conceptualization to deployment, ensuring a methodical and well-documented development process for computer-aided concept cartoons. In this model, the entire package development life cycle is divided into distinct phases including requirements analysis, system design, implementation, testing, deployment, and maintenance. Subsequently, the implementation stage involves developing the package based on the design specifications. Testing is then conducted at various levels, ensuring that the package met quality standards and functions as intended. Once the package passes testing, it is then deployed for use in the classroom.

Statement of the Research Problem

Technology is getting more popular in all the activities of human endeavour daily. Educational sector is not left behind in terms of technology usage in all the educational activities. For instance, the JAMB Examinations have been changed to E-Computer Base Test (CBT), so also in our University system today admission screenings are done via computer online process. More also, schools record keeping mostly is based on computer data base where candidate's information are stored and use anytime such need arises. However, despite the above usage of computer in our educational system today, the teaching and learning of computer science in our junior secondary schools suffers due to limited resources and equipment (Oladejo 2021). Meanwhile, based on the investigation conducted by the researcher which clearly stated that the failure of computer science at junior secondary schools is due to limited resources, equipment and poor teaching methods. The intent to solve the above problems is recommended to the educational stakeholders, and Ministry of Education to give more attention to the training of more computer specialists and the government to supply more computers to the schools especially at the Junior secondary school level so that before they migrate to senior class they will have known more and develop more interest for the learning of computer science in our higher institutions. Finally, it is based on the above challenges that the researcher seeks to

develop and evaluate computer aided concept cartoons for teaching and learning of computer science at junior secondary schools in Bida, Niger state.

Aim and Objectives of the Study

This study aims to develop and evaluate Computer Aided Concept Cartoons for teaching computer science at junior secondary schools in Bida, Niger State. Specifically, the objectives of the study are to:

1. Develop Computer Aided Concept Cartoons for junior secondary school students.
2. Determine the stages involved in the validation of Computer Aided Concept Cartoons for junior secondary students offering Computer Science in Bida, Niger State.
3. Determine the difference in the achievement scores of junior secondary school students before and after Exposure to Computer Aided Concept Cartoons for learning Computer Science concepts.

Research Questions

The following research questions were raised to guide this study:

1. What are the phases involved in the development of Computer Aided Concept Cartoons for junior secondary school students offering Computer Science in Bida, Niger State?
2. What are the stages involved in the validation of Computer Aided Concept Cartoons for junior secondary school students offering Computer Science in Bida, Niger State?
3. What is the difference in the achievement scores of junior secondary school students before and after exposure to Computer Aided Concept Cartoons for learning Computer Science concepts?

Research Methodology

Quasi experimental research design was used for the study. Waterfall Model was used in the development of the computer aided concept cartoons where it was divided into distinct phases, including requirements analysis, system design, implementation, testing, deployment, and maintenance. The experimental group was treated with the use of computer aided concept cartoon (CACC) package, while students in Control group were treated with traditional method. Both groups were given a Computer Achievement Test (CAT) before and after treatments to assess the participating students' prior understanding of the taught concept and to evaluate the effectiveness of the Computer Aided Concept Cartoon. The population for the study consists of 22,876 Junior Secondary Schools students in Bida, Niger State. The target population for the study comprised Junior Secondary School year II students with sample size of 265 students which were drawn from the intact classes of selected secondary schools in Bida, Niger State. Intact class of the selected schools for the study was 265 in number (148 males and 117 females). Two co-educational schools were purposively sampled for the study. A multistage sampling technique was used and simple random sampling technique was employed to select two (2) schools out of 16 junior secondary schools in Bida, Niger State. The research instrument that was used in this study is grouped into three. They include Computer Aided Concept Cartoons, Computer Science Content Expert Assessment Report (CSCEAR), and Computer Science Achievement Test (CSAT). Sections A and D of the CACCAQ as well as CSAT along with the prototype CACC package, tables of specification, scoring guide, lesson plans and teachers' training manual were validated by three Educational Technologists in the Departments of educational technology, Federal University of Technology Minna, Niger state. In addition, fifty exercises constructed by the researcher were subjected to scrutiny by Subject Matter Experts in line with the stated instructional objectives in stage four of the R & D model as part of the validation process. The experts were requested to suggest modifications on the structure of the items, organization as well as their appropriateness and then rated them according to their suitability for use in the present study. The suggestions made were effected in the final copies of the instruments. For instance, one of the Computer experts opined that the

behavioural objectives in the lesson plans should be stated in measurable terms. The CACCAQ was pilot tested using 46 Computer students in Government Model Science College, Bida. The school used for the trial testing is part of population in the main study. Data obtained was computed using Kuder-Richardson 20 (KR20) and the coefficient of internal consistency of CACCAQ was determined using Kuder-Richardson formula 20 (K-R 20) and it was found to be 0.82. K-R 20 was used in establishing the reliability of CACCAQ because it is a multiple-choice test. The research was conducted within 6 weeks. In the first week, two research assistants were coached in data collection and the installation of the developed Computer Aided Concept Cartoon. Learning activities lasted for 4 weeks after which a Post-test was administered in the 5th week to evaluate the effectiveness of the Computer Aided Concept Cartoon. Research question one was answered by explaining the steps involved in developing the Computer Aided Concept Cartoon. Research questions two was answered using qualitative data derived from the reports issued by Experts. The results from the administered Computer Science Achievement Test (CSAT) was analysed using descriptive statistics of Mean and Standard deviation to answer research question three. However, to test for the null hypotheses, the paired t-test statistics through the aid of Statistical Package for Social Sciences (SPSS) version 23, with a significance level for rejection or accepting any hypothesis fixed at 0.05 alpha level was used.

Results and Discussion

Phases Involved in the Development of Computer Aided Concept Cartoons

The phases for the development of Computer Aided Concept Cartoons for teaching computer science at junior secondary schools in Bida, Niger State were as follows:

1. **Needs Assessment Phase:** At this phase, the current learning situation in computer science classes as well as challenges in the existing teaching methods were identified through survey.
2. **Concept Development Phase**: This is the phase where the key topics and concepts from the curriculum were determined based on the needs assessment. Drafts of concept cartoons were created for each of these topics to be included in the software.
3. **Design Phase:** At this phase the drafted concept cartoons were designed using computer-aided design tools. The researcher collaborated with subject matter experts to ensure the Computer Aided Concept Cartoons were engaging and accurately portrayed the concepts.
4. **Content Validation Phase:** The Computer Aided Concept Cartoons were reviewed by subject matter experts and teachers for factual accuracy, relevance, and pedagogical effectiveness at the validation phase.
5. **Pilot Testing Phase:** At this phase the concept cartoons were tested in a few classrooms. This pilot run provided feedback from teachers and students about their effectiveness and any potential areas for improvement.
6. **Revision Phase:** Based on the feedback received during the pilot testing, necessary revisions were made to the Computer Aided Concept Cartoons. These changes are related to content, design, and instructional strategies.
7. **Implementation Phase: This** is the phase were the final version of the cartoons was introduced into computer science classes across the study area. Teachers received training on how to use the Computer Aided Concept Cartoons effectively.
8. **Evaluation Phase:** After full implementation, the effectiveness of the cartoons in enhancing teaching and learning was continuously evaluated. The effect of Computer Aided Concept Cartoons was ascertained through quasi-experiment. The collected data after carefully analyzed revealed that the developed Computer Aided Concept Cartoons

is effective in enhancing the academic achievement of junior secondary school students offering Computer Science in Bida, Niger State.

Stages of **validation of Computer Aided Concept Cartoons**

Table 1.1 presents mean responses and standard deviations related to the stages involved in the validation of Computer Aided Concept Cartoons for junior secondary school students studying Computer Science in Bida, Niger State and all the seven items had mean scores between 3.33 to 4.00 and standard deviations between .56 to .60, indicating strong agreement among the respondents about the comprehensibility, structure, relevancy of diagrams, clarity of sub-headings, and the comprehensiveness and simplicity of classwork and assignments in the Computer Aided Concept Cartoons for Junior Secondary School students studying Computer Science. Result revealed that the developed Computer Aided Concept Cartoons is highly appropriate for teaching Computer Science to junior secondary school students in Bida, Niger State, with clear and simple language that was effective for the targeted audience level, comprehensive coverage of topics, and a well-structured course content that added value to the overall learning experience.

Table1.1 Validation of Computer Aided Concept Cartoons for junior secondary school.

No.	Items	Mean	Std. Deviation	Remark
1	The developed course content which you have evaluated adequately covers Computer Studies comment for JSS Two computer students	3.67	.59	Strong
2	The developed course comment can be understood by JSS Two Computer students	3.67	.57	Strong
3	The diagrams in the course content are relevant to the concepts	3.33	.56	Strong
	The various sub-headings are well explained for students to understand the concepts	3.66	.57	Strong
5	The classwork and assignment given are comprehensive enough for students to understand.	3.66	.58	Strong
6	The classwork and assignment conform to the standard and are sequentially arranged	3.33	.57	Strong
7	The language used for the construction of the classwork and assignment is simple for students to comprehend	4.00	.60	Strong

Source: Authors Field Experiment 2024.

Achievement scores of junior secondary school students before and after exposure to Computer

Table 1.2 presents the mean and standard deviation of both pre-test and post-test achievement scores from junior secondary school students before and after exposure to Computer Aided Concept Cartoons for learning Computer Science concepts. In the Control Group, the pre-test mean score was 31.28 with a standard deviation of 3.88, while the post-test mean score was 54.54 with a standard deviation of 4.92. This provides a mean gain of 23.26. In contrast, the Experimental Group exposed to Computer Aided Concept Cartoons for learning, their pre-test mean score was 31.37 with a standard deviation of 4.06 while the post-test mean score was 69.03, with a standard deviation of 6.23, resulting in a mean gain of 37.66. The findings imply that there is a significant increase in the achievement scores of students exposed to Computer Aided Concept Cartoons for learning Computer Science concepts.

Table 1.2: Pre-test and post-test mean achievement scores of junior secondary school students before and after exposure to Computer Aided Concept Cartoons for learning Computer Science concepts

Groups		Pretest		Posttest		
	N	Mean	SD	Mean	SD	Mean Gain
Control Group	150	31.28	3.88	54.54	4.92	23.26
Experimental Group	115	31.37	4.06	69.03	6.23	37.66

Source: Authors Field Experiment 2024.

Findings of the Study

1. The findings of this study shows the needs assessment, concept development, design, content validation, pilot testing, revision, implementation and evaluation phases were phases involved in the development of Computer Aided Concept Cartoons for junior secondary school students
2. The findings of this study revealed that the developed Computer Aided Concept Cartoons is comprehensive, understandable, and well-structured with relevant diagrams, clear sub-headings, comprehensive classwork and assignments, and that these elements are sequentially arranged and written in language simple enough for Junior Secondary School students to comprehend. Furthermore, the qualitative feedback affirms that this educational tool is highly suitable for teaching purposes due to its clarity, simplicity, broad topic coverage, and effective structuring enhancing the overall learning experience.
3. The finding of this study shows that the use of Computer Aided Concept Cartoons has positively impacted student achievement in learning Computer Science concepts.

Discussion of Findings

Findings on research question one found that the development of Computer Aided Concept Cartoons (CACC) for junior secondary schools involved various stage that includes: needs assessment, concept development, design, content validation, pilot testing, revision, implementation, and evaluation. The need assessment phase is crucial because it helps identify the necessity for a new educational tool in a particular context (Balim et al. 2018). The findings from this stage shows a lack in current teaching methodologies or resources used in teaching computer science at the junior secondary school level. It implies a demand for a more engaging, visually appealing, and comprehensible tool like CACC to facilitate learning. The concept development stage involves creating an idea or blueprint for the CACC based on the identified needs (Kogler et al., 2021). These findings affirm the importance of grounding the tool's development in actual classroom needs, thus increasing its relevance and potential effectiveness. Furthermore, during the design phase, the physical creation of the CACC takes place (Pekel, 2019). The outcome emphasizes the role of user-friendly interface and engaging visual content in enhancing students' interest and comprehension of computer science concepts. Moreover, in the content validation phase, subject-matter experts ensure that the educational content is accurate, relevant, and suitable for the target audience (Akbaay, 2020). This step strengthens the reliability of the tool, ensuring that students receive correct information. Also, the pilot testing and revision phases underline the importance of feedback and iterative improvement in instructional design (Atasoy et al., 2020). They offered empirical evidence of the CACC's impact on students' learning outcomes, potentially making a case for its wider adoption. This process mirrors other instructional design models like the ADDIE model (analysis, design, development, implementation, evaluation), suggesting that it is a well-established practice in educational technology development.

Findings on research question two revealed that the developed CACC is comprehensive, understandable, well-structured and suitable for teaching purposes. The comprehensiveness

and structure highlight the tool's quality in delivering complete and logically sequenced information. The clear sub-headings and relevant diagrams make the content more manageable and visually appealing, aligning with Yin and Fitzgerald, (2017) principles of multimedia learning that recommend breaking down complex information into manageable segments and using visuals to support understanding.

This kind of evidence is crucial for persuading stakeholders such as educators, school administrators, and policymakers to adopt new technologies in classrooms (Çelik & Gundogdu, 2019).

Conclusion

The essence of this study is to develop and Evaluate the Computer Aided Concept Cartoons for Teaching Computer Science at Junior Secondary Schools in Bida, Niger State. In the ever-evolving landscape of education, the integration of technology has become imperative. Computer Aided Concept Cartoon development represents a pioneering approach, leveraging advanced software tools to enhance conceptual understanding and foster interactive learning experiences. Within the realm of instructional design models, the Computer Aided Concept Cartoon development aligns with a learner-centred approach by integrating technology to create engaging and interactive educational experiences. The study also found out that the use of Computer Aided Concept Cartoons has positively impacted student achievement in learning Computer Science concepts.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. The State Government, local government and the ministries in-charge and departments of the junior secondary schools in Bida in Niger State should ensure qualified teaching staff are employ to teach student science subjects using Computer Aided Concept Cartoons
2. Teachers should ensure proper utilization of the available instructional resources for teaching science subjects and learning using Computer Aided Concept Cartoons
3. Teachers should cultivate the habit of using the appropriate procedures or techniques for evaluating junior secondary school students performance using Computer Aided Concept Cartoons which will help in promotion, placement and certification.

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CONCEPTUAL REVIEW OF THE INFLUENCE OF ACADEMIC SOCIAL NETWORKING SITES (ASNS) ON THE RESEARCH PRODUCTIVITY OF LECTURERS IN UNIVERSITIES

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Abstract
This paper examined the influence of Academic Social Networking Sites (ASNS) on the research productivity of lecturers in universities. Through a conceptual analysis and by synthesizing existing literatures, the paper provided comprehensive overview of the concept of ASNS. The paper argued that ASNS, such as ResearchGate and LinkedIn have transformed the way academics collaborate, share knowledge and disseminate research findings. By leveraging these platforms, lecturers can enhance their research visibility, networking and collaboration, ultimately leading to increased research productivity. It also identified factors that facilitate or hinders the effective use of ASNS among lecturers in universities.. The paper concluded by emphasizing the need for universities to harness the potential of ASNS to boost research productivity and contribute meaningfully to the global knowledge economy. The study recommended among others that the management of universities should establish clear guidelines for lecturers' use of ASNS, ensuring responsible and productive engagement.

Keywords: Academic social networking sites, Universities, Lecturers, Research productivity

Introduction

Research productivity can be measured in a variety of formats, including the number of journal articles and books that have been published, book chapters, technical reports, conference papers, seminar papers, edited works, workshop papers, theses, and other sorts of publications (Basiru, 2018). One of the key indicators and criteria of academic greatness has been and will continue to be the measure and volume of an institution's research output.

Research productivity of lecturers is key to the advancement of societies and career growth of lecturers in higher educational institutions. According to the Organisation of Economic Corporation and Development (2017), research involves any creative systematic activity undertaken in order to increase the stock of knowledge and the use of this knowledge to develop new applications for modern living. Research can also be seen as a systematic analysis to uncover new facts with the intention of gaining knowledge to resolve or address a problem.

Research plays a key role in modern-day civilisation in that it is done with the motive for societal development and propelled by high-level curiosity which translates or builds up to further investigation (Salami *et al.,* 2020). In the academia, the concept of research is taken seriously since the promotion of lecturers is dependent on the number of publications they have. This requirement makes it mandatory for lecturers to be productive scholars.
Okonedo *et al.* (2015) define research productivity as the whole of research conducted by academics in universities in their vocation over a predetermined period. This period can be a

period of 3 years which rest largely on the quality and quantity of scholarly publications such as documents published through a peer-review process and acknowledged as recorded sources such as books, book chapters, journal articles, conference papers and proceedings, creative works and visual arts among others (Tsafe *et al.*, 2016).

Research productivity is viewed as the measure of an academic's achievement viewed in terms of quantity or quality of publications over a given period of time. One of the fundamental goals of research is to create new knowledge that can be applied. Hence, it is important to state that research productivity is a robust measure of academic achievement and recognition as well as the totality of research activities performed by lecturers over a given period of time (Basiru, 2018). Research productivity is crucial to lecturers, researchers' and learned members especially in the tertiary institutions and central to the teaching capability of lecturers or academic staff. This is because the academic mandate of a lecturer is to teach, conduct research and participate in community service. This makes it crucial for lecturers or academic staff to engage in research and become productive.

Academic Social Networking Sites (ASNS) have surely helped to enhance the fruitful and collaborative relationships among lecturer and researchers. Notwithstanding, lecturers are increasingly sharing their knowledge with colleagues as they present their papers in seminars and conferences. After publication, their contributions may then be cited by other scholars, including students. The lecturers' visibility does not solely rely on the number of publications they produce. Both the lecturers as well as their institutions are continuously being under scrutiny as they are rated and classified by independent reviewers.

In this modern era social networking site has become the new way of communication between people. With the increasing popularity of social networking sites, .lecturers also prefer to use social networking sites to do research. Different academic social networking sites such as Facebook, ResearchGate, Academia.edu, pen profile, linkedIn, Google scholar to mention but a few enhance the process of information procurement, sharing and dissemination of researches among lecturers. Academic Social Networking Sites (ASNS) help lecturers to cope up with the current trends in their respective fields.

Academic social networking service is a broad term that refers to an online service, tool, or platform that can help lecturers to build their professional networks with other researchers and facilitate their various activities when conducting research. According to Hussain *et al.* (2017), Academic Social Networking Sites (ASNS) are profile-based websites that allow users to maintain social relationships by viewing, visiting, and sharing their lists of social connections with other members.

Nwachi and Igbokwe (2019) posited that ASNS refers to a number of online platforms that have aimed to make the advantages of online networking available to a target audience that is explicitly academic. *Academia.edu* and *Research Gate* are two examples of the first types of ASNS, which was built primarily to make it easier to connect and create profiles (similar to Facebook), as opposed to the second type, which was built primarily to make it easier to post and share academic content before incorporating social networking features (such as Mendeley). This demonstrates a distinction that is consistent throughout ASNS in general (Khot and Bansode, 2017).

Academic social networking sites (ASNS) is a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, which allows the creation and

exchange of user-generated contents (Kietzmann and Kristopher, 2018). Academic Social Networking Sites (ASNS) are academic platforms specifically created for various research activities such as uploading and downloading of research publications, interactions and collaborations among users, as well as follow-up of latest research trends and discussion among researchers, academics, students and institutions of higher learning globally.

According to Stephen and Pramanathan (2020), these online platforms enable you to create a profile, engage with other scholars and share academically relevant information. Usually, using these tools is free. These services help provide a simple means for lecturers to share their scholarly work with peers and academic communities throughout the World. ASNS offers different combination of tools and unique features that supports research and academic activities through interaction and collaboration of various kinds among researchers, academics, students and institutions of higher learning (Vasquez and Bastidas, 2015).

According to Wiechetek *et al.* (2020), common tools provided by ASNS includes: discussion boards, email, instant messaging, library, newsfeed, file repository, citation count, altmetrics, public, public profile, group collaboration, reference management, collaborative document processing, network visibility, upload publications and linking of information to social media sites. ASNS offers lecturer and researchers the opportunity to upload research articles and make their networks more visible to other users, some of these sites also allow inter-link with nonacademic social sites platform such as Facebook and Twitter so as to enable for further reaching of their publications.

Also, academic social networking sites are increasingly being utilised by lecturers for a variety of purposes, including the creation of academic profiles, the sharing of research articles and peer interaction which helps increase their research productivity and online visibility. Research productivity is crucial for lecturers' professional development, peer recognition, increased income, and a closer bond with academic advisors and other colleagues.

While general social media are less ideal for lecturers, there are specific academic social networking sites that can enhance their research and teaching experience some of which include *ResearchGate, Google scholar* and *Academia.edu* while these are not exclusive to lecturers alone, materials can be shared so as to spark discussions. The Academic social networking sites has features for content sharing, collaborative tools and serve as discussion forums. Some of the Academic Social Networking Sites characteristics Include integration, focus, security and accessibility. Maintaining a profile on academic social networking sites will further enhance the research visibility of lecturers and the institutions of affiliation. This visibility on the Web in recent times is one of the goals that management of academic institution seek to achieve.

Research Productivity

As a mandate to conduct research in tertiary institutions by lecturers, during these processes, digital contents such as seminar papers, conference papers, technical reports, datasets, theses and dissertations and journal articles to mention but a few are produced. Lecturers determine the development of tertiary institutions of learning by developing curriculum, controlling the academic rules and creating a better method for students' teaching (Gunawan *et al.*, 2018). Lecturers enhance their research productivity by carrying out investigations on identified problem(s), presentation of findings of such investigations in conferences/seminars and publishing the findings in journals and/or text books.

According to Andrew (2018), most research productivity measure in universities is to assess publications that are submitted or accepted (in press), or published which could be journal articles (refereed and non-refereed), books (including edited books and textbooks), book chapters, monographs, conference papers, and research proposals written to receive external and internal grants. In the academia, the concept of research productivity is regarded as an indication of the success of lecturers which influences promotions, rank, levels, honorariums and lecturers' benefits, (Ladipo *et al.*, 2022). In this assertion, emphasis is laid on quantitative rank of related journals, qualitative measures of total and average research productivity of lecturer and quantitative measures of total and average research productivity. It has been reported that the benefit of research is the advancement of knowledge being created and communicated in an academic environment through scholarly seminars, conferences and publications.

Studies, such as Simisaye (2019) had revealed that lecturers research productivity is influenced by individual factors (self-efficacy, affiliation, motivation, commitment, orientation skills, research skills, achievement motivation, community contribution, sense of responsibility, scientific pursuit, autonomy and flexibility, satisfying interest and curiosity). Lecturers in tertiary institutions of learning engage in research activities to transfer knowledge and to keep abreast with current trends as they teach. The total volume of research production from the lecturers on an individual level determines how productive they are. The idea behind the productivity of researchers is that it is directed towards knowing and measuring the quality of teaching in the institution. Furthermore, research is an important criterion in determining the career growth of a lecture in tertiary institutions published in notable databases.

Academic Social Networking Sites (ASNSs)

According to Otolo and Saibikumo (2021), the growth of the Internet as one of the newest instruments of information and communication technology (ICT) has enabled open access to a wide range of resources all over the world. Academic social networking sites are becoming commonplace on the Internet. Designed specifically for the academic community, academic social networking sites are similar to social networking sites. According to Olanusi and Olanusi (2022), more academics are joining online research communities as a result of the social web's rising popularity and the advancement of ever more powerful network technologies.

ASNS, according to Meisher-Tal and Pieterse (2017), enable users to post academic papers, abstracts, and links to previously published works; monitor demand for their articles; and interact with other users in a professional capacity through discussions and question-and-answer sessions. Krause (2015) also confirmed that these sites frequently allow users to communicate ideas, follow one another's research, stay up to date with emerging trends in the field, share academic materials, and, most significantly, develop their professional networks. Academic social networking sites (ASNSs), as mentioned by Wiechetek *et al.* (2020), are increasingly being utilised by academics for a variety of purposes, including the creation of academic profiles, the sharing of research articles, and peer interaction.

Opesanwo and Mabawokun (2016) emphasised the expanding usage of academic social media in nearly every aspect of life, including academic parlance. As a result, lecturers and researchers are starting to rely on and integrate them for simple access to current scholarly publications, current news, current information, up-to-date sources, efficacy and efficiency as well as for cooperation. Academic social networking sites (ASNs) have emerged as one of the most significant platforms in the contemporary information and education sectors. It will

undoubtedly become a crucial tool for the academic community's communication, connection, and collaboration.

Types of academic social networking sites

Academia.edu

This platform enables lecturers to make personal profiles, follow and communicate with other lecturers who share similar interests, post papers, get comments, and track the engagement and effect of their papers using analytics (Stephen and Pramanathan, 2020). Users of Academia.edu may utilise the "import contact" option to get in touch with coworkers from other social networking sites like Facebook, Twitter, Google to mention but a few. Whenever a lecturer on a user's follow list publishes a paper, a notification function allows users to be notified through email.

Research Gate

Research Gate was established in 2008 by Ijad Madisch, Horst Fickenscher, and Sören Hofmayer. Lecturers and other researchers may submit journal articles, conference papers, posters, data and code to an online repository using Research Gate. According to Mohamed Jelani *et al.* (2019), finding conference materials that are not saved in other online databases, including posters and slide shows, may be made especially easy using Research Gate. Lecturers and other users of Research Gate also receive publishing metrics, including information on how often their papers have been viewed and referenced.

Pen profile

An academic social networking site called Pen profile encourages International (social) contacts between academics and scholars, students, and educational institutions with the goal of greatly accelerating the creation and development of knowledge (Asmi and Madhusudham, 2015). It offers a number of networking and productivity-enhancing capabilities and is accessible to anyone.

LinkedIn

LinkedIn is a professional networking site that connects people and businesses to create professional relationships, career opportunities, skill acquisition, information exchange to mention but a few. Despite the fact that LinkedIn accepts users from all professions, academic researchers have found it to be a useful platform over time (Asmi and Madhusudham, 2015).

Google scholar

A search engine specifically designed to locate intellectual resources is Google Scholar. It enables lecturers to do comprehensive academic literature searches using data from scholarly websites, institutional libraries, university repositories, professional associations and periodicals (Methodspace, 2014). Users can keep their articles in the Scholar Library and import their citations after creating a Scholar profile. Lecturers and other authors may easily keep track of citations to their papers using Google Scholar's citation function. Additionally, it offers a metrics tool that enables authors to easily assess the popularity and impact of recent papers in scientific journals (Mohamed Jelani, *et al.,* 2019).

The influence of academic social networking sites on research productivity

According to Kulkarni and Poornashankar (2018), researchers primarily use academic social networking sites (ASNS) for the purposes which include: to refer to other research when choosing a topic; to collect data using a questionnaire through Google forms; to avoid spending time, money, and effort on field visits for data collection; to use project management tools like

Trello, which encourage team members to participate in all phases of a project and facilitate completion of necessary tasks on time; and the exposure of the researcher as well as him/her on academic platforms is also increased.

ASNS is similar to a lecturer posting his/her Curriculum Vitae (CV) online to create a personal profile where places of employment and study, the conferences at which he/she has given presentations and list of publications are all visible to others. A lecturer's profile may be searched in these ASNS databases if the platforms he/she uses are linked to a database of journal articles, making it easier for other researchers to remain up to date on his/her most recent achievements (Behrendt 2020). The patterns of information exchange and dissemination in the academic setting may be completely altered by ASNS. They may affect the composition and dynamics of the research community by providing venues for global interactions between academics (Meishar-Tal and Pieterse, 2017).

As a result of the shifting paradigm of lecturers and researchers' information seeking patterns, academic social networking sites (ASNSs) provide new opportunities for communication, collaboration, and knowledge gathering. Lecturers and researchers are gathered in one location by Academic Social Networking Sites (ASNS). Information flows freely when ideas are freely exchanged and discussed in public (Asmi and Madhusudhan, 2017). These websites let users contribute academic papers, abstracts and links to published works. They also let users monitor published work's demand and connect with other professionals. They boost scientific collaboration and make it easier to share research results with the public (Thelwall and Kousha, 2015).

The Factors that Hinder Research Productivity of Lecturers

In spite of the numerous benefits offered from the use of academic social networking sites, there are numerous challenges in their utilisation by lecturers in tertiary institutions particularly in developing countries. These challenges include:

Poor funding system

Funding has always been a critical constraint on enhancement of lecturers' effective research productivity in tertiary institutions in Nigeria. Most public tertiary institutions are poorly funded in Nigeria. Lack of funds hampers the provision of ICT facilities, thereby hindering the effective utilisation of academic social networking for research activities (Olanusi and Olanusi, 2022).

Inadequate use of social networking sites

Adegbenjo in Abimbola (2014) observed that government investment in education was low and that the government finds it difficult to release the meager 26 percent International benchmark recommended by UNESCO as budgetary allocation to education for developing countries. This affects the use of academic social networking sites by lecturers in terms of their research productivity and visibility to the outside world.

Poor Internet connectivity

Tertiary institution lecturers and students' accessibility to Internet connectivity is a challenge to social networking sites development and utilisation of such facilities to enhance effective teaching and learning. According to Jegbefume *et al.* (2014), this situation affects the smooth flow of information for and about education. Lack of Internet connectivity will invariably affect the visibility of research outputs of a lecturer which makes it difficult to be seen as cited by other scholars and researchers.

Irregular power supply

Irregular power supply is one of the major challenges of academic social networking sites' usage in Nigeria. Most tertiary institutions lack stable electricity. Inadequate power supply is the major challenge militating against the use of social networking in enhancing lecturers' effective teaching in higher institutions (Nwokedi, 2019). Power supply is needed to put virtually all the academic social networking sites in use, especially as it relates to the teaching, learning and online visibility. Regrettably, the unavailability of power supply could lead to total failure of the use of academic social network devices to enhance teaching and learning in tertiary institutions.

Conclusion

The conceptual paper has explored the potential influence of ASNS on research productivity of lecturers in federal universities in North-central, Nigeria. The paper has demonstrated the concept of research productivity, concept of ASNS, the influence of ASNS on the research productivity of lecturers and the challenges affecting the use of ASNS among lecturers for their research productivity. By embracing ASNS, lecturers can overcome traditional barriers to research collaboration, increase their visibility and contribute meaningfully to the global knowledge economy.

Recommendations

1. The management of universities should establish clear guidelines for lecturers' use of ASNS, ensuring responsible and productive engagement.
2. The management of universities should offer workshops, training sessions and technical support to enhance lecturers' digital literacy and ASNS usage skills
3. The management of universities should foster a culture of collaboration, recognizing and rewarding lecturers who actively engage in ASNS-facilitated research collaborations.
4. The management of universities should assess the impact of ASNS on research productivity, identifying best practices and areas for improvement.
5. The management of universities should facilitate collaborations across disciplines by engaging in interdisciplinary research, enhancing the quality and impact of research output.

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EMERGING TECHNOLOGIES IN AUTOMOBILE TECHOLOGY FOR ECONOMIC DEVELOPMENT IN NIGERIA.

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Abstract
Technology is vital and pivotal to skills acquisition and the empowerment of human capacity in the society. The innovations in automobile technology are veritable tools bringing about evolving trend in the advancement of automobile industry and contributing to drive the national economy. This study examined the emerging technologies in automobile technology for economic development. The paper therefore investigated the following components: emerging technologies in automobile technology in the 21st century, information and communication technology in automobile technology, emerging technologies in automotive industry as a sub-sector, the recent automobile technologies that are changing the automotive industry and the aspect of economic development. The investigation through case study and analysis indicates that emerging technologies creates significant social or economic effects such that with artificial intelligence (AI) technologies, the automobile industries have integrated machine learning, deep learning, computer vision and autonomous vehicles experiences. With economic development, emerging technologies have enhanced the manufacturing of various products for transportation, utility and other social services. It opened opportunities to engage different workforce in the consolidation of economic development globally.

Key words: Automobile Technology, Emerging, Emerging Technologies, Automobile Sub-sector and Economic Development

Introduction

An automobile is usually a four-wheeled vehicle designed primarily for passenger transportation and commonly propelled by an internal-combustion engine using a volatile fuel according to (Pugi *et al.*, 2017). Automotive technology is the cornerstone of vehicle innovation, focusing on the development, integration, and maintenance of complex systems that make modern transportation possible (Loo, 2024). Motor vehicle field is all about embracing efficiency, safety, and connectivity to meet the demands of today's drivers and industry standards. Automotive technology is the study of how self-propelled vehicles move and refers to the creation or design of vehicle technology and the remediation or repairs required in innovation as a pillar of sustainable economy in the automotive industry.

Emerging in the context of technologies implies to terms that commonly refer to technologies that are currently developing, or that are expected to be available within the next five to ten years, and is usually reserved for technologies that are creating, or are expected to create, significant social or economic effects. In automobiles this involves the engine and other systems, engineering, mechanics and computer technology (Loo, 2024). The emerging technologies in automotive industry have seen a surge like in artificial intelligence (AI) technologies, such as machine learning, deep learning, computer vision and autonomous vehicles or enhancing in-car experiences. These are used to guide self-driving cars, and others like electric vehicles manage fleets and assist drivers for improved safety as stated by Kuru, (2022). However, emerging technology is a term generally used to describe a new technology, but it may also refer to the continuing development of an existing technology. Transportation is a sector of the economy that includes sub-sectors such as train, trucking, airline industries and the manufacturing of automobile.

Research Methodology

The research employed a systematic literature review to get the appropriate information to guide the study. Using the title Emerging Technologies in Automobile Technology for Economic Development in Nigeria, the study sought to review the emerging automobile technologies and the processes of economic development in the auto-industry. Databases such as Research Gate, Springer, Elsevier and articles from other reputable database was considered and limiting the search to only the use of title of the study.

Automobile Technology

Automotive technology is the study of how self-propelled vehicles move and refers to the creation or design of vehicle technology and the remediation or repairs required. This involves the engine and other systems, engineering, mechanics and computer technology. The automobile industry uses the relevant data to manufacture automobiles. Companies are embracing innovative technologies in all areas of the business, such as simulation testing of vehicles, operational efficiencies, predictive maintenance, and autonomous vehicles or enhancing in-car experiences (Chan, 2017). All the aforementioned innovative techniques operational factors to a large extend helps to improve the comfort of the passenger and vehicle safety. The efficiency and functionality of automobiles are handled by trained automotive mechanics. Automotive mechanics, also known as auto mechanics, specialize in repairing and maintaining automobiles, including cars, trucks lorries and motorcycles. They work on engines, transmissions, brakes, steering and suspension systems, and other mechanical components of vehicles.

Emerging Technologies in Automobile Technology in the 21st Century

Advancements in science and technology are driving the future of the automotive industry by way of making high technological trends. Reaping the benefits of these forward thinking improvements will not only be for the consumer but also the populace and the environment in many cases as well. The Internet is pioneering and leading in providing free high technological trend automotive information. However, the General Motors through the Green Revolution Electric Vehicle Initiative made the first major ground breaking all-electric vehicle paved the way for alternative fuelled vehicle by developing the following:

Fuel cell: Fuel technology offers an infinitely renewable power source with almost zero pollutants. It works like a continuous battery but reverses it capacity. The fuel cell use either hydrogen or methanol to drive the cells to convert chemical energy into electricity by a simple oxidation process.

Hybrid: These model vehicles, presently available in United State of America. It uses a blend of high technological innovations to produce electronic drive and is backed up by a traditional internal combustion engine for main automotive power. Hybrid vehicles offer a practical and affordable way to increase fuel efficiency while at the same time reducing emissions. Hybrid presents a viable and logical transition from gasoline dependence to more renewable resources.

Digital Satellite Radio: These offer 100s of channels of programming to provide information from national service and within the environment.

Auto Security: In recent development there has been improvement in tracking and retrieving of stolen vehicles upon the use of existing technologies (Martínez, 2021).

Information and Communication Technology in Automobile Technology

Information and Communication Technology (ICT) such as the world-wide application of mobile phones and internet have contributed substantially to the fast-growing world economy in unprecedented ways. In recent times luxury cars have up to 100 microcomputer- based systems that control nearly all aspects of the car's operation with sub-applications including Car GPS, Self-parking cars, Augmented reality windscreens and heads up displays, Self driving cars.

Technology is the cornerstone of vehicle innovation, focusing on the development, integration, and maintenance of complex systems that make modern transportation possible. This field is all about embracing efficiency, safety, and connectivity to meet the demands of today's drivers and industry standards (Kaur & Sobti 2017). The used of ICT in automobile is very pertinent in the vehicle engine. The engine control unit (ECU), also called engine control module (ECM), is a device which controls multiple systems of an internal combustion engine in a single unit.

Emerging Technology in Automotive Industry as a Sub-sector

These are new technologies in the automotive industry that opens up new opportunities. They are technologies transforming automotive industries. They include artificial intelligent (AI), additive manufacturing, the Internet of Things (IoT), 5G, Intelligent All-Wheel Drive, Active Aerodynamics, Augmented Reality Windshields, Autonomous Emergency Braking, Connected Cars, Electric Vehicles and Fuel Cells which have become sources of product innovation and manufacturing efficiency and in turn has led to revolutionary changes in automotive production and customer experiences (Ghosh, *et al.*, 2022). Pertinent technologies that are examined in this paper are Valvetronic Engines, Downsizing and Turbocharging, Variable Valve Ttiming, Advanced Combustion Modes, Hybrid / Electric vehicle, Fuel Cell Technology, Weight Reduction Materials, Alternative Fuels and others as well.

The recent Automobile Technologies that are changing the Automotive Industry

Valvetronic Engines

Valvetronic engines varies the timing and the lift of the intake valves. The Valvetronic system has a conventional intake cam, but it also uses a secondary eccentric shaft with a series of levers and roller followers, activated by a stepper motor. This engine reduces maintenance costs, lowers exhaust emissions, and provides a smoother running engine.

Downsizing and Turbo sizing

Downsized engines are lighter than conventional engines, therefore reducing vehicle mass and as such refining vehicle fuel consumption. In petrol and diesel vehicles, the turbocharger has a Centrifugal compressor powered by a turbine that is run by the engines exhausts gases. Hot

exhaust gases flow through the turbine's wheel blades, accelerating the turbine and driving the compressor. Turbocharging recovers the energy of the exhaust gasses to increase the inducted charge, therefore increasing the power-to-displacement ratio.

Variable Valve Timing
In this camshafts are cut with a three-dimensional profile that change along the length of the Cam lobe. The shaft still spins just like a regular camshaft, but earlier by gradually sliding the Camshaft laterally as the engine speed and load increase and in this way the valve timing can be optimized.

Advanced Combustion Modes
Some of advanced combustion modes includes direct combustion system in both petrol and diesel engine with advance version like GDI (Gasoline direct injection) in petrol CRDI (Common rail diesel injection) in diesel and. Another mode is Some Studies on Advanced Technologies used in Automobiles 345 called (homogeneous charge compression ignition) HCCI. It use spark ignition for heavy load operation but in case of light load the lean mixture can be ignited throughout a cylinder without a spark.

Hybrid/Electric Vehicles
Hybrid vehicles are equipped with both combustion and electric engines. This technology holds great ability, especially for its use in smaller vehicles running at lower speeds for short distances, in highly populated urban areas. The two variants recently launched in India are Honda Civic is Toyota Prius.

Fuel Cell Technology
A fuel cell works as an electrochemical cell by combining hydrogen and oxygen without combustion to produce electricity. Inside a cell fuel hydrogen is passed over a negatively charged pole, or anode, where electrons are stripped off through catalytic action.

Ethanol, methanol and hydrogen are the main sources of fuel for the production of electricity from fuel cells. The electricity generated drives the car, according to Won *et al.,* (2005).

Weight Reduction Materials
As it takes less energy to accelerate a lighter object than heavier one, Lightweight materials offer great potential for increasing vehicle efficiency. Substituting cast iron and traditional steel components with lightweight materials such as high strength steel, magnesium (Mg) alloys, carbon fiber, aluminum (Al) alloys and polymer composites can directly lower the weight of a vehicle's body and chassis by up to 50% and therefore reduce a vehicle's fuel consumption.

Alternative Fuels
The alternative fuels being verified at present are Liquefied Petroleum Gas (LPG), Compressed Natural Gas (CNG), Liquefied Natural Gas (LNG), Ethanol, Hydrogen, Methanol. These are designed to reduce emission and release less greenhouse gas emissions. Aside these are: Batteries and Energy Storage, 42 Volt Systems, Drive by Wire Technology, Camless Engines, Exhaust-Gas Recirculation Systems (EGR), Stirling Engines, Opposed Piston Engine, Split Cycle Engine, Free Piston Engine and Wankel Rotary Engine (Athanasopoulou, 2019).

Nigeria Strategic Plans for Economic Development of Automobile sector
Nigeria remains Africa's largest automobile market with an average annual growth rate of 3% over the last decade. Activities in the industry commenced around 1950 with the assembly of

major brands such as Volkswagen, Bedford, Leyland, Peugeot and Steyr producing trucks and saloon cars in partnership with the Nigerian government which dominated the market till the 1980s Ugwueze (2020). .Transportation is another sector of the economy. This sector includes automobile manufacturing, train, trucking, and airline industries. Starting in the 1960s, robotic equipment was introduced to the process, and most cars are now mainly assembled by automated machinery (Benotsmane *et al.*, 2020). The Federal Government through its agency, NADDC continues to implement and enforce policies that are aimed to protect the industry to ensure steady growth and development (Daniel & Usman, 2020).

Conclusion

This study focused on emerging technologies in automobile technology and economic development. The technologies that are examined in this paper include: emerging technologies in automobile technology in the 21st century, information and communication technology in automobile technology, emerging technologies in automotive industry as a sub-sector, the recent automobile technologies that are changing the automotive industry and economic development.

Recommendations

The study recommends that the Federal Government through its agency, National Automotive Design and Development Council continues to implement and enforce policies that are aimed to protect the industry to ensure steady growth and development. It is also recommended that the following be strengthen in order to mitigate the factors that are barriers to the growth of automobile companies in Nigeria, checkmate the smuggling activities across our borders and invest more in automobile industries and the auxiliaries. Set-up more skill acquisition centers and makes inputs into the curriculum for in technical colleges, engineering institutions, tertiary institutions and the relevant institutions.

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STRATEGIES FOR THE ADOPTION OF ARTIFICIAL INTELLIGENCE TO ENHANCE THE IMPLEMENTATION OF MINIMUM STANDARD FOR NIGERIAN CERTIFICATE IN EDUCATION TECHNICAL PROGRAMME

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Abstract
This study explored strategies for the adoption of Artificial Intelligence (AI) to enhance the implementation of minimum standards for Nigerian Certificate in Education (NCE) technical programme. One research question and a null hypothesis guided the study. The study adopted a descriptive survey design using a cross-sectional approach. The target population was 231 comprising 8 policy makers from the Federal Ministry of Education, 8 regulations officials from the National Council for Colleges of Education (NCCE), and 215 technical education lecturers from all the 9 Federal Colleges of Education offering technical education. A sample of 79 respondents were selected using purposive and stratified random sampling techniques. Purposive sampling technique was used to select all the policymakers and regulations officials while stratified random sampling technique was used to select 63 technology education lecturers. Data was collected through an electronic Likert scale questionnaire, which underwent rigorous validation and reliability testing processes that yielded .87 reliability index. Data analysis was conducted using mean, mode and standard deviation to answer the research question and Analysis of Variance (ANOVA) was used to test the null hypothesis. Regular training programs, adequate funding, collaboration with AI technology providers, encouraging AI research, continuous evaluation and monitoring, setting ethical guidelines, and policy advocacy were found to be key adoption strategies. Based on these findings, the study recommended among others that the Federal Ministry of Education should develop and implement policies that support AI integration; the National Commission for Colleges of Education should collaborate with AI technology providers to facilitate the adoption of AI in the implementation of minimum standard for NCE technical programme.

Keywords: Strategies, Adoption, Artificial Intelligence, Minimum Standard, Nigerian Certificate in Education

Introduction
The development of the economy of every nation hinges significantly on the quality of education, notably technical education. UNESCO (2017) defined technical education as a branch of educational studies that specializes in the practical application of skills related to specific trades or occupations, technical education focuses on equipping students with the knowledge they need to succeed in the workforce. The primary objectives of technical education encompass producing a skilled workforce capable of meeting labor market demands, fostering self-employment through the provision of relevant skills, and promoting socio-economic advancement (Aliyu, 2016). Technical education is crucial because it fuels economic growth, reduces unemployment rates, and contributes to societal welfare by creating a competent workforce primed for technological innovation and industrial growth Nonetheless, Oduolowu (2019) noted that the significant challenges associated with technical education is lack of adequate competence among graduates from technical education programmes like the Nigerian Certificate in Education.

The Nigerian Certificate in Education (NCE) technical programme is a three-year vocational and technical training programme designed to produce skilled educators capable of teaching practical and applied aspects of science, technology, and mathematics subjects in junior secondary schools. The primary objectives of the NCE technical programme are to prepare teachers for junior secondary schools and technical colleges; to provide technical knowledge and vocational skills necessary for industrial development of Nigeria; and to prepare students for further studies in technical education (Federal Republic of Nigeria, 2013). The importance of this programme cannot be overemphasized as it directly contributes to the capacity building of technical teachers required for imparting essential skills to students in the age of rapid technological advancement (Odu, 2023). Notably, these skills help fuel the growth of industry sectors critical to the Nigerian economy. Despite its significance, there are several challenges confronting the NCE technical programme such as non-implementation of the minimum standards for the programme.

Minimum standards for the NCE programme refer to the benchmark guidelines established by the National Commission for Colleges of Education (NCCE) to ensure quality and uniformity in the delivery of the programme across all Colleges of Education in Nigeria. These minimum standards stipulate the necessary curriculum content, instructional methods, assessment procedures, and infrastructural requirements that must be met to achieve the objectives of the NCE technical programme (NCCE, 2012). These standards are structured to encompass a comprehensive curriculum that includes theoretical knowledge and practical skills in various areas such as metalwork, electricity, automobile technology, and woodwork. The aim is to equip trainee teachers with the requisite technical competencies and pedagogical skills to effectively educate future generations of Nigerians in these important fields (Federal Republic of Nigeria, 2013). However, there have been significant challenges in the implementation of these minimum standards. Some of these issues include inadequate infrastructural facilities, limited exposure to modern teaching tools, and the non-adoption of recent technologies such as Artificial Intelligence.

Artificial Intelligence (AI) refers to the simulation of human intelligence processes by machines, particularly computer systems. These processes include learning (the acquisition of information and rules for using the information), reasoning (using the rules to reach approximate or definite conclusions), and self-correction (Russell & Norvig, 2020). AI has immense potential to enhance the implementation of minimum standards for NCE technical programme. For instance, AI can facilitate personalized instruction, provide real-time analytics to monitor students' progress, automate grading tasks, and develop virtual simulations for practical lessons, thereby improving teaching and learning processes (Blikstein, 2018). Consequently, given the potential benefits and transformative power of AI, there is need to provide valuable insights into how AI can be effectively adopted thereby contributing to the implementation of minimum standards for NCE technical programme in Nigeria.

Statement of the Research Problem

The ideal situation in the context of technical education in Nigeria involves the effective implementation of minimum standards as stipulated by the NCCE for the NCE programme. These standards are designed to ensure a high-quality and uniform delivery of technical and vocational education across the country (National Commission for Colleges of Education, 2012). However, the present reality contrasts sharply with this ideal. The standard implementation is frequently undermined due to factors such as inadequate infrastructural facilities, limited access to modern teaching tools, and insufficient professionally trained educators (Odu, 2023). Thus, there exists a significant challenge that manifested the non-

implementation of the minimum standards. Efforts have been made to address these issues, including governmental interventions aimed at improving infrastructural development and educating teachers more effectively. Yet, despite these endeavors, the problem persists, resulting in subpar technical education that falls short of the NCCE's intended standards (Odu, 2023). The implications of this persistent challenge are grave. It detracts from the quality of technical education, thereby impacting negatively on the employability of graduates, stifling industrial growth, and hindering national development. Thus, this research sought to investigate the strategies for the adoption of AI to enhance the implementation of the minimum standards for NCE technical programme in order to provide actionable pathways to overcoming longstanding challenges in actualizing the set educational standards.

Aim and Objective of the Study

The study aimed to investigate the strategies for the adoption of AI to enhance the implementation of minimum standard for NCE technical programme. Specifically, the objective of the study sought to identify the:

2 Strategies for the adoption of AI to enhance the implementation of minimum standards for NCE technical programme.

Research Question

The following research question was raised and answered to achieve the objective of the study:

1. What are the strategies for the adoption of AI to enhance the implementation of minimum standards for NCE technical programme?

Hypothesis

The following null hypothesis was formulated and tested at .05 level of significance:

HO1: There is no significant difference among the mean responses of technical education lecturers, regulations officials and policy makers on the strategies for the adoption of AI to enhance the implementation of minimum standards for NCE technical programme.

Methodology

This study adopted a descriptive survey research design with a cross-sectional approach to explore the adoption strategies for utilizing AI to enhance the implementation of minimum standards for NCE technical programme. The choice of this design was based on its strength in collecting detailed information through direct interaction with subjects, allowing for comprehensive analysis of the current state of affairs (Creswell, 2023). The area of the study was Nigeria, a diverse country with a dynamic educational landscape that is currently experiencing significant technological shifts. The target population was 231 comprising 8 policy makers from the Federal Ministry of Education, 8 regulations officials from the NCCE, and 215 technical education lecturers from all the 9 Federal Colleges of Education offering technical education. From this group, a sample of 79 respondents were selected using purposive and stratified random sampling techniques. Purposive sampling technique was used to select all the policymakers and regulations officials while stratified random sampling technique was used to select 63 technology education lecturers. Data collection was conducted using an electronic Likert scale questionnaire with 7 items developed by the research team. The instrument was subjected to face and content validation by three experts in the field to enhance its validity. Reliability of the instrument was confirmed via Cronbach's Alpha statistics, yielding reliability index of .87. Cronbach's Alpha is a standard measure of internal consistency among test items and is widely recommended for studies involving psychometric testing (Tavakol & Dennick, 2021). Out of 79 questionnaires distributed electronically, 75 were

returned completed, yielding a response rate of approximately 95%. Data analysis was conducted using mean, mode and standard deviation to answer the research question. The real limit of numbers served as the decision rule. Additionally, Analysis of Variance (ANOVA) was used to test the null hypothesis. Hypothesis was accepted or rejected at a .05 level of significance, a common threshold in social science research that balances the risks of Type I and Type II errors.

Results:

Research Question One

What are the strategies for the adoption of AI to enhance the implementation of minimum standards for NCE technical programme? Results for answering research question one is contained in Table 1.

Table 1: Mean, mode and standard deviation for the responses of the respondents on the strategies for the adoption of AI to enhance the implementation of minimum standards for NCE technical programme

S/N	Items	Mean	Mode	SD	Remark
1	Regular educator training programs are essential for successful AI adoption.	3.97	4.00	1.13	Agreed
2	Adequate funding must be allocated for incorporating AI in education.	4.12	4.00	.76	Agreed
3	Collaboration with AI technology providers can accelerate the adoption process.	4.15	4.00	.93	Agreed
4	Encouraging research in AI for education can lead to innovative solutions.	4.28	4.00	.75	Agreed
5	Continuous evaluation and monitoring are necessary to align AI use with educational objectives.	4.25	4.00	.84	Agreed
6	Ethical guidelines on AI use in education need to be established and followed.	4.07	4.00	.99	Agreed
7	Policies promoting AI use in technical education should be advocated for and implemented.	4.10	4.00	.98	Agreed

Table 1 showcases data on strategies for the adoption of AI to enhance the implementation of minimum standards for NCE technical programme. The mean values range from 3.97 to 4.28, demonstrating general agreement on the importance of these strategies. Most items have a mode score of 4, reflecting a high level of agreement among participants, while standard deviations between 0.75 and 1.13 suggest a degree of variability in the responses, implying that divergent views might be present.

Hypothesis One

There is no significant difference among the mean responses of technical education lecturers, regulations officials and policy makers on the strategies for the adoption of AI to enhance the implementation of minimum standards for NCE technical programme. Data for testing hypothesis two is contained in Table 2.

Table 2: One-way ANOVA for the test of significant difference among the mean responses of technical education lecturers, regulations officials and policy makers on the strategies

for the adoption of AI to enhance the implementation of minimum standards for NCE technical programme.

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.741	1	4.741	87.981	.099*
Within Groups	8.192	77	.054		
Total	12.933	78			

Table 2 revealed that Significant (P) value of .099, which is greater than .05. This implied that, there is no significant difference among the mean responses of technical education lecturers, regulations officials and policy makers on the strategies for the adoption of AI to enhance the implementation of minimum standards for NCE technical programme. Hence, the null hypothesis two is accepted.

Findings

4. Regular educator training programs, adequate funding, collaboration with AI technology providers, encouraging AI research, continuous evaluation and monitoring, establishment of ethical guidelines, and policy advocacy were found to be key strategies for adopting AI to enhance the implementation of minimum standards for NCE technical programme.

5. There is no significant difference among the mean responses of technical education lecturers, regulations officials and policy makers on the strategies for the adoption of AI to enhance the implementation of minimum standards for NCE technical programme.

Discussion of Findings

This study identified several key strategies deemed crucial for adopting AI to enhance the implementation of minimum standards for NCE technical programme. These strategies include regular educator training programs, adequate funding, collaboration with AI technology providers, encouraging AI research, continuous evaluation and monitoring, establishment of ethical guidelines, and policy advocacy. A parallel finding was reported by Al-Fraihat *et al*. (2020), who highlighted the importance of regular training, adequate funding, and strong collaborations in effectively integrating AI technologies into educational settings. Their findings further accentuated the role of persistent evaluation and adherence to ethical standards for successful AI adoption. However, a slightly contrasting perspective was offered in a study by Hall *et al*. (2019), which suggested that while these strategies are important, there may be varying degrees of emphasis placed on each, depending on the specific educational context and available resources. The similarity between our findings and those of Al-Fraihat *et al*. could stem from comparable socio-economic conditions and educational contexts which necessitate a comprehensive approach to AI integration. Conversely, the difference observed in Hall's study might be attributable to their consideration of diverse educational environments with different priorities and resource availability. Implicatively, these insights call for comprehensive policy measures that address all these key strategies.

The study revealed no substantial difference in how educational technology lecturers, AI specialists, and AI solution providers perceive the role of various AI technologies in enhancing the implementation of minimum standards for Nigeria's Certificate in Education programme. This consensus suggests a shared understanding and belief in the transformative potential of AI across these different professional groups. This finding aligns well with a similar study by Liu *et al*. (2020) where they found general agreement among diverse stakeholders regarding

the promise of AI technologies such as machine learning, natural language processing, and predictive analytics in education. Contrastingly, a study by Bunker *et al*. (2019) reported differing opinions among educational technologists and AI experts regarding the use of specific AI technologies. They attributed this discrepancy to varying levels of familiarity and the distinct roles these professionals play in the educational ecosystem. The similarity between the finding of this study and that of Liu *et al*. can be explained by the growing recognition of AI's transformative potential in education across varied stakeholders worldwide. The differences observed in Bunker *et al*.'s study may be due to different contexts or perhaps to the evolving nature of AI understanding and application in education. In terms of implications, this study emphasizes the need for an inclusive dialogue involving all relevant stakeholders when formulating policies or interventions relating to AI adoption in education.

Conclusion

The study presented valuable insights into the strategies for the adoption of artificial intelligence (AI) to enhance the implementation of minimum standards for NCE technical programme. Key strategies for adopting AI technologies were identified, including regular educator training programs, sufficient funding, collaboration with AI technology providers, encouragement of AI research, continuous evaluation and monitoring, adherence to ethical guidelines, and policy advocacy. Interestingly, the study found a general consensus among different stakeholders, such as technical education lecturers, regulations officials, and policy makers. Their agreement on the necessary strategies for AI adoption underscores the shared vision and collective commitment towards leveraging AI technologies to advance NCE technical programme in Nigeria. This unanimous recognition and the suggested strategies form a robust foundation for devising effective policies and interventions aimed at integrating AI in Nigeria's technical education curriculum.

Recommendations

Based on the findings of this study, the following recommendations were made for the stakeholders:

6. The Federal Ministry of Education should develop and implement policies that support AI integration into education, particularly in regard to technical education minimum standards. This includes allocating sufficient resources and funding for AI research and the acquisition of necessary infrastructure, as well as supporting the development of ethical guidelines for AI use in education.

7. The National Commission for Colleges of Education should collaborate with AI technology providers to facilitate the adoption of machine learning, natural language processing, AI-driven chatbots, recommender systems, predictive analytics, computer vision, and robotic process automation in the minimum standard for NCE technical programme.

8. The Administrators of Colleges of Education should establish regular educator training programs to increase teacher competency in utilizing AI technologies effectively, while also working closely with the Federal Ministry of Education and the National Commission for colleges of education to ensure the successful implementation of AI strategies.

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AVAILABILITY AND UTISATION OF ONLINE DATABASES IN LIBRARIES BY POSTGRADUATE STUDENTS OF LIBRARY AND INFORMATION SCIENCE DEPARTMENT IN NORTH-WEST, NIGERIA

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Abstract
The study investigated the influence of availability and utilisation of online databases in libraries by postgraduate students of library and information science department in North-west, Nigeria. The study was guided by two objectives. The total population for the study was 376 postgraduate students of Library and Information Science Department in three (3) universities in North-west, Nigeria. The study adopted census or total enumeration to arrive at the sample size due to the manageable size of the population. Out of 376 copies of questionnaire administered, 329 copies were filled, returned and used for the analysis representing 88% response rate. Descriptive statistical tools, mean and standard deviation were used to analyse the data. The findings of the study revealed that the types of online databases available in all the university libraries include: HINARI, AGORA and science direct and the respondents indicated high use of DOAJ, AJOL, EBSCOHost, JSTOR, HHINARI, AGORA, ProQuest and Science direct databases. The study recommended among others that the management of federal university libraries in North-West, Nigeria should ensure the provision of adequate online databases especially Research4life, LexisNexis, Scopus and Elsevier which appears to be missing in some of the libraries and ensure that online databases are made user friendly in terms of set up. That is, search, access and retrieval of information or document.

Keywords: Availability, Utilisation, Online databases, Postgraduate students, LIS

Introduction

One of the cardinal objectives of library and information science program in Nigeria is concerned at producing competent librarians to manage all types of libraries in the countries for sustainability. Postgraduate programs are highly needed to fill the gap of professional manpower in the field of library and information sciences. In view of this, Oni *et al*., (2017) observed that postgraduate students in tertiary institutions are the major users of information resources. It is the duty of libraries and librarians to provide for the information needs of postgraduate students both in print and electronic format in the library.

Postgraduate programs in library and information science depend upon the system of awarding higher degree at different levels such as Postgraduate Diploma, Masters and Doctor of Philosophy among others. Research is hallmark of postgraduate programmes in library and information science as majority of the students may require information resources such as online databases to enable them pursue their respective programs (Mbagwu *et al*., 2018). This indicates that available and utilisation of online databases can solve the information needs of postgraduate students of library and information sciences, especially those databases subscribed by libraries.

The libraries today are more proactive in their activities especially with the introduction of online databases facilities to university libraries, which has brought about an advanced way in the techniques of accessing and retrieving information resources that a library acquired to serve its users; it has also changed the ways of providing services offered to users community. On this note, libraries include the following: academic libraries, public libraries, special libraries, school libraries, and private libraries. Academic libraries as posited by Kolawole and Igwe (2016) encompass research libraries, Master's and Doctoral Degree Granting Institutions, Junior and Community Colleges and Distance Learning Programs of Higher Education. Academic libraries work together with other members of their institutional communities to participate in, support and achieve the educational mission of institutions by teaching the core competencies of information literacy. It is therefore imperative for academic libraries to have in their possession, online databases in diverse formats suitable for postgraduate students of library and information science.

Databases according to Abubakar and Akor (2017) are organized collections of information. As the authors further observed, databases are often characterized by the type of information they contain-text, numbers or fields. E-databases can be categorized as CD ROM Databases and Online Databases. CD ROM Database**;** CD-ROM databases are the e- resources which allow users to access to relevant databases without robust Internet connectivity in libraries. In line with the above, online database plays significant roles as it provide information sources to postgraduate students nowadays. Online databases or web-based databases are widely available to library patrons in the entire world, and many patrons can tap into these databases from their own computers or electronic devices anywhere in the world. The Internet, through electronic databases or digital libraries, has become an important source of academic information for tertiary students (Akinola *et al*., 2018). In this regard, postgraduate students of library and information science must know how to use online databases available as it's linked to computer literacy level and may feel more comfortable in using e-resources and thus gain more from using them.

On the utilisation of online databases, it is a procedure that gives researchers access to soft copy, online, or digital information material with the goal of improving the caliber and efficacy of their research efforts. Musa *et al*., (2017) opined that utilisation of digital information resources constitutes the process that enables researchers to effectively and efficiently access the soft copy, online or offline databases for their research activities. With this, effective utilisation of digital information resources depends on the information resources available in the library and also accessible to the student. In a nutshell, online databases can influence postgraduate students of library and information sciences in their daily academic activities. It is crucial for library to sensitize postgraduate students about the availability of online databases in library for their academic activities.

In this direction, availability refers to the ability to a user to access information or resources in a specified location and in the correct format. Availability of online databases in libraries according to Ternenge and Kashimana (2019) is not just enough, users must know of their existence to be able to use them effectively; and to put to use what's available, users must possess requisite skills that will enable them to exploit these resources and services. Libraries are very vital for the betterment on academic activities of postgraduate students as it the information hub that disseminate information of all kind to users. In this direction, availability of online databases creates an avenue for better learning and promotes academic excellence of postgraduate students of library and information science.

It is on this basis, this research study seeks to establish the availability and utilisation of online databases in libraries by postgraduate students in library and information sciences department in North-west, Nigeria.

Statement of the Problem

The availability and utilisation of online databases can be useful tool to enhancing postgraduate students of library and information science academic activities. It is assumed that the availability and utilisation of online databases could positively affect a student's endeavours. However, academic libraries are lagging behind in the areas of low level availability and utilisation of online databases. The researcher observed that postgraduate students have difficulties sourcing for information resources for their academic activities. It is against this backdrop that this study investigated the influence of availability and utilisation of online databases in libraries by postgraduate students of library and information science department in North-west, Nigeria.

Objectives of the Study

The objectives of the study were to:

viii. identify the availability of online databases in libraries by postgraduate students of library and information science department in North-west, Nigeria;

ix. identify the level of utilisation of online databases in libraries by postgraduate students of library and information science department in North-west, Nigeria.

Literature Review

A number of studies, including a study conducted by A study conducted by Afianmagbon *et al* (2020) Availability of information resources as factors that influence research productivity of academic staff at Lead City University, Nigeria, on information literacy skills, indicates high level information resources availability to lecturers and other academic staff in Lead City University who are utilizing them in conducting researches. Musa *et al*. (2017) found that digital information resources are free of cost, saves time, easily accessible, and allows information seekers to acquire all the information needed in one place. In this regard, the motives for adoption of digital libraries in universities in Nigeria is mainly to provide digital and online information resources for staff and students in order to enhance educational development and provide educational resources so as to achieve an effective teaching, learning and research activities (Anyim, 2018).

Ternenge and Kashimana (2019) conducted a study on availability, accessibility and use of electronic information resources for research by students in Francis Sulemanu Idachaba library university of Agriculture, Makurdi, Benue state, Nigeria. The findings revealed that, electronic information resources mentioned above were available for research by students to a great extent. This is in line with the findings of Edem and Egbe (2016) determined the level of availability and utilisation of digital information resources by undergraduate students in the university of Calabar library. The study revealed that digital information resources were available in the Library and students utilized them as expected. The study further revealed that digital information resources were adequately available in the university library. Nevertheless, studies conducted by Adeleke and Nwalo (2017) on availability, use and constraints to use of digital information resources by postgraduate students at the university of Ibadan. The findings of the study revealed that, availability of information does not necessarily mean actual use. Moreover, ineffective use of digital information resources by postgraduate students at the university of Ibadan occurred due to number of factors which include interrupted power supply,

speed and capacity of computers, non-possession of requisite IT skills and problems accessing the internet.

A study by Marama and Ogunrombi cited in Ankrah and Atuase (2018) confirms high unavailability of library and information science (LIS) collections in most Nigerian university libraries, which had a negative effect on the use of information resources in the libraries studied. Qasim et al (2015) conducted a study at the former Bendel State University to determine the unavailability rate in the library and to find out its causes. The survey revealed an unavailability rate of 34 percent. In a nutshell, the proliferation of online databases has brought significant impact on the way in which the users use information in their day to day activities. With this, postgraduate student of library and information science need to be informed on a regular basis about the various resources which are available in the library so that they will be in position to get the information they need.

In view of the above, Daramola, (2016) conducted a study on the reasons for utilisation of digital information resources in Federal University of Technology Akure library, The study revealed that most of the student visited the digital library section so as to do their assignment and also access their emails. The study further reMusavealed that there was fair utilisation of the digital information resources by the undergraduate student. However, the researcher noted some challenges faced by the student in utilisation and accessibility; the challenges are lack of information literacy skills, large number of irrelevant information resources, poor internet connectivity, epileptic power supply and inconsistency in databases subscription among others. Additionally, Azubuike and Ebisemen (2017) conducted a study on awareness and utilisation of digital information resources among academic staff of Port Harcourt polytechnic, Rivers state. A descriptive survey research design was adopted and the findings revealed that the academic staff are fully aware of digital information resources and seems to use them frequently. Findings showed that the academic staffs were motivated to use digital information resources for research purposes, extend access to a wide range of e-books, and updated information resources.

Methodology

The study adopted the survey research design method. Population of the study consists of 376 postgraduate students of Library and Information Science Department in three (3) universities in North-west, Nigeria. Census or total enumeration was used to arrive at the sample size due to the manageable size of the population out of which Three hundred and twenty-nine (329) copies of the questionnaire were returned and used for the analysis representing 88% response rate. Questionnaire and observation checklist were the instruments for data collection. Simple frequency, percentage and mean and standard deviation were used for data analysis.

Results

A total of three hundred and seventy-six (376) copies of questionnaire were administered to postgraduate students of Library and Information Science Department in three (3) universities in North-west, Nigeria. Three hundred and twenty-nine (329) copies of the questionnaire were returned and used for the analysis representing 88% response rate.

Table 1.1: Types of Online Databases Available for Postgraduate Students of Library and Information Science in Universities in North-West, Nigeria

	Kashim Ibrahim Library, A.B.U. Zaria		BUK Library		Prof. Garba Daura Library, UMYU	
Online Databases	AV	NA	AV	NA	AV	NA
DOAJ	√			X	√	
AJOL	√			X	√	
EBSCOHost	√			X	√	
JSTOR	√			X		X
HINARI	√		√		√	
AGORA	√		√		√	
ProQuest	√		√			X
Research4life	√			X		X
LexisNexis		X		X		X
Scopus		X	√		√	
Elsevier	√		√			X
Science direct	√		√		√	

The result in Table 4.3 shows the types of online databases available and those not available in the university libraries in North-West, Nigeria. Online databases such as HINARI, AGORA and science direct were all available in all the university libraries. Similarly, Elsevier, ProQuest were available in only Kashim Ibrahim and BUK Libraries, while DOAJ, AJOL and EBSCOHost were available in only Kashim Ibrahim and Prof. Garba Daura libraries. In addition, JSTOR is available in only Kashim Ibrahim Library. On the other hand, LexisNexis were not available in all the university libraries. In addition, Scopus was not available in Kashim Ibrahim Library. Prof. Garba Daura Library indicated the availability of AJLS as part of online databases available under the column of others please specify.

Table 2.2: Level of Utilisation of Online Databases by Postgraduate Students of Library and Information Science Department for their Academic Activities

S/N	Statements	VH	H	L	VL	N	FX	x□	STD	Decision
		4	3	2	1	329				
1	DOAJ	96	107	67	59	329	898	2.73	0.22	High
2	AJOL	89	104	81	55	329	885	2.69	0.19	High
3	EBSCOHost	91	78	103	57	329	861	2.62	0.12	High
4	JSTOR	91	99	93	46	329	893	2.71	0.21	High
5	HINARI	117	100	76	36	329	956	2.91	0.41	High
6	AGORA	103	109	82	35	329	938	2.85	0.35	High
7	ProQuest	99	97	72	61	329	892	2.71	0.21	High
8	Research4life	57	81	108	83	329	770	2.34	0.16	Low
9	LexisNexis	30	57	107	135	329	640	1.94	0.55	Low
10	Scopus	39	72	108	110	329	698	2.12	0.37	Low
11	Elsevier	81	78	113	57	329	841	2.56	0.06	Low
12	Science direct	138	99	51	41	329	992	3.02	0.52	High
	Weighted mean							**2.60**		

Table 2.2 showed the level of utilisation of online databases by postgraduate students of library and information science department. Out of the twelve items listed, eight items listed produced high mean scores which were above the weighted mean of 2.60. These items include item 12: Science direct (x□=3.02; SD=0.52), item 5: HINARI (x□=2.91; SD=0.41), item 6: AGORA (x□=2.85; SD=0.35), item 1: DOAJ (x□=2.73; SD=0.22), item 4: JSTOR (x□=2.71; SD=0.21), item 7: ProQuest (x□=2.71; SD=0.21), item 2: AJOL (x□=2.69; SD=0.19) and item 3: EBSCOHost (x□=2.62; SD=0.12). On the other hand, four items produced low mean scores which were below the weighted mean of 2.60. These items include item 11: Elsevier (x□=2.56; SD=0.06), item 8: Research4life (x□=2.34; SD=0.16), item 10: Scopus (x□=2.12; SD=0.37) and item 9: LexisNexis (x□=1.94; SD=0.55). The decision mean of 2.60 and above is considered as the level of utilisation of online databases by postgraduate students of library and information science department for academic activities and vice versa. Consequently, the weighted mean of 2.60 shows that level of utilisation of online databases by postgraduate students of library and information science department for their academic activities is high.

Above all, the highest mean score was discovered from item 12 which is Science direct. From the analysis, the study revealed that items 1, 2, 3, 4, 5, 6, 7 and 12 were rated high by the respondents as their of utilisation of online databases for academic activities, while items 8, 9, 10 and 11 were rated low as their level of utilisation of online databases for academic activities.

Discussion of the Findings

The findings from research question one revealed that online databases such as HINARI, AGORA and science direct were all available in all the university libraries. Similarly, Elsevier, ProQuest were available in only Kashim Ibrahim and BUK Libraries, while DOAJ, AJOL and EBSCOHost were available in only Kashim Ibrahim and Prof. Garba Daura libraries. In addition, JSTOR is available in only Kashim Ibrahim Library. Furthermore, Prof. Garba Daura

Library, Umaru Musa Yar'adua University indicated the availability of AJLS as part of online databases available and was added under the column of others please specify. The reason for the availability of these databases is because they cover the full range of academic disciples. This is in line with the findings of Ahmed *et al*. (2020) who revealed the categories of online databases which include: EBSCO, EMERALD, AJOL, JSTOR, DOAJ, TEEAL and HINARI among others, which are meant to augment the print and cover full range of academic disciples. On the other hand, LexisNexis were not available in all the university libraries. In addition, Scopus was not available in Kashim Ibrahim Library. The reason for the unavailability of these databases could be because of lack of fund to subscribe to these databases. This is in line with the findings of Anie (2015) who listed challenges confronting online databases access in Africa ranging from lack of enough skilled manpower, inadequate competition in the communication industry, an absence of defined regulations, the high cost of satellite Internet hardware, limited funding from the government and inadequate power supply.

The findings of the study as regards to research question 3 it revealed that the level of utilisation of online databases by postgraduate students of library and information science department for their academic activities is high. The reason for the use of these databases among Postgraduate students of library and information science Department could be because they are popular online databases and most subscribed by universities for the community of users. This is in line with the findings of Nanda (2017) who points out that the majority of students, faculty members and research scholars efficiently utilised science direct and springer link. These findings echoed those of Kumar and Reddy (2016), who discovered that Science Direct, Springer Link and JECC were the most popular and widely used databases among students, academic staff and researchers.

However, Research4life, Scopus, LexisNexis and Elsevier were lowly utilised among postgraduate students of library and information science department for their academic activities. These could be because they lack skills in the use of these databases for their academic activities. This support the findings of Daramola (2017) who revealed some of the challenges faced by student in the utilisation and accessibility of digital information resources include lack of information literacy skills, large number of irrelevant information resources, poor Internet connectivity, epileptic power supply and inconsistency in databases subscription among others.

Recommendations

Based on the findings of the study, the following recommendations are made:

9. The management of university libraries in North-west, Nigeria should ensure the provision of adequate online databases especially Research4life, LexisNexis, Scopus and Elsevier which appears to be missing in some of the libraries.

10. The management of university libraries in North-west, Nigeria should ensure that online databases are made user friendly in terms of set up. This will improve the level of satisfaction with the use of online databases by postgraduate students of library and information science department for their academic activities

Conclusion

Based on the results of the findings, the study revealed that the types of online databases available in all the university libraries include: HINARI, AGORA and science direct and the respondents indicated high use of DOAJ, AJOL, EBSCOHost, JSTOR, HHINARI, AGORA, ProQuest and Science direct databases.

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USE OF INFORMATION RESOURCES IN PUBLIC LIBRARIES BY GRASSROOT PEOPLE FOR COMMUNITY TRANSFORMATION IN NORTH-CENTRAL, NIGERIA

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Abstract
This study investigated the use of information resources in public libraries by grassroot people for community transformation in North-Central, Nigeria. The study was guided by 2 research objectives and 2 corresponding research questions. The total population for the study was 198 librarians in public libraries in North-Central, Nigeria. The researcher adopted census sampling technique to cover the entire population of library staff in the State public libraries. Questionnaire and checklist were the research instruments used for data collection. Out of the 198 copies of questionnaire administered, 174 copies were filled, returned and used for the analysis representing 88% success rate. Descriptive statistical tool involving frequency counts and percentages, mean and standard deviation were used to analyse the data. The findings of the study revealed the availability of library catalogue, indexes, bibliography, abstracts, textbooks, journals and monographs as information resources available in all the public libraries. The study revealed further that the grassroot people use books, journals article, dictionaries, newspapers and manuscripts for community transformation with the weighted $x\bar{}$ of 2.67. The study concluded that public libraries in North-central, Nigeria have the potential to play a significant role in community transformation through the use of information resources by grassroots people. By harnessing the power of information, grassroots people can become active agents of change, driving development and improving the quality of life in their communities. The study recommended among others that the management of public libraries in North-central, Nigeria should prioritize the development of relevant information resources and services that meet the needs of grassroot people.

Keywords: Community transformation, Information resources, Grassroot people, Public libraries, Use.

Introduction
Public libraries play a pivotal role in community development and transformation by serving as vital centres for information, education, and cultural enrichment (Etebu and Zacchaeus, 2020). In the context of North–central, Nigeria, understanding the access and utilisation of public libraries by grassroots communities is essential for fostering community development. Community transformation refers to a comprehensive and sustainable process of positive change that occurs within a community, affecting its social, economic, cultural, and environmental dimensions. It involves a shift from existing conditions to a more desirable state, often with the aim of improving the well-being and quality of life of community members (Okojie and Okiy, 2020). Community transformation is a collaborative effort that requires active participation from all stakeholders, including government agencies, non-profit organisations, and community members themselves.

Leveraging the resources and services provided by public libraries, grassroots communities can empower themselves with the knowledge and skills to drive sustainable development

initiatives. Community transformation is a dynamic and multifaceted concept that encompasses various aspects of development. By actively engaging with individuals and organisations within their community, grassroots communities can work together to address social issues and create positive change.

Community transformation is an ongoing and participatory process that often requires collaboration among community members, local organisations, governments, and other stakeholders (Idhalama & Ikenwe, 2018). It involves building trust, fostering inclusivity, and promoting collective decision-making to ensure that all voices are heard and valued. Through these collaborative efforts, communities can build resilience, promote social cohesion, and achieve long-lasting impact. It involves a collective effort to identify priorities, set goals, and implement strategies that lead to positive and sustainable changes within the community.

Public libraries play a crucial role in fostering community development, providing access to information, and empowering individuals with knowledge (Kattari *et al.,* 2023). The significance of public libraries extends beyond urban areas, impacting the lives of people in rural or grassroots communities. Public libraries serve as hubs for lifelong learning, cultural enrichment, and social engagement for individuals of all ages and backgrounds. They offer resources such as books, technology, and programming that contribute to the overall well-being and education of communities. Public libraries serve as valuable community resources, offering a wide range of information resources, educational materials, and cultural enrichment opportunities. They are essential in bridging the information gap, promoting literacy, and supporting lifelong learning.

Library professionals play a major role in the advancement of users' digital literacy through the provision of Internet and Information and Communication Technology (ICT) access, as well as specialised training or formal initiatives. Libraries also offer resources such as online databases, e-books, and digital media to further enhance users' digital skills. Additionally, library staff are often trained to assist patrons in navigating the complexities of the digital world, making them valuable allies in the journey towards digital literacy. By providing access to technology and guidance on how to use it effectively. Through their commitment to digital literacy, libraries are helping individuals develop the skills needed to succeed in today's increasingly digital society.

Utilisation is the extent to which library resources and services are consulted to meet users' information and academic needs (Akanbi and Sambo, 2022). By monitoring utilisation rates, libraries can identify areas where additional support or resources may be needed to better serve their communities. Ahmed *et al.* (2020) asserted that the utilisation of information resources and services is the extent to which library resources like books and journals are exploited and used for study, teaching, learning, and research activities. Furthermore, understanding the patterns of resource usage can help libraries tailor their collections and services to better meet the needs of their users. By analysing data on as opined by, Abubakar (2017) opined that the effectiveness of the public library, to a large extent, depends on the utilisation of its resources and services, which is premised on the quality of services rendered as well as the availability and accessibility of information resources to the user community.

Statement of the Research Problem

Public libraries play a crucial role in fostering community transformation by serving as hubs for information, education and cultural enrichment. They provide access to resources that can empower individuals to pursue lifelong learning and personal growth. However, it could be

observed by the researcher that there exists a critical gap in understanding the extent to which grassroots populations access and use information resources in public libraries for community development in North-central, Nigeria. This gap in knowledge hinders the ability of individuals in the grassroot to effectively use information resources for community transformation in North-central, Nigeria. It could be observed further by the researcher that despite the potential benefits offered by public libraries towards empowering individuals especially those at the grassroot level with needed information, there are several challenges and uncertainties that need to be addressed, such as funding limitations, technological barriers and changing community needs in terms of access and use of information resources.

Objectives of the Study

The aim of the study is to examine the use of information resources in public libraries by grassroot people for community transformation in North-central, Nigeria. The specific objectives of the study were to:

a. identify available information resources for use in public libraries for community transformation in North-Central, Nigeria;

b. determine the extent of use of information resources by grassroots people in public libraries for community transformation in North-Central, Nigeria.

Literature Review

Concept of public library

The primary purposes of the public library are to provide resources and services in a variety of media to meet the needs of individuals and groups for education, information and personal development including recreation and leisure. They have an important role in the development and maintenance of a rural communities by giving the individual access to a wide and varied range of knowledge, ideas and opinions (Okojie and Okiy, 2020).

Libraries are playing a significant role in implementing and moderating a country's information society agenda (Nwankwo *et al.,* 2020). Library is the focal point of learning and research activities in academic institutions due to its indispensable information acquisition, organisation, storage, retrieval and dissemination functions to the learning community. The achievement of the goals of the university for instance, is paramount to the establishment of the university library. Librarians are at the threshold of these activities and are now faced with the emergence of information technology in the scene of information exchange. This brought new tools and techniques of acquiring and handling information. To effectively serve the academic community in the ICT environment, the librarians need to move along with the new development. Librarians are those who have the care of library and its content; the work includes selection of stock, its arrangement and exploitation in the widest sense, and the provision of a range of services in the best interest of al groups of users (Ordu & Emmanuel, 2021). They are also involved in the coordination of activities, setting of priorities, evaluation and other managerial tasks and their involvement in the community they serve facilitate sustainable development.

In the present age, besides using the new tool to fulfill the traditional roles of the library, librarians, as the managers and gate-keepers of libraries evolved some new practices in the profession (Okeji *et al.* 2020). Some of the new developments include digital environment for information acquisition, processing and dissemination. All these practices anchor on ICT. Information is now mostly in electronic format. Library services are also affected by the new format. Therefore, the new era librarians that can operate in the digital or ICT environment are

indispensible (Onah *et al.* 2015). Librarians are compelled to be content creators of information, web page planners, designers and internet navigators. As a result of the digital technology inroad into the profession, such nomenclatures as internet librarians, digital librarians, cyberians or weberians were attributed to the emerging librarians. These are librarians that have acquired the new literacy skills in the manipulation of the ICT tools for information service delivery to the library clientele. Libraries with ICT literate librarians, furnish their users with information that foster sustainable development where the users are ICT friendly.

Concept of information use

Use entails the action of making practical and effective use of something, steps to increase the use of resources, or action taken to increase the use of something. Information use is the practical and maximum use of library resources identified and acquired for the purpose of solving a problem or achieving a set goal. Information resources' use in libraries is a process comprising of initiation, selection, formulation, collection and use of information resources. It is simply the process which initiates the search and use of information resources for answering pertinent questions of great importance to the information seeker. In a similar vein, Olorunfemi and Ipadeola, (2021) asserted that use of information resources is the extent to which the resources of the library are actually used for teaching, learning and research. Also, Ibrahim and Sakiyo (2015) opined that use of information resources connotes pattern and frequency of information resources usage by the library's community of users. Therefore, information resources use is the actual putting into appropriate use of acquired information and may differ from person to person, one discipline to another, one faculty to another as well as from one corporate organisation to the other according to their information needs and other socio-economic imperatives (Olorunfemi & Ipadeola, 2021).

The use of resources is essential for the justification of the existence and survival of any library user. This is because no matter how rich a library may be in terms of resources; it is believed that if the users of the library are not aware and use the resources effectively, the acquisition of the resources is regarded as a waste. It is a known fact in this digital era that, any library user at the higher level who intends to do better or go further in academics should have the ability to explore the resources of the library. The major objectives of any library are to ensure that maximum use is made of its resources and services. Yebowaah (2017) stated that users' ability to find and retrieve information effectively is a transferable skill useful for their future life as well as enabling the positive and successful use of the resources while at school. Information resources use serve as a motivating factor to library users as it provides them opportunity to transmit, acquire or download, process and disseminate information on a subject of interest (Urhiewhu e*t al.*, 2015).

Relevance of public library to community transformation

Unobe (2019) defines library is an institution equipped with treasures of knowledge maintained, organised and managed by trained personnel to educate the children, men and women continuously and assist in their self-improvement through an effective and prompt dissemination of information embodied in the resources. There are different types of library and they play vital role in national development. National library, Academic Library and Public Library, special library, school library. A library is an instrument of self-education, a means of knowledge and factual information, a centre of intellectual recreations and a beacon of enlightenment that provides accumulated preserved knowledge of civilization which consequently enriches one's mental vision and dignifies his habit, behaviour, character, taste, attitude, conduct and outlook on life.

According to Zhao *et al.* (2022) public library is an institution which offers to people free access to information. To a large extent it is related to the principle of access. The role of the public library is linked to national development through providing knowledge that is critical in shaping the community, developing workforce capacity and improving early literacy as well as school readiness. The public library has been identified as a natural partner in promoting economic development. Further contribution by Mansour (2020) is that libraries are the corner stone of democracy in communities because they assist the public in locating diversity of resources and in developing the information literacy skills necessary to become responsible, informed citizen who can participate in democracy. Adeniji and Adeniran (2020) attests to the fact that economic growth is not possible without extensive use of scientific and technical know-how embodied in books, and other mediums access to right book or information at the right time for scientist, engineer or agronomist could have multiplier effect on the economy. It is at this juncture that the role of libraries becomes a cornerstone for development by collecting knowledge valuable to the engineers, entrepreneurs and scientist alike.

Libraries as a Tool for Educational Development Libraries are viewed as an important component of the massive educational effort of the Federal Government of Nigeria, without the library no meaningful academic achievement can be realized. Library services improve knowledge and skills for positive productivity as a tool for national development. If education is to have a greater share in the moulding and building of a happier individual and a better society, the providers of education must go further than their roles as literacy facilitators to a more practical role of providing libraries for sustaining the newly acquired skills of learners. Organizing a library to aid education calls for an atmosphere of friendliness and useful collection. For example parts of goals of learning in higher institution in Nigeria are: contribution to national development through high level relevant manpower training; development and inculcation proper values for the survival of the individual and society; and developing the intellectual capability of individuals to understand and appreciate their local and external environments.

Methodology

Survey research design was adopted for this study. The descriptive survey approach for the study served as a means of providing basic information in the area of study. Sharma (2017) posited that descriptive survey research method deals with describing the situation of a given population using some characteristics or features common to them. The population of the study was 198 which consisted of all librarians in public libraries in North-Central, Nigeria. The researcher adopted census sampling technique to cover the entire population of library staff in the State public libraries. This is because the population size of librarians in all the State public libraries in North-Central, Nigeria is manageable. The research instruments used for collecting data for the study were questionnaire and checklist. Data collected from the responses to the questionnaire items were analysed and presented using descriptive statistic, such as frequencies, mean and standard deviation.

Result and Discussions

Table 1: Information Resources Available for Use in Public Libraries for Community Transformation

Information Resources	Name of Public Libraries													
	Abuja Public Library, Wuse		Benue State Public Library		Kogi State Public Library		Kwara State Public Library		Nasarawa State Public Library		Niger State Public Library		Plateau State Public Library	
	AV	**NA**	**AV**	**NA**	**AV**	**NA**	**AV**	**NA**	**AV**	**NA**	**AV**	**NA**	**AV**	**NA**
Library catalogue	√		√		√		√		√		√		√	
Indexes	√		√		√		√		√		√		√	
Bibliography	√		√		√		√		√		√		√	
Abstracts	√		√		√		√		√		√		√	
Text Books	√		√		√		√		√		√		√	
Journals	√		√		√		√		√		√		√	
Encyclopaedia	√			X		X	√		√		√		√	
Electronic resources	√			X		X	√			X		X	√	
Cartographic sources	√			X		X		X		X		X		X
Monograph	√		√		√		√		√		√		√	

Key: Available (√), Not Available (x)

The result in Table 1 showed the information resources available and those not available for community transformation in the public libraries in North-central, Nigeria. Seven (7) of the public libraries had library catalogue, indexes, bibliography, abstracts, textbooks, journals and monographs, while encyclopaedia were available in only four (4) public libraries (Abuja, Kwara, Nasarawa, Niger and Plateau) respectively. Similarly, three (3) public libraries (Abuja, Kwara and Plateau) had electronic resources. On the other hand, cartographic resources were not available in six (6) public libraries (Benue, Kogi, Kwara, Nasarawa, Niger and Plateau).

Table 42: Extent of Use of Information Resources by Grassroots People for Community Transformation

S/N	Statements	VH	H	L	VL	n	FX	$\bar{x}$	STD	Decision
		4	**3**	**2**	**1**	**174**				
1	The grassroot people use books in both print and electronic format for community transformation	85	61	24	4	174	575	3.30	0.80	High
2	The grassroot people use journals article for self-development and community transformation	75	71	18	10	174	559	3.21	0.71	High
3	The grassroot people use dictionaries through consultation for knowledge development and community transformation	54	69	29	22	174	503	2.89	0.39	High
4	The grass root people use encyclopaedia for community transformation	32	47	50	45	174	414	2.38	0.12	Low
5	The grass root people use newspapers for social and economic development	80	53	21	20	174	541	3.11	0.61	High
6	The grass root people use abstracts for community transformation	21	37	69	47	174	380	2.18	0.32	Low
7	The grass root people use indexes for easy retrieval of information resources pertinent to community transformation	17	32	63	62	174	352	2.02	0.48	Low
8	The grass root people use manuscripts for community transformation	83	47	28	16	174	545	3.13	0.63	High
9	The grass root people use available magazines for self and community development	19	36	53	66	174	356	2.05	0.45	Low
10	The grass root people do not use maps for community development	36	44	56	38	174	426	2.45	0.05	Low
	Weighted mean							**2.67**		

Key: Very High (VH), High (H), Low (LE), Very Low (VL), n = Number of Retrieved Copies of Questionnaire, $\bar{X}$=Mean and (Weighted mean = 2.67)

Table 4.5 showed the extent of use of information resources by grassroots people for community transformation. Out of the ten items listed, five items listed produced high mean scores which were above the weighted mean of 2.67. These items include item 1: The grass root people use books in both print and electronic format for community transformation (x□=3.30; SD=0.80), item 2: The grass root people use journals article for self-development and community transformation (x□=3.21; SD=0.71), item 8: The grass root people use manuscripts for community transformation (x□=3.13; SD=0.63), item 5: The grass root people use newspapers for social and economic development (x□=3.11; SD=0.61) and item 3: The grass root people use dictionaries through consultation for knowledge development and community transformation (x□=2.89; SD=0.39). Similarly, five other times produced low mean scores which were below the weighted mean of 2.67. These items include item 10: The grass root people do not use maps for community development (x□=2.45; SD=0.05), item 4:

The grass root people use encyclopaedia for community transformation (x□=2.38; SD=0.12), item 6: The grass root people use abstracts for community transformation (x□=2.18; SD=0.32), item 9: The grass root people use available magazines for self and community development (x□=2.05; SD=0.45) and item 7: The grass root people use indexes for easy retrieval of information resources pertinent to community transformation (x□=2.02; SD=0.48).

The weighted mean of 2.67 and above is considered as the mean rate of the extent of use of information resources by grassroots people for community transformation, while the weighted mean below 2.67 is not considered as the extent of use of information resources by grassroots people for community transformation. Above all, the highest mean score was discovered from item 1 on the grass root people use books in both print and electronic format for community transformation. This is not far from the fact that books both in print and electronic are easily access by users in satisfying their information needs. From the analysis, the study revealed that item 1, 2, 3, 5 and 8 were rated high, while item 4, 6, 7 and 10 were rated low by the respondents as extent of use of information resources by grassroots people for community transformation.

Conclusion

In conclusion, this study has demonstrated that public libraries in North-central, Nigeria have the potential to play a significant role in community transformation through the use of information resources by grassroot people. By harnessing the power of information, grassroots people can become active agents of change, driving development and improving the quality of life in their communities.

Recommendations

The following recommendations are made based on the findings of the study.

1. The management of public libraries in North-central, Nigeria should acquire adequate information resources and subscribe to relevant online databases and e-book platforms offering access to academic journals, research papers and informative books for community transformation.

2. The management of public libraries in North-central, Nigeria should conduct outreach programmes to raise awareness about available information resources and their benefits for community transformation. They should also collaborate with local organisations, community groups and stakeholders to promote information resource use.

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SURVEY ON THE LEVEL OF INTERNET ADDICTION AMONG SCIENCE EDUCATION STUDENTS IN FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE.

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Abstract
The study is to examine the level of internet addiction among Science Education Students in FUT Minna. The objectives of this study are to examine the level of internet addiction among Science Education Students in FUT Minna, examine the difference in the level of male and female Science Education Students' internet addiction and determine the difference in the level of Science Education Students' internet addiction in FUT Minna based on parental occupation. The study was guided by three research questions and two hypotheses. The research adopted the descriptive survey research design. Population of the study comprise of 525; from 100 level-500 level students of Science Education. One hundred and twenty (120) questionnaires were distributed base on Krejce and Morgan (1970) sample size determination. Data collected was analyzed using descriptive and inferential statistics. From the findings, it was discovered that the level of internet addiction among Science Education students is high. Furthermore the male students have a higher mean rank of 61.21 compared to the female students having 59.47. Consequently, the students whose parental occupations is entrepreneur have a mean rank of 60.96 compared to the students whose parental occupation is civil servants, having a mean rank of 59.92*. The result found that there is no predominance in the internet addiction between male and female Science Education Students (*2914.000*, p =*.78*) and the difference in the internet addiction of science education students based on parental occupation was statistically insignificant at U* 1744.500*P = .87. After data analysis on the level of internet addiction, it was shown that the statistical population was at risk of internet addiction. Hence, it is recommended that special training and entertainment plans are developed so that their internet use is reduced.*

Keyword: *internet addiction, science education students, gender, and parental occupation.*

Introduction
The digital revolution has transformed the way we live, learn, and interact with the world. With just a few clicks, we can access a vast ocean of information, connect with people across continents, and engage in various online activities. However, this technological marvel has brought about a concerning phenomenon that demands our attention - internet addiction. According to Venuleo *et al.* (2016), addiction is a strong and harmful need to regularly do something (such as gamble) or engage in certain activities. In the research paper on the prevalence and forms of internet addiction, Mustapha and Muhammed (2017), defined internet addiction as a compulsive need for and use of internet to play games, watch pornography or shop online which may impact the user in several harmful ways such as loss of money, sleep or productivity, with such individuals experiencing security, peace, success, attachment, and intimacy even if they are temporary and artificial.

In recent years, internet usage has experienced a remarkable surge globally, with billions of people connecting to the online world. Nigeria, as a leading country in Africa, has witnessed significant growth in internet penetration due to improved infrastructure and increased availability of affordable devices and internet services. According to Statista, the internet penetration rate in Nigeria was 51% as at January 2022, meaning that about half of the total

population used the internet. Among various demographics, students have embraced the internet as an essential tool for academic pursuits, communication, and social interaction. However, according to Yusuf *et al*. (2020), the increasing prevalence of internet usage among students also raises concerns about the potential negative consequences of excessive and unregulated internet use, such as poor grades and negligence to studies. Several researchers have studied internet addiction and its effects on students 'characteristics, but more is needed to be known about the problem in Nigeria (Afolabi *et al.*, 2022) Oyinvwi and Ojimaoyo, 2021, and Olatoke *et al.*, 2023). According to Buhari (2013), the internet provides numerous benefits to students, such as access to educational resources, global connectivity, communication and social interaction, entertainment and recreational activities as well as the convenience and efficiency it offers to various tasks, it is crucial to understand the implications of extensive internet usage among students. In a study carried out by Samaha and Hawi (2016), the reliance on the internet for academic and social purposes can have both positive and negative impacts on students' well-being and academic performance. Therefore, exploring these implications is vital to ensure a balanced approach that maximizes the benefits while mitigating the potential risks associated with internet usage among Science Education Students. Internet usage patterns among students are diverse and multifaceted. Some students prioritize educational purposes, utilizing the internet for e-learning, research, and academic collaboration. Others are more inclined towards recreational activities, such as online gaming, video streaming, and social media engagement. These patterns vary based on individual preferences, academic demands, and personal interests. However, an important aspect to consider is the potential dependency and habitual behavior that can emerge from internet usage among students. The ease of access and the appeal of online platforms may lead to the development of routines or rituals around internet use, posing challenges in managing time and maintaining a healthy balance between online and offline activities.

Understanding these internet usage patterns is crucial for educators, parents, and policymakers. It enables the development of strategies and interventions that promote responsible internet use, enhance digital literacy skills, and address potential risks associated with excessive or problematic internet use among students. By recognizing and addressing these patterns, stakeholders can support students in maximizing the benefits of the internet while mitigating potential negative consequences.

As students increasingly rely on the internet in their daily lives, it is important to consider the potential implications of extensive internet usage. While the internet offers numerous benefits, it also brings forth certain challenges and risks that can impact students' well-being, academic performance, and overall development, while exploring the potential effects of excessive internet use on students in FUT Minna, Niger State. By understanding these implications, we can develop strategies and interventions to promote responsible internet use and support students in harnessing the benefits of the online world while mitigating any negative consequences.

Statement of Problem

There has been a considerable increase of internet users worldwide in the last decade. Students use the internet due to their educational research needs. The rate and type of the internet use may affect their information-seeking behavior. The excessive use of the internet causes dangers in the improper use of it. Its addiction may have serious consequences such as changing the lifestyle in order to spend more time on the internet, ignoring the health and main activities, ignoring family and friends, and finally educational and physical problems such as Carpal Tunnel Syndrome (Pain and numbness in hands and wrists), dry eyes or strained vision,

backaches and neck aches; severe headaches, sleep disturbance and pronounced weight gain or weight loss. Tak and Catsambis (2023), observed that children spend more time watching television and movies, playing video games and surfing the Internet than they spend in school per year. Singh and Barmola (2015)**,** reported that the students who were in the severe and profound groups of internet addiction were found to have detrimental effects on both in their academic performance and mental health rather than the students who were addicted to the internet usage moderately. Hence, this research work seeks to survey the level of internet addiction among Science Education Students in FUT Minna Niger State.

Aim and Objectives of the Study

The aim of this study is to examine the level of internet addiction among Science Education Students in FUT Minna.

The study objectives are to;

1. assess the level of internet addiction among Science Education Students in FUT Minna.
2. examine the difference in the level of male and female Science Education students' internet addiction in FUT Minna.
3. determine the difference in the level of Science Education Students' internet addiction in FUT Minna based on parental occupation.

Research Questions

1. What is the level of internet addiction among Science Education Students in FUT Minna?
2. What is the difference in the level of male and female Science students' internet addiction in FUT Minna, Niger State?
3. What is the difference in the level of Science Education students' internet addiction in FUT Minna, based on parental occupation?

Research Hypotheses

$H0_1$. There is no significant differences in the internet addiction among male and female students in Science Education FUT Minna

$H0_2$. There is no significant difference in the internet addiction between students in Science Education FUT Minna based on parental occupation.

Research Methodology

Research Design

The research design used in this study is descriptive survey research design. Survey method was used because it enabled the researcher to gather large amount of information which focused on internet addiction among Science Education Students in FUT Minna Niger State.

Population of the Study

The population of the study comprises of all the 525 undergraduate students for the 2022/2023 academic session of the department of Science Education, Federal University of Technology Minna, Niger State.

Summary of Population 2022/2023 Academic Session

LEVEL	MALE	FEMALE	TOTAL
100	74	53	127
200	64	50	114

300	64	51	115
400	66	35	101
500	36	32	68
TOTAL	304	221	525

Sample and Sampling Techniques

The sample size for this study is one hundred and twenty (120) students from Science Education. Dependent with the aid of Sample Advisor at 3% confidence interval from 500-100 levels. The 120 students will be selected via stratified sampling technique which will allow representation at all levels.

Research Instrument

A well-structured questionnaire was used as the research instrument. The researcher designed the questionnaire on Internet Addiction which was tagged as Internet Addiction Questionnaire (IAQ). The questionnaire consisted of Section A and B. Section A has to do with the demographic information about the respondents. Sections B consist of twenty (20) items that examines internet usage, symptoms of addiction, distractions from daily routines and health challenges, having Always, Often, Sometimes, Rarely and Never as well as the type of scale to be used. On a likert scale of 5-1.

Validity of the Research Instrument

In order to determine the appropriateness, content coverage, in terms of accountability, adequacy and relevance to the stated objectives, the questionnaire IAQ was validated by two (2) experts; from Science Education Department and from the Department of Educational Technology, Federal University of Technology Minna. Their comments, suggestions and corrections was used to produce the final copy of the instrument that was used for this research.

Reliability of the Instrument

The reliability of the instrument was determined by carrying out a pilot study on College of Education (COE) students, Minna Niger State, who were not part of the main study. The reliability analysis was calculated using crobach alpha method of internal consistency to ascertain the reliability of the instrument, which check showed the reliability coefficient of 0.80.

Method of Data Collection

The researcher gained access by obtaining a letter of introduction from the department which was given to the authorities of the sampled institutions. Two research assistants were employed for the exercise. The researcher who administered the questionnaires to the respondents waited for the retrieval of the questionnaires in order to ensure compliance and return of all the copies of instruments that was administered. There is high return-rate of one hundred percent (100%) of the questionnaires.

Method of Data Analysis

The data obtained was analyzed using descriptive and inferential statistics. Mean and standard deviation to answer the research questions. For hypotheses testing, Mam Whitney U-test was used with the aid of statistical package for social sciences (SPSS version 23.0). All hypotheses were tested at 0.05 level of significance.

Results and Analysis

Research Question 1: What is the level of internet addiction among Science Education Students in FUT Minna?

Table 1: Analysis of result on the level of internet addiction among Science Education Students in FUT Minna.

S/NO	ITEMS	MEAN	SD	REMARK
1.	How frequently do you feel restless, anxious, or distressed when you are unable to access the internet for an extended period of time?	3.73	1.13	Addicted
2.	To what extent do you feel bored while you are not using an internet device?	3.57	1.12	Addicted
3.	How frequently do you experience negative consequences (e.g. poor performance, health problems) as a result of excessive internet use?	2.36	1.18	Not Addicted
4.	How frequently does spending time on the internet distract you from your academic responsibilities (e.g., assignments, studying)?	3.03	1.20	Addicted
5.	How frequently do you fear that life without the internet would be boring, empty, and joyless?	3.63	1.26	Addicted
6.	How frequently do you lose sleep due to over-browsing, chatting, etc.?	3.17	1.19	Addicted
7.	How frequently do you feel disturbed or annoyed if someone bothers you while you are online?	3.11	1.20	Addicted
8.	How frequently do others in your life complain to you about the amount of time you spend online?	3.02	1.23	Addicted
9.	How frequently do you experience headaches or eye strain as a result of the amount of time spent on the internet?	2.95	1.24	Not Addicted
10.	How frequently do you find it difficult to control the amount of time you spend on the internet?	3.10	1.27	Addicted
11.	To what extent do you use severe social media?	3.72	1.13	Addicted
12.	To what extent do you feel isolated from people due to the constant use of the internet?	2.95	1.18	Not Addicted
13.	To what extent do you subscribe to online programs?	3.54	1.18	Addicted
14.	How frequently do you subscribe to unlimited data plans?	3.32	1.30	Addicted

15.	To what extent do you upgrade your mobile devices to access the internet?	3.79	1.14	Addicted
16.	How frequently do you use the internet mainly for socializing and entertainment (e.g., social media, streaming, and gaming)?	3.88	1.15	Addicted
17.	How frequently do you feel pressured to present a certain picture or persona on social media?	2.97	1.22	Not Addicted
18.	How many hours per day do you spend on the internet for online gaming or other forms of digital entertainment?	2.83	1.42	Not Addicted
19.	How many hours per day do you spend on the Internet for academic purposes?	2.78	1.07	Not Addicted
20.	How many hours per day do you spend on social media platforms chatting?	2.84	1.30	Not Addicted
21.	How many days per week do you engage in excessive internet usage?	3.71	1.43	Addicted
	GRAND MEAN	**3.23**	**1.21**	**Addicted**

Table 1 shows the mean response of the level of internet addiction among Science Education Students in FUT Minna. The grand mean response to all statement is 3.23, with standard deviation of 1.21 considering the bench mark of 3.00. From the findings in the table, it can be seen that majority of the science education students are highly addicted to the internet.

Research Question 2: What is the difference in the level of male and female Science students' internet addiction in FUT Minna, Niger State?

Table 2: Analysis on difference in the internet addiction between male and female students in Science Education.

Rank	GENDER	N	Mean Rank
Addiction	Male	71	61.21
	Female	49	59.47
	Total	120	

Based on gender, Table 2 presents the result on Mann- Whitney ranking of the difference between male and female internet addiction. Analysis revealed that the male students have the highest mean rank of 61.21 compared to the female students having the mean rank of 59.47.

4. **Research Question 3**: What is the difference in the level of Science Education students' internet addiction in FUT Minna, based on parental occupation?

Table 3: Analysis on the difference in the internet addiction of Science Education students in FUT Minna, based on parental occupation.

Rank	PO	N	Mean Rank
Addiction	Civil Servant	53	59.92
	Entrepreneur	67	60.96
	Total	120	

Based on parental occupation, Table 3 presents the result on Mann- Whitney ranking of the difference in the internet addiction among Science Education students. Analysis revealed that students whose parents are in the category of the entrepreneur have the highest mean rank of 60.96 compared students whose parents are in the category of civil servants, having the mean rank of 59.92.

Testing of Hypotheses

Hypotheses 1: There is no significant differences in the internet addiction among male and female students in Science Education FUT Minna

Table 1: Mann-Whitney Test of difference in the internet addiction between male and female students in Science Education FUT Minna, Niger State

Ranks	GENDER	N	Mean Rank	Sum of Ranks	Mann-Whitney U	P
Addiction	Male	71	61.21	4346.00	2914.000	.787*
	Female	49	59.47	2914.00		
	Total	120				

***Insignificant**

Table 1 above presents the Mann-Whitney Test of the differences in internet addiction based on gender. The results indicates that U-test (71, 49) = 2914.000, P> 0.05, hence the null hypothesis was accepted. This indicates that there is no predominance in internet addiction based on gender.

Hypotheses 2: There is no significant difference in the internet addiction between students in Science Education FUT Minna based on parental occupation.

Table 2: Mann-Whitney Test of Internet addiction based on Parental Occupation.

Ranks	PO	N	Mean Rank	Sum of Ranks	Mann- Whitney U	P
Addiction	Civil Servant	53	59.92	3175.50	1744.500	.870*
	Entrepreneur	67	60.96	4084.50		
	Total	120				

* **Insignificant**

Table 2 above presents the Mann-Whitney Test of the differences in internet addiction based on parental occupation. The results indicates that U-test (53, 67) = 1744.500, P> 0.05, hence the null hypothesis was accepted. This implies that there was no significant difference in the internet addiction of science education students based on parental occupation, which indicates that students whose parents are in the category of either civil servants or entrepreneurs can have access to android phones as well as the internet.

Discussion of Findings

Internet addiction levels of science education students were found to be highly addictive as seen in the mean scores of the students. It has also been determined by the tables that there was no significant difference between male and female and also there was no significant difference

in the internet addiction based on parental occupation. University students are frequently viewed by the professional public as one of the most vulnerable demographic groups. This high susceptibility is often attributed to their constant access to the internet, adaptable daily schedules, and the fact that upon entering university, they often find themselves in a new environment without their previous social connections, prompting the development of new relationships and social statuses—a process significantly facilitated by the Internet (Chraska, 2019). Moreover, the internet serves as an ubiquitous tool deeply integrated into daily routines, notably prevalent among student populations (Rahmani *et al.,* 2022). The study indicates that due to the widespread availability of the internet across society, it unveils a statistically insignificant difference between internet addiction (IA) and parents' socioeconomic status. This finding aligns with the results of previous research conducted in Turkish and Iranian contexts, which also observed that socioeconomic status had no discernible impact on internet addiction (Karaca *et al.,* 2021; Yasmeen *et al.,* 2022).

Some studies have suggested notable gender disparities in Internet addiction, with male respondents demonstrating a significantly higher propensity for Internet addiction compared to their female counterparts (Nduanya *et al.,* 2018; Shahnaz and Karim, 2014). However, it's important to note that other research contradicts these findings, Dufour *et al.,* (2016) in his research work stated that, there was no significant difference between genders with regard to the proportion who were considered at risk of internet addiction problem no matter which cut-off point was employed. To address this inconsistency, a meta-analysis on gender differences in Internet addiction was conducted by Sua *et al.,* (2019), this meta-analysis covered a wide range of geographical regions and the analysis revealed that the average effect size was relatively small. However, when considering individual nations, social norms and Internet penetration emerged as associated factors for these gender differences in Internet addiction.

Conclusion

According to certain authors (Hayat *et al.,* 2020), excessive internet dependency can result in adverse outcomes for students, particularly concerning their academic pursuits. The overuse of the internet has emerged as a prominent issue in contemporary society, leading to both physical and mental detriments. This review paper reveals that the internet has evolved into a crucial information source for students, with a profound impact. It leads to numerous disruptions in academic performance, social relationships, emotional well-being, and more. Thus, it is imperative to regulate internet usage and explore treatment methods for internet addiction.

Recommendation

Based on the findings, the following recommendations were made:

1. School administrators and policymakers should organize conferences, workshops, and seminars to enlighten students about the importance of obtaining realistic, objective self-assessments.

2. School counselors should lead initiatives to raise awareness among students regarding the detrimental effects of excessive internet usage.

3. It is recommended that students who have internet addiction are appropriately treated by family and school so that they can come back to the normal life.

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THE ROLE OF AI IN EMBEDDED LEARNING PEDAGOGY FOR ECONOMIC DEVELOPMENT: EVALUATING ENTREPRENEURIAL READINESS OF SECONDARY SCHOOL TEACHERS IN ABUJA

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Abstract
This paper analyzed the application of artificial intelligence in embedded learning methods within secondary school teachers in Abuja, focusing on the edupreneurial readiness among educators to implement AI-driven pedagogical methods. Descriptive and analytical statistical tools in Google Forms were used to survey the opinions of 80 willing teachers. Bar graphs, pie charts, and percentages were used to analyze generated data, and their salient insights were discussed. Critical challenges that hinder the efficient adoption of AI-embedded learning identified include inadequate infrastructure, such as unreliable electricity supply, which disrupts the use of AI tools; insufficient access to computers and smart devices, limiting the technology available for teachers and students; and unreliable internet connectivity. Furthermore, the lack of comprehensive training programs for teachers results in a skills gap, leaving many educators unprepared to utilize AI effectively in their classrooms. Providing these resources alongside contextualized policies by the Nigerian government will enhance the role of AI in our secondary schools for economic development.

Keywords: Artificial intelligence, Secondary school, Education, Pedagogy, Economic development.

Background of the Study
Artificial intelligence (AI) means machines capable of mimicking human thinking, reasoning, and in ways, thus mimicking the intelligence of mankind. Kamalov et al. (2023). As the Nigerian economy struggles to regain its lost glory of economic strength and development, the integration of AI becomes a strategic option in the right direction to equip teachers with the current necessary edupreneurship mindset with which they will nurture students who will make up tomorrow's workforce for economic development. The popularity of AI and its applications to various aspects of human endeavors has ignited lots of discussion (Antonenko and Abramowitz 2022). Education policymakers, researchers, and practitioners, primarily in advanced countries like North America and Europe, generally agree that secondary education is an important stage in the development of a child (Miao and Shiohira, 2022). Therefore, several policymakers and educators strongly submit that adequate professional development can help teachers transmit the literacy of AI applications to secondary school education. To promote AI literacy, Ajani, O. A. (2023) opined that African stakeholders and policymakers should implement effective Professional Development (PD) programs for teachers and teacher training. In Nigeria, there are ongoing policy discussions about the strategic development of teachers with advanced AI tools and skills to meet the needs of secondary education (Ayanwale et al., 2022; Ogbonnia, 2017).

Statement of the Problem
Nigeria needs to effectively integrate AI into the national education curriculum (Endurance, A., *et al*) Recently, the Nigerian government established an AI center and introduced a grant to promote AI literacy; however, it is not targeted at secondary school students. Professional

development (PD) programs are essential for experts and teachers. Studies reveal that many teachers in public secondary schools do not have sufficient or lack the AI literacy skills necessary for 21st-century pedagogy (Shafie, H., *et al., 2019*). A key reason identified is the shortage of professionals with expertise in teaching AI to secondary school students. This study therefore investigates the current need for AI and the entrepreneurial readiness of teachers in Abuja public secondary schools to identify policy needs to drive AI literacy for economic development.

Aims and Objective of the study

This study aim to examine the role of artificial intelligence (AI) in embedded learning pedagogy for enhancing economic development of Nigeria. The specific objectives are to:

1. Assess the current level of AI literacy and integration in the teaching practices of secondary school teachers in Abuja.
2. Evaluate the entrepreneurial readiness of secondary school teachers to adopt AI-based embedded teaching for learning that will foster economic development
3. Identify the challenges and opportunities of AI pedagogy to foster entrepreneurial skills among teachers and to provide recommendations for professional development among teachers in Abuja.

Research Questions

1. What is the level of familiarity with AI technologies among secondary school teachers in Abuja?
2. How do teachers in secondary school perceive the effectiveness of AI tools in enhancing student learning outcomes and engagement?
3. What training do secondary school teachers in Abuja believe is necessary for effectively integrating AI into their teaching for economic development?
4. What challenges do secondary school teachers face when integrating AI into their teaching practices?

Literature Review

AI Embedded Edupreneurship Education as a Catalyst for Economic Development

Artificial Intelligence (AI) is rapidly emerging as a transformative catalyst for economic development, particularly through educational pedagogy in secondary schools. (Olatunde-Aiyedun, 2024). That AI has begun to gain popularity in Nigeria is noted by Ogbonnia (2017), he revealed that the 1990s and 2000s witnessed the emergence of several ideas and policies to integrate AI into STEM curricula for secondary school education. Hence, Oyelere *et al.*, (2022) argue that teachers need to be motivated to adopt the use of AI to achieving Sustainable Development Goal 4, of equitable, quality education for all. (UNESCO. Artificial intelligence in education. https://www.unesco.org/en/digital-education/artificial-intelligence). Edupreneurship conveys the connection between education and entrepreneurial skills. Akgün, E., and Farina, İ. A. (2022) emphasized the need for teachers to prepare students for learning outcome achievement through critical thinking, and innovations. Edupreneurship empowers teachers to engender; Project-Based Learning (PBL), and real-world projects pedagogy, helping students solve community issues (Taliak, *et al.,* 2022)

Theoritical Framework

Entrepreneurial Orientation (EO) was developed by Danny Miller in 1983 to explain how firms engage in entrepreneurial endeavors, with a focus on innovation, risk-taking, and provocativeness. Later other scholars like Covin and Slevin (1989) enlarged the framework.

Entrepreneurial orientation is needed to foster an edupreneurial mindset. This is apt for this study because "no nation cannot grow beyond its educational standard". The combination of Entrepreneurial Orientation and AI skills will position educators to equip students with the skills for economic development.

Factors that Motivate Teachers Toward AI Orientation and Adoption

i. Awareness: This refers to how well secondary school teachers recognize their expected roles in this AI era. Casal-Otero et al. (2023) noted that AI cognition, can affect teachers' profession.

ii. **Interest and Readiness:** Teachers interest and readiness to learn and teach with AI is necessary for continuous reforms. are necessary in African countries, to enhance readiness of teachers for AI-embedded pedagogy (Pang, et al 2024).

iii. Competence and Capability: Teachers in secondary school need to learn and develop their competence and capability to integrate AI technologies for solution to pedagogical challenges in their classes (Haliru, & Nura, 2022).

iv. Attitude and Perspective: Secondary school teachers' attitude must be positive toward the immense benefits and cost-effectiveness of deploying the now globally accentuated AI methodologies (Schiff, 2022).

Conceptual Clarification

Artificial (AI) in Nigeria Secondary Education

Secondary school education in Nigeria is encouraged especially between ages 5-15, it covers six years of post-primary school education, with three years of junior secondary and three years of senior secondary schools. Instruction is typically delivered in English language or a local language for indigenous subjects like hausa, igbo, yoruba etc. AI in Nigeria education is gradually emerging as Cleopas, 2023-pointed, AI literacy is becoming a trend for students to navigate a world dominated by data-driven decision-making, and automated technology. Jacob, and Josiah, (2021). affirmed, that Nigeria secondary schools, especially in rural areas, are under-funded and affected by infrastructural deficit. AI in Nigeria is still exposed to challenges. The Nigerian Ministry of Education in 2021, fronted policy discussions about AI-related subjects in Science Technology, Engineering, and Mathematics (STEM), but more still to be done (UBEC, 2023; NITDA, 2021).

Obstacles to Incorporating Generative AI into Nigerian Digital Education Initiatives

There have been several studies on the problems of integrating AI embedded technologies into the Nigeria educational space. With reference to secondary school, Adigun and Igboechesi (2024), identified these challenges:

i. Infrastructure Deficit: Power supply has been epileptic and inadequate to secondary schools in Nigeria. Inadequate access to reliable internet connectivity, insufficient softwares and hardwares.

ii. Constraints of Financial Resources: Secondary schools do not get the much-needed budget and funding for financing AI the purchase of AI resources.

iii. Technical Skills Gap: Many teachers especially in rural areas are not technologically savvy, hence there are shortage of educators proficient in AI and its supportive technologies.

iv. Curriculum Development: The curriculum in secondary schools does not recognize up-to-date AI educational resources.

v. Limited Access to Training: Inadequate opportunities at home and abroad for Nigerian teachers to train for proficiency enough at implementing AI-embedded pedagogy.

Research Design

A mixed-methods approach was adopted. Quantitative and Qualitative data were gathered through Google Forms and generated responses were statistically analyzed.

Graphical Overview of Respondents' Data and Analysis

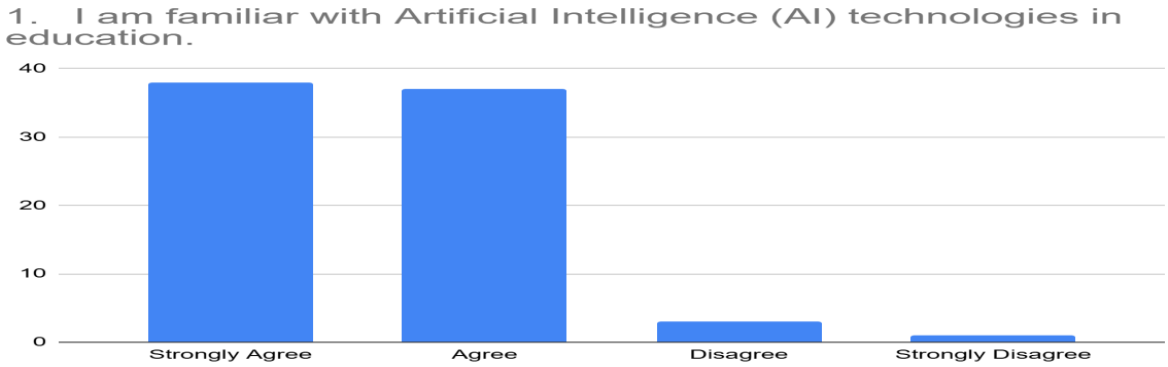

Fig 1. Bar chart of familiarity with AI level of respondents

The responses reveal a high level of familiarity with AI technology in education, with a highly significant combined total of 77 Strongly Agree and Agree (i.e 95.1%).

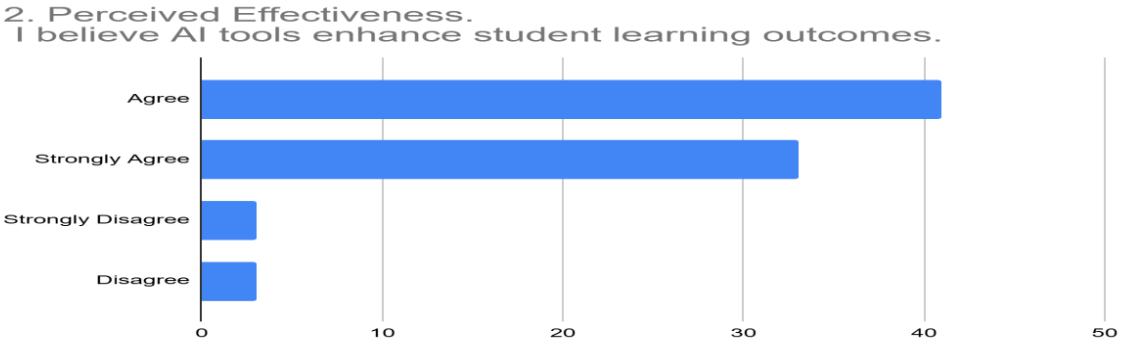

Fig 2. Level of Perceived Effectiveness of AI to Enhance Learning outcome

A significant 93.75% (41 Strongly Agree and 34 Agree) of the respondents strongly maintained that AI is effectiveness tools to engaging and enhancing student's learning outcome.

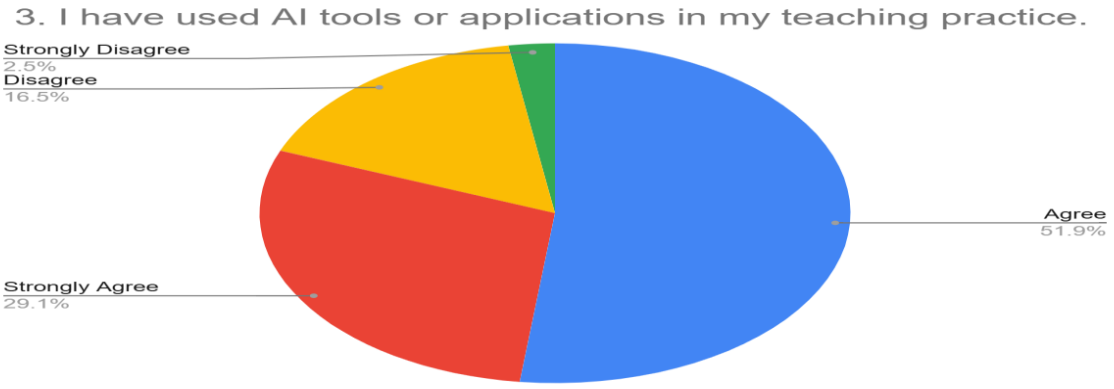

Fig 3. Pie chart of Response to Application of AI in Secondary school Teaching
The high level of readiness to formally adopt AI in secondary school teaching is obvious in the combined total of 81% respondents (29.1% Strongly Agree + 51.9% Agree) that have utilized AI applications in their teaching.

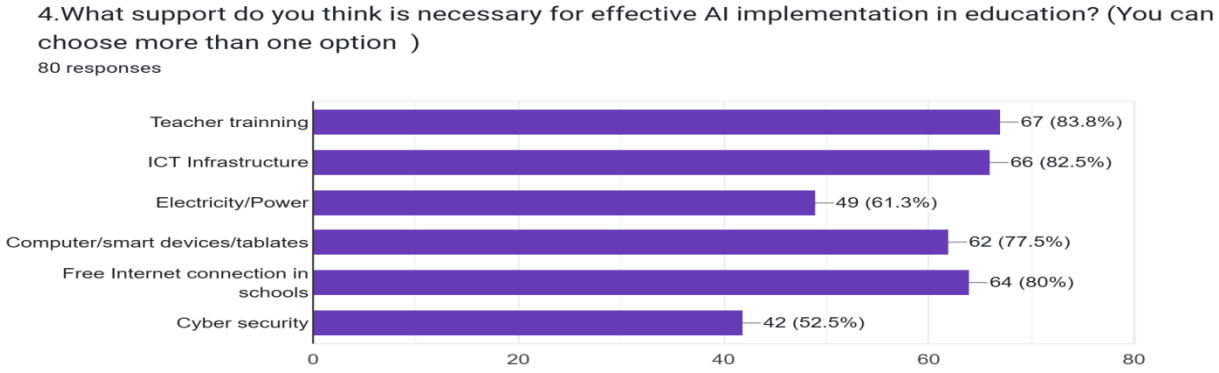

Fig 4. Graph of Support Required (due to challenges) for AI integration.
Bar chart above reveals various supports respondents believe are essential for effective AI integration in secondary schools. Most frequently identified are: Teacher training, at 83.8%, ICT infrastructure 82.5, and Internet connections availability 80%, among others.

Summary and Discussion of Research Questions with Findings
This study investigated the role of artificial intelligence in embedded learning pedagogy and its implication for economic development, focusing on the entrepreneurial readiness of secondary school teachers in Abuja. The findings alongside research questions are discussed below:

Research Question 1: What is the level of familiarity with AI technology among secondary school teacher in Abuja? A remarkable 95.1% are found to be already familiar with AI technology, a strong base line awareness in teachers already with edupreneurial mindset which is essential for AI embedded teaching.

Research Question 2: How do secondary school teachers perceive the effectiveness of AI tools in enhancing student learning outcome and engagement? The positively significant 93.75% opinion of respondents reveal a positive perception of AI tools as effective for improving the learning outcomes of students. This highlights the confidence in the prospect of AI for economic development.

Research Question 3: What type of training do secondary school teachers in Abuja believe is necessary for effective integration of AI into their teaching for economic development? An overwhelming 83.8% of teachers expressed the need for Professional Teacher training focused on AI integration, and 82.5 accentuated need for ICT infrastructure to integrate AI pedagogy, and 80%-pointed need for internet access at secondary schools.

Research Question 4: What challenges do secondary school teachers face when integrating AI into their teaching practices? All respondents as substantiated above, acknowledged challenges of inadequate professional development training for teachers, computers, electricity, cyber security, as hindering effective AI integration.

Conclusion

The findings indicate that enhancing AI literacy among teachers is vital for preparing students for a technological-driven economy. By integrating AI into the curriculum, teachers can foster edupreneurial skills essential for 21st-century economic development The study emphasized the need for teachers to be abreast with the tools and knowledge to create a workforce that is dynamic and capable of addressing societal challenges against economic development.

Recommendations

Based on the findings of the study, the following recommendations are made:

1. Comprehensive Professional Development: Government and stakeholders on policy formulation should implement targeted training programs to enhance teachers' AI literacy and pedagogical strategies for secondary school education.

2. Strengthen Institutional Support: Schools must provide adequate resources and infrastructure to facilitate AI integration in teaching practices

3. Curriculum Integration: A thorough revision of the secondary school curriculum should be carried out to ascertain how AI-embedded teaching can be implemented to align educational outcomes with digital workforce demands.

4. Research and Policy Advocacy: Promote policies that recognize and prioritize AI literacy in teacher education, fostering a research culture on how AI can be better integrated into Nigeria educational system.

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ENHANCING ENTREPRENEURIAL THINKING IN STUDENTS THROUGH EMERGING TECHNOLOGIES IN MATHEMATICS EDUCATION

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Abstract

Emerging technologies have the potential to significantly enhance entrepreneurial thinking in students, especially within the context of mathematics education. These technologies, such as artificial intelligence (AI), virtual reality (VR), and adaptive learning platforms, foster an interactive and personalized learning environment. By leveraging these tools, educators can transform traditional mathematics instruction into a more dynamic and problem-solving-based approach, which is crucial for cultivating entrepreneurial skills such as creativity, critical thinking, and innovation. This paper examines how emerging technologies can be integrated into mathematics education to nurture entrepreneurial thinking. The use of adaptive learning systems allows students to engage in self-directed learning, fostering autonomy and resilience, key traits of successful entrepreneurs. Additionally, AI-powered tools provide real-time feedback and promote collaborative problem-solving, allowing students to work on real-world projects that mirror entrepreneurial challenges. The implementation of VR and gamification can simulate complex business environments, enabling students to experiment with mathematical concepts in entrepreneurial contexts. Despite the benefits, the challenges of accessibility, teacher training, and technological infrastructure must be addressed to fully harness these technologies' potential in developing entrepreneurial mindsets. This study concludes that the thoughtful integration of emerging technologies into mathematics education can significantly enhance students' entrepreneurial thinking, preparing them to contribute innovatively to the digital economy. The research also calls for comprehensive policies that support the use of emerging technologies in education for fostering a generation of future entrepreneurs.

Key Words: Enhancing, Entrepreneurial, Thinking, Emerging, Technologies and Mathematics Education

Introduction

The rise of the digital economy has emphasized the importance of entrepreneurial thinking as a vital skill for students across all fields of study, particularly in science, technology, engineering, and mathematics (STEM) education. With the integration of emerging technologies in education, especially in mathematics, there has been a significant shift in pedagogical strategies aimed at fostering entrepreneurial thinking. This article examines how emerging technologies such as artificial intelligence (AI), virtual and augmented reality (VR/AR), machine learning, and adaptive learning platforms can be leveraged to enhance entrepreneurial thinking among students in mathematics education.

Emerging Technologies in Education

Emerging technologies refer to novel tools and platforms that have the potential to revolutionize teaching and learning practices. These technologies encompass innovations such as AI, VR/AR, and machine learning, all of which have already begun reshaping educational

landscapes. In mathematics education, these tools allow for more interactive, personalized, and adaptive learning experiences that promote critical thinking and problem-solving skills (Organisation for Economic Co-operation and Development, (2019). The use of these technologies aligns with the global shift toward digital learning environments that prepare students to meet the demands of the modern job market.

Artificial Intelligence (AI) in Mathematics Education

AI-driven platforms have the capacity to provide personalized learning experiences for students. These platforms analyze student's performance data to create customized lesson plans that address individual learning needs. By doing so, AI enhances students' understanding of mathematical concepts, enabling them to think critically and apply their knowledge in entrepreneurial contexts. For example, AI-powered tools such as chatbots and virtual tutors can guide students through complex problem-solving processes, helping them develop the resilience and creativity required for entrepreneurial ventures (Crompton & Burke, 2018).

Virtual and Augmented Reality (VR/AR)

VR and AR offer immersive learning environments that enable students to visualize and interact with abstract mathematical concepts. These technologies help bridge the gap between theoretical knowledge and real-world applications, which is crucial for fostering entrepreneurial thinking. For instance, students can use AR to simulate business models or financial scenarios, thus gaining hands-on experience in managing resources and solving practical problems (Bacca, *et al.,* 2014).

Machine Learning and Data Analytics

Machine learning algorithms are used in educational platforms to identify patterns in student's performance and predict future learning outcomes. In mathematics education, this enables educators to identify areas where students may struggle and provide targeted interventions. Gordon (2018) said that by fostering a data-driven approach to learning, machine learning empowers students to develop analytical skills, which are essential for entrepreneurship. These skills allow students to analyze market trends, optimize business operations, and make data-informed decisions.

Adaptive Learning Systems

Adaptive learning systems use AI and machine learning to adjust the difficulty level of exercises based on the student's progress. This promotes a personalized learning experience that helps students tackle challenging mathematical problems at their own pace. Prinsloo (2019) said that through continuous feedback and guidance, adaptive systems encourage the development of problem-solving skills, which are directly linked to entrepreneurial thinking.

Enhancing Entrepreneurial Thinking through Mathematics Education

Mathematics education plays a crucial role in developing students' ability to think analytically and solve problems creatively. These skills are essential for entrepreneurship, where individuals must identify opportunities, assess risks, and develop innovative solutions to complex challenges. Emerging technologies offer unique opportunities to integrate entrepreneurial concepts into mathematics education, thereby enhancing students' readiness for the entrepreneurial world.

Critical Thinking and Problem-Solving Skills

Entrepreneurial thinking requires a high level of critical thinking and the ability to approach problems from multiple perspectives. Mathematics provides a foundation for these skills by

teaching students to break down complex problems into smaller, manageable components. Emerging technologies further support this by offering real-time feedback and dynamic learning environments that challenge students to think critically and iteratively. Studies have shown that students who engage in technology-enhanced mathematics education are better equipped to approach problems with creativity and flexibility (Wang, *et al.*, 2016).

Innovation and Creativity

Entrepreneurship thrives on innovation and mathematics education provides the tools needed for students to develop creative solutions to real-world problems. By integrating emerging technologies, educators can present mathematical concepts in ways that inspire innovation. For instance, students can use VR to design and test prototypes, or AI tools to create financial models for potential business ventures. These activities promote entrepreneurial thinking by encouraging students to apply mathematical principles in creative and innovative ways (Selwyn, 2019).

Collaborative Learning and Networking

Emerging technologies also enable collaborative learning environments where students can work together on entrepreneurial projects. Online platforms and social media facilitate networking among students, educators, and industry professionals, providing opportunities for mentorship and collaboration. Kim (2020) stated that in mathematics education, this collaboration can take the form of group problem-solving exercises, where students use digital tools to brainstorm and develop business ideas. This prepares students for the collaborative nature of entrepreneurship, where teamwork and networking are critical to success.

Challenges of Implementing Emerging Technologies in Mathematics Education

Despite the potential benefits, there are several challenges to implementing emerging technologies in mathematics education. In many developing countries, including Nigeria, access to digital tools and the internet remains limited. Ajayi (2018) stated that this digital divide creates a barrier to the widespread adoption of technology-enhanced education, particularly in rural areas. Additionally, there is a need for teacher training programs to equip educators with the skills necessary to integrate emerging technologies into their teaching practices. Without proper training, teachers may struggle to effectively use these tools to foster entrepreneurial thinking in students.

Integrating Technology into Mathematics Education

In Nigeria, there have been efforts to integrate technology into mathematics education through initiatives such as the National ICT Policy and the Nigerian Digital Economy Policy and Strategy (NDEPS). These policies aim to promote digital literacy and the use of emerging technologies in education. However, the implementation of these initiatives has been slow due to infrastructural challenges and a lack of teacher training (Adebowale & Adedokun, 2021).

Globally, countries like Finland and Singapore have successfully integrated emerging technologies into their educational systems, with a focus on enhancing entrepreneurial thinking. In Finland, for example, students use AI tools to create business models and simulations, which help them develop the skills needed for entrepreneurship (Salomaa, 2018). These examples highlight the potential for emerging technologies to transform mathematics education and foster entrepreneurial thinking when supported by strong policies and infrastructure.

Conclusion

The integration of emerging technologies into mathematics education has the potential to significantly enhance entrepreneurial thinking in students. By providing interactive, personalized, and data-driven learning experiences, these technologies equip students with the critical thinking, creativity, and problem-solving skills necessary for success in the entrepreneurial world. However, challenges such as limited access to technology and the need for teacher training must be addressed to ensure the effective implementation of these tools. With the right policies and infrastructure in place, emerging technologies can play a pivotal role in preparing students for the digital economy and fostering national development.

Recommendations

To fully realize the potential of emerging technologies in enhancing entrepreneurial thinking in students through mathematics education, the following recommendations were made;

1. Governments and educational institutions should work together to bridge the digital divide by providing access to digital tools and internet connectivity in rural and underserved areas.

2. Educational stakeholders should develop comprehensive training programs that equip teachers with the skills to integrate emerging technologies into their teaching practices.

3. Mathematics curricula should be updated to include entrepreneurship-focused modules that encourage students to apply mathematical concepts to real-world business challenges.

4. Educational institutions should establish partnerships with industry professionals to provide students with mentorship opportunities and real-world insights into entrepreneurship.

5. Ongoing monitoring and evaluation of technology-enhanced mathematics education programs should be conducted to assess their impact on students' outcomes and entrepreneurial thinking.

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PRE-SERVICE UNIVERSITY TEACHERS' PERFORMANCE EXPECTANCY AND EFFORT EXPECTANCY ON THE ADOPTION OF ARTIFICIAL INTELLIGENCE IN NIGER STATE

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ABSTRACT
Integrating Artificial Intelligence (AI) in education has transformed teaching and learning, hence, teachers' attitudes and performance expectancy play a crucial role in its adoption However, the adoption of AI among pre-service teachers be influenced by their perception. This study aims to determinine the relationship between effort expectancy and behavioural intentions to use artificial intelligence among pre-service university teachers. The research adopted the correlational research design. The population of the study comprises (404) four hundred and four students; of final year students of pre-service university students in Niger State. (50) fifty questionnaires were distributed based on Krejce and Morgan (1970) sample size determination. The study was guided by two research questions and two research hypotheses. Data was collected using a 5-point rating scale questionnaire which was validated by 3 experts in the Department of Science Education and the instrument yielded a reliability of 0.74. The data was analysed using descriptive statistics to answer the research question, the formulated hypotheses were tested using Pearson Product Moment Correlation. The findings reveal that there is a weak positive correlation between performance expectancy and behavioural intention to adopt AI (r=0.108, p=0.458, N= 49) and a weak positive correlation between effort expectancy and behavioural intentions to adopt AI (r= 0.114, p=0.437, N=49). It was recommended that Artificial Intelligence should be integrated into teachers' preparation programs, among other.

Keywords: Artificial Intelligence, Effort Expectancy, Performance Expectancy, Pre-service Teachers, Teacher Education, UTAUT, Nigeria.

Introduction
Globally, the knowledge of science and technological growth, development and advancement are rapid. This increase of science knowledge has necessitated the integration of science in all levels of Nigeria education, that has reflected her National Policy on Education FME (Adolphus, 2019), which emphasizes the study of science in all levels of education. The field of education has continuously evolved over the years, with various modification in curriculum made to accommodate science needs of the learners. Science has been an integral instrument of human societies even during the paleolithic era when the man was assumed to be less endowed, its impact is felt in every sphere of human endeavour and therefore essential for the 21st century competitive world and intricately connected to nation's development. Ravetz, (2020) asserted that the application of scientific knowledge has improved the standard of living of humankind in its entire ramifications. In order for us to equip our students with the skills needed to face the 21st century challenges, who must align our system of education with instructional strategies and approaches that will pave way for acquisition of such competencies. This is because education is an important catalyst that speeds up national growth and development, therefore, it must be in line with basic needs of the society.

Education is also a lifelong process which enhances the individual's quality of life, build up his personality and enable him or her to contribute meaningfully and effectively to the

development of his or her society. It is also the process through which a society reproduces itself by passing on its quality and mode of life to younger generations. No matter what we do in the classroom or educational principles we adopt in the process of teaching, all efforts would be fruitless if the learners do not understand content taught effectively (Atabey *et al*, 2021).

Technology is constantly evolving, reshaping industries, societies, and human experiences. From the invention of the wheel to the rise of Artificial Intelligence (AI), technological advancements have transformed the way we live, work, communicate, and interact with the world around us. Technological advancement has transformed the social-cultural society we know, and technology landscape seems to improve and change through each decade. Dakota, (2024), noted that the innovation of technology had increased social homogenization; social homogenization is a trend that has changed the standardization of how we communicate as a culture in a global market, taking us through a stage of conformity. Hence, integration of innovative technologies in human endeavours becomes inevitable especially in this recent time. Learning is a multifaceted process that involves acquiring new knowledge, skills, attitudes, and behaviors. Reverence, or a deep respect and admiration, can significantly enhance the learning experience. Learning is a complex and dynamic process that involves acquiring knowledge, skills, and attitudes through various experiences. It encompasses cognitive, emotional, and behavioral dimensions (Hasanaov *et al*., 2021). From infancy through adulthood, humans engage in learning activities that shape their understanding of the world and their place within it.

Learning in technology encompasses the acquisition of knowledge, skills, and competencies related to the use, development, and application of technological tools and systems. It involves both formal and informal learning processes that enable individuals to adapt to technological advancements and leverage them for various purposes. Learning Environments in Technology, online learning platforms, such as learning management systems (LMS) and massive open online courses (MOOCs), provide access to educational resources, interactive modules, and collaborative tools (Tserklevych *et al.*, 2021). They offer flexibility and scalability for learners worldwide. VR and AR technologies create immersive learning environments that simulate real-world scenarios and enhance experiential learning (Rusell, 2020). They are used in fields such as medical training, engineering, and cultural heritage preservation.

AI refers to the simulation of human intelligence in machines, enabling them to perform tasks that typically require human cognition, such as problem-solving, decision-making, and natural language processing (Mondal, 2020). AI applications range from virtual assistants to autonomous vehicles. The Internet of things (IoT), refers to a network of interconnected devices embedded with sensors, software, and other technologies that enable them to collect and exchange data (Koptetz and Steiner, 2022). IoT applications include smart homes, wearable devices, and industrial automation. Blockchain is a decentralized, distributed ledger technology that enables secure and transparent transactions without the need for intermediaries (Deshpande, 2017). It has applications in cryptocurrency, supply chain management, and digital identity verification. Biotechnology involves the use of living organisms, cells, and biological systems to develop products and technologies for various purposes, such as healthcare, agriculture, and environmental conservation (Pandey and Singhal, 2022). Advances in biotechnology include gene editing, synthetic biology, and personalized medicine.

Several models and theories have provided a framework to investigate the factors that influence an individual behavioural intention to adopt a given technology. Some of these models and theories include Technology Acceptance Model (TAM), Unified Theory of Acceptance and

Use Theory (UTAUT), Diffusion of Innovation Theory. This study adopts UTAUT, the Unified Theory of Acceptance and the Use of Theory (UTAUT) and diffusion of innovation theory is concerned with the use and acceptance innovation and how innovation propagates through and education system. The theoretical model of UTAUT suggested that the actual use of technology is determined by behavioural intention. The perceived likelihood of adopting the technology is dependent on the direct effect of four key constructs, namely performance expectancy, effort expectancy, social influence, and facilitating conditions. The effect of predictors is moderated by age, gender, experience and voluntariness of use (Rhie *et al*., 2021).

Effort expectancy, a concept rooted in the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh *et al*. (2003), refers to the perceived ease of use associated with a particular system or technology. In the context of AI tools among pre-service university teachers, effort expectancy plays a crucial role in determining whether they will adopt and effectively integrate AI into their learning activities. A well-designed user interface significantly enhances effort expectancy. Pre-service teachers, who might already be juggling various responsibilities and learning new pedagogical methods, benefit from AI tools that are intuitive and straightforward. Simplified navigation, clear instructions, and a minimal learning curve can make AI tools more appealing and less intimidating. Adequate training and continuous technical support are vital. According to Davis (2019), perceived ease of use is greatly influenced by how well users are trained and supported. Workshops, tutorials, and hands-on training sessions can help pre-service teachers feel more comfortable and competent in using AI tools.

Performance expectancy, effort expectancy, and social influence. As proposed by Venkatesh et al. (2003), the UTAUT model includes four moderators: experience, voluntariness, gender, and age. (Wu *et al*., 2022; Alzahrani *et al.*, 2023). This study aims to collect data from students who are actual users of AI. For this purpose, age and voluntariness cannot provide value to the model, but this study aims to develop the UTAUT model by employing gender and experience as explanatory variables instead of moderators and including another three descriptive and behavioural variables as independent variables: education, income, and equipment used for Internet access.

An examination of gender disparities in the context of technological proficiency revealed a nuanced relationship between perceived and actual online skills. The findings suggested that although there are discernible differences in how men and women view their technological capabilities, these perceptions do not consistently correlate with tangible skill gaps in digital environments (Bain and Rice, 2006; Hargittai and Shafer, 2006). Specifically, the research highlighted that female participant tended to express higher levels of technology anxiety, lower confidence in their technology-related abilities, and generally less positive and more stereotypical views about technology compared to their male counterparts (Cai *et al*., 2017; Jackson *et al*., 2001). Despite these differences in attitude, the direct impact on actual technological proficiency was less clear, indicating that while gender may influence how students feel about technology, it does not necessarily predict their ability to use it effectively.

Statement of Research Problems

Despite the availability and potential benefits of AI tools in education, there is a noticeable reluctance among pre-service teachers to adopt these technologies. There is a lack of comprehensive understanding of the factors that influence pre-service teachers' behavioural intention and use of AI tools. While various models exist, the Unified Theory of Acceptance

and Use of Technology (UTAUT) offers a holistic framework that has not been extensively applied on AI usage. Hence research is needed to explore how UTAUT constructs—such as performance expectancy, effort expectancy, social influence, and facilitating conditions—affect AI adoption among pre-service teachers. Performance expectancy, or the degree to which pre-service teachers believe that using AI tools will enhance their learning and teaching effectiveness, is a critical factor. However, there is limited empirical evidence on how these perceived benefits influence their intention to use AI tools. Effort expectancy, which refers to the perceived ease of use of AI tools, can significantly impact their adoption. Pre-service teachers may find AI tools complex or challenging to integrate into their learning processes. Research is needed to identify specific usability concerns and how they affect AI tool usage. Social influence, including the impact of peers, mentors, and institutional culture, plays a vital role in technology adoption. Understanding how these social factors affect pre-service teachers' attitudes towards AI tools can provide insights into developing supportive environments that promote AI usage.

Aims and Objectives of the Study

The aim of the study is to determine pre-service university teachers' performance expectancy and effort expectancy on the adoption of artificial intelligence in Niger State. While the objectives are to identify:

11. The relationship between effort expectancy and behavioural intentions to use artificial intelligence among pre-service university teachers.

12. The relationship between performance expectancy and behavioural intention to use artificial intelligence among pre-service university teachers.

Research questions

The following research questions will be answered in this research

1. What is the relationship between effort expectancy and behavioural intentions to use Artificial Intelligence among pre-service university teachers?

2. What is the relationship between performance expectancy and behavioural intention to use Artificial Intelligence among pre-service university teachers?

Null Hypotheses

The following are the null hypotheses of the study.

$H0_1$ There is no significant relationship between effort expectancy and behavioural intentions to use Artificial Intelligence among pre-service university teachers.

$H0_2$ There is no significant relationship between performance expectancy and behavioural intention to use artificial intelligence among pre-service university teachers.

Research Methodology

Research design

This study would employ a descriptive (correlational) research design. Descriptive survey is research which exists or uses the sampled data of an investigation to document, describe, and explain existing phenomena or the absence (Usulor, 2014). Bello and Ajayi (2020) opined that survey design is a method usually adopted when handling a large population especially on issue of the moment that involve systematic collection of data from population of study through the use of questionnaire. This study will involve the use of questionnaires to access the adoption of Unified-Theory of Acceptance and Use of

Technology to assess pre-service teachers' Artificial Intelligence usage for learning. Since the study would be considering the relationship between the constructs of UTAUT, correlational approach is most suitable.

Population of the study

The population for the study will comprises of pre-service university teachers from universities in Niger state. With the total number of 1551 pre-service university teachers studying biology education, mathematics education, physics education, chemistry education, geography education, computer education, the target population were final year students of the department of Science Education, Federal University of Technology, Niger state and Department of Science Education Ibrahim Babangida University Lapai Niger state. As at the period in which this research was carried out, the available targets are 500level students of school of Science and Technology Education.

The 500l students of the department of Science Education consist of one hundred and thirty-seven (137) students, and Ibrahim Babangida University Lapai, the targets are the 400level students of Department of Science Education. The 400l students of the department of Science Education consist of two hundred sixty-seven (267) students.

Sample and Sample Technique

From the population of the study Proportionate stratified random sampling technique will be used to select 70% of students from each department in Federal University Minna Niger state and Ibrahim Badamusi Babangida University Lapai Niger State. The number of respondents from each sub group is determined by the number of the entire population. College of Education Minna, Niger State will be used for the pilot test.

Research instrument

The instrument that was used for data collection is researchers developed questionnaire made of four sections. Questionnaire Section A- Demographic data of the respondents, Section A- Pre-service teachers Performance Expectancy on the usage of AI, Section B- Pre-service teacher Effort Expectancy on the usage of AI, Section C- Behavioural Intention to use AI.

Validity of Instrument

To ascertain the content validity of the instrument, three (3) experts in the department of Science and Technology Education FUT Minna, Niger State. The corrections and suggestions made by those experts is used to ensure the content. Validity of the research instrument, and a clean copy of the instrument was produced for data collection.

Pilot study

In order to establish the reliability of the instrument, pilot study was carried out, College of Education Minna, Niger State. The reason for choosing the school was the fact that the school is out of the study area and will not be any way used for the main study. The essence for pilot study was to test the adequacy and suitability of the instrument in measuring what it is supposed to measure and to ascertain any difficulty that the researcher may encounter. For the purpose of this, twenty (20) copies of the questionnaire were administered to pre-service teachers in the above-mentioned schools. The filled questionnaire was collected and subjected to statistical analysis using Cronbach Alpha correlational formula in order to determine the reliability of the instrument as well as the internal consistency of the items within the instrument.

Reliability of Instrument

Reliability refers to the extent to which an instrument consistently produces stable results (Moses and Yamat, 2021). The data collected from the pilot study was calculated using Cronbach Alpha and reliability index of 0.88 was obtained. Benett (2020) testified that, for a scale to be considered reliable they should have an alpha value of 0.50 to 1. With this level of reliability index, the instrument was considered reliable for use in this study.

Method of Data Collection

To collect the necessary data for the study, the researcher visited the sampled schools with an introductory letter from Science Education Department, Federal University of Technology Minna. The letter will be presented to appropriate authorities in all the sampled schools in order to seek permission to have access to the Pre-service teachers. The class representatives will serve as research assistant who will be instructed by be researcher on how to distribute and retrieve the copies of the questionnaire. The respondents will be provided with instructions on how to complete the questionnaires. The questionnaire will distribute and collected immediately.

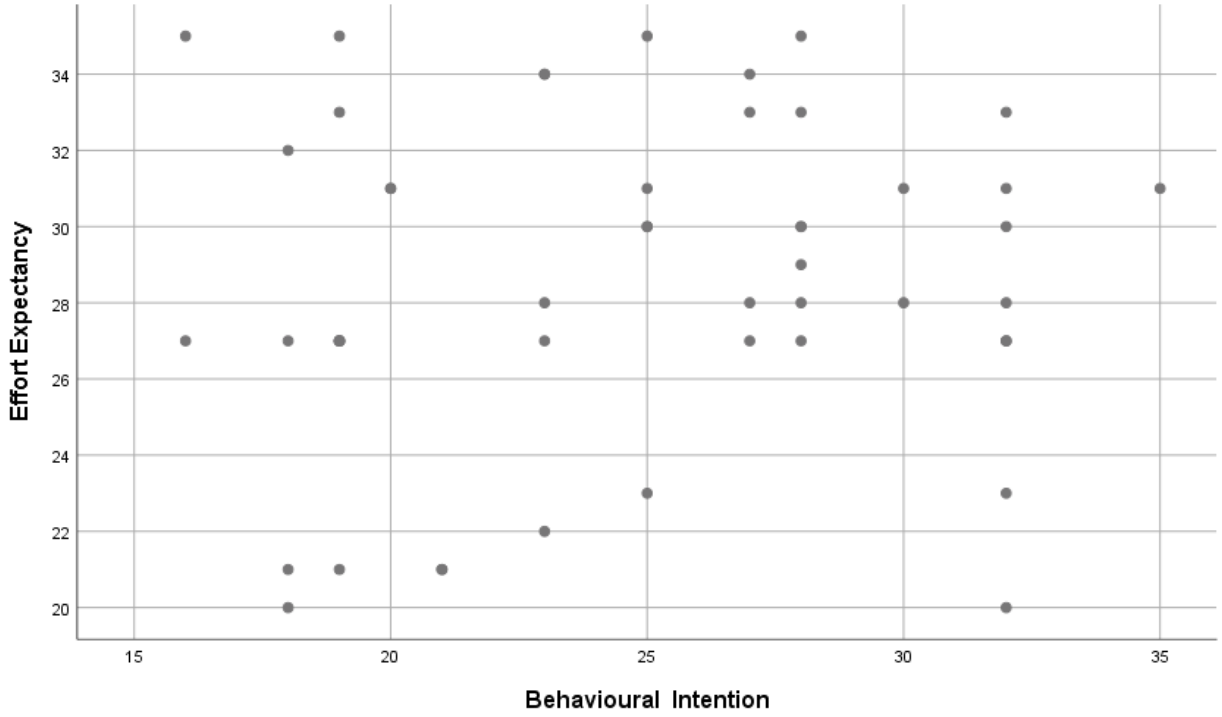
Method of Data Analysis

The data collected will be analyzed using the following statistical tools. Descriptive statistics of standard deviation, and frequencies to understand the demographic characteristics of the pre-service teachers' and the AI Usage. For the demographic data, frequency and percentage will be used to analyse, the research questions scattered plots will be used to analyse and Pearson Product Moment Correlation will be used to analyse the hypotheses of the study. The significant relationship will be ascertained at 0.05 alpha levels. The Statistical Package for Social Science (SPSS) version 23.0 will be used for the analysis.

Results and Analysis

Research Question1: What is the relationship between effort expectancy and behavioural intention to use artificial intelligence among pre-service university teachers?

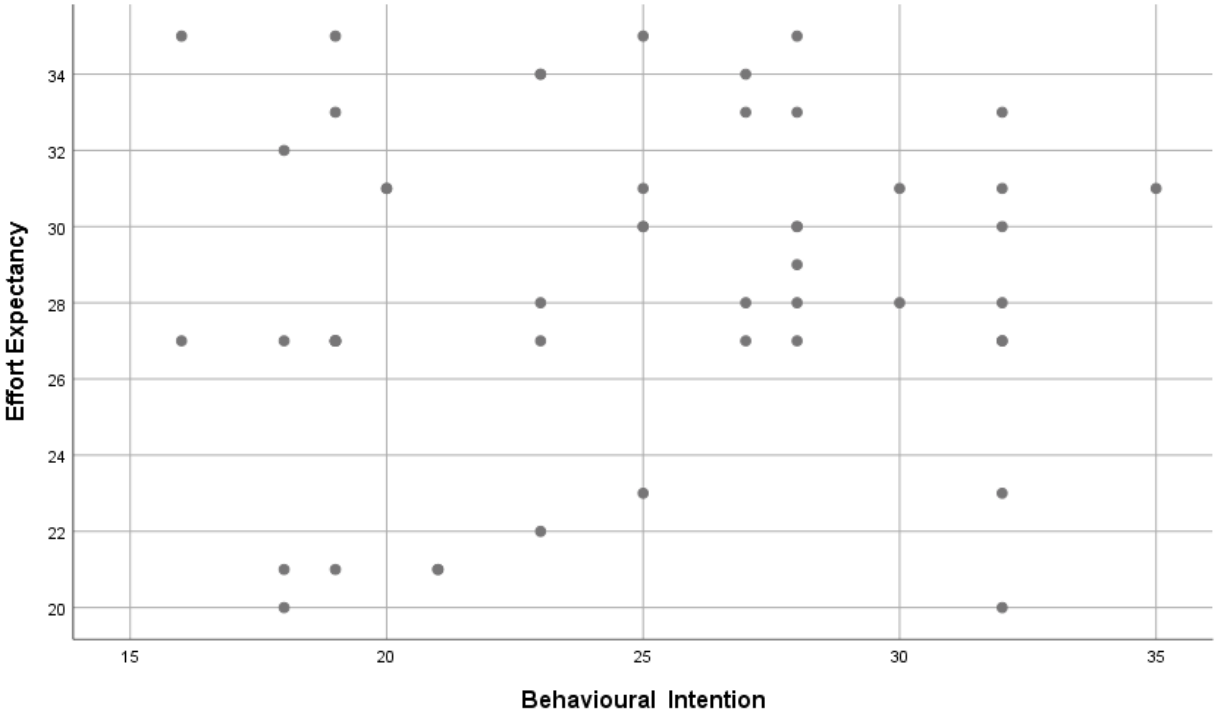
Graph1: Showing the scatter plot of the Pre-service University teachers' performance and effort expectancy on the adoption of Artificial Intelligence.



The scatterplot above shows the effort expectancy and behavioural intentions with almost no correction. The correction coefficient is actually -0.05. This indicates a very weak negative correlation.

Research Question2: What is the relationship between performance expectancy and behavioural intentions to use artificial intelligence among pre-service university teachers?

Graph 2: Showing the scatter plot of the Pre-service University teachers' performance and effort expectancy on the adoption of Artificial Intelligence.



The scatterplot above shows the performance expectancy and behavioural intentions with a correlation of -0.69. This indicates strong negative correlation

Testing of Hypotheses

Hypothesis 1: $H0_1$. There is no significant relationship between effort expectancy and behavioural intentions to use artificial intelligence among pre-service university teachers.

Table1: Showing the Pearson correlational coefficient of the Pre-service University teachers' performance and effort expectancy on the adoption of Artificial Intelligence.

Items	Correlation Coefficient (r)	N	Sig 2 tail P value
Performance Expectancy	0.108	49	0.458
Behavioural Intentions			

Table 1 shows the correlation between performance expectancy and behavioural intention, correlation coefficient (r) is 0.108, the N is 49, P value is 0.458, this indicate that the correlation is not statistically significant at the 0.05 level ($p>0.05$). The hypothesis is thereby accepted.

Hypothesis 2: Showing the scatter plot of the Pre-service University teachers' performance and effort expectancy on the adoption of Artificial Intelligence.

Table 2: Showing the Pearson correlational coefficient of the Pre-service University teachers' performance and effort expectancy on the adoption of Artificial Intelligence.

Items	Correlation Coefficient **(r)**	**N**	Sig 2 tail P value
Effort Expectancy	0.114	49	0.437
Behavioural Intention			

Table2 shows the correlation between performance expectancy and behavioural intention, correlation coefficient (r) is 0.114, the N is 49, P value is 0.437, this indicate that the correlation is not statistically significant at the 0.05 level ($p>0.05$). The hypothesis is thereby accepted.

Discussion of Findings

The study investigated the relationship between pre-service university teachers' performance expectancy, effort expectancy and intention to adopt Artificial Intelligence in teaching and learning. The findings weak positive correlation between performance expectancy and behavioural intention to adopt AI ($r=0.108$, $p=0.458$, $N= 49$) and weak positive correlation between effort expectancy and behavioural intentions to adopt AI ($r= 0.114$, $p=0.437$, $N=49$).

Conclusion

This study underscores the importance of addressing pre-service teachers' performance expectancy and effort expectancy to facilitate AI adoption in education. By doing so, we can harness the potential of AI to enhance teaching and improve students' outcomes.

Recommendation

Artificial Intelligence education and training should be integrated into teachers preparation programs, there should be development and promotion of user-friendly AI tools and foster a supportive environment for AI adoption.

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SIMULATION PACKAGE (SP) AS ARTIFICIAL INTELLIGENCE (AI) AND NEW TECHNOLOGY FOR ENHANCING TEACHING AND LEARNING IN TECHNICAL AND VOCATIONAL EDUCATION (TVE)

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Abstract

The potential of Simulation Package (SP) as Artificial Intelligence (AI) in Technical and Vocational Education (TVE) in Nigeria, has an advantage in Education. Given the swift progress of SP as AI technology, Nigeria's TVE sector can utilise SP as AI-assisted learning to improve teaching and learning. Nigeria's TVE institutions can enhance skill acquisition among students by adopting new technology innovation advanced tools like adaptive learning algorithms, virtual simulations, and intelligent tutoring systems, which cater to diverse teaching/learning styles. Nevertheless, like any other country, Nigeria encounters obstacles such as ethical dilemmas, digital inequality, and the necessity for enhancing skills in implementing SP as AI-supported teaching/learning in TVE. To fully capitalise on the advantages of SP as AI in educational sector, it is imperative to tackle these challenges. By surmounting these challenges and adopting SP as AI-assisted education, TVE sector can initiate a profound transformation aimed at enhancing educational achievements, promoting innovation, and equipping the workforce with the necessary skills for the modern economy.

Keywords: Simulation Package (SP) Artificial Intelligence (AI), Technical Vocational Education (TVE)

Introduction

Technical and Vocational Education (TVE) need to be updated so that our students and teachers can be more competitive in teaching/learning and can achieve a new achievement by using a nowadays technology known as artificial intelligence (AI) tools. The incorporation of artificial intelligence (AI) into Technical and Vocational Education (TVET) in Nigeria is in line with the worldwide trend identified by Abdullah and Tahir (2023) to meet the need for a proficient workforce in a fast-changing economy. The focus on AI-supported education aligns with the objectives of improving the effectiveness of teaching/learning in TVET programme and providing personalized learning experiences. (Lin *et al.*, 2020). By integrating artificial intelligence (AI) technologies, Nigeria's TVE sector can enhance the readiness of its students for success in the digital era by providing them with pertinent skills and competencies. The introduction establishes the context for examining how AI can enable individuals in Nigeria to prosper in a progressively digital and competitive environment, emphasizing the significance

of embracing technological progress to address the demands of the contemporary labour market.

The combination of AI-assisted teaching/ learning on TVE in Nigeria has the potential to greatly transform the educational field (Chikoti, 2018). By incorporating artificial intelligence (AI) technologies into TVE programme, educational institutions can provide customized teaching/ learning experiences that cater for varied requirements and inclinations of individual students, while also being in line with the cultural and socio-economic environment of the region. The use of adaptive learning algorithms, simulation package (SP) and intelligent tutoring systems allows instructors to improve teaching methods, offer instant feedback, and create a collaborative teaching/learning environment that promotes skill development (Vallejo Guevara *et al*., 2019). In addition, the incorporation of simulation package (SP) for TVE programme provides practical training opportunities, enabling students to acquire practical experience in a controlled environment and develop crucial skills pertinent to their selected disciplines or professions. The interdependent connection between AI-supported teaching/learning of TVE in Nigeria not only improves educational results but also promotes empowerment and new technology innovations, placing the local workforce in a favorable position to succeed in a progressively digital and competitive global economy.

The incorporation of SP as AI-driven analytics into TVE programme, as emphasized by Saritha *et al* (2022), offers great potential for enhancing educational results. Through the analysis of data derived from student interactions with AI-powered educational platforms, educators in Nigeria can acquire valuable insights regarding student progress and performance (Ismawi *et al*., 2022). This enables them to customize instruction according to individual needs and implement specific interventions when required. The utilization of data in teaching/learning methods not only improves their effectiveness but also promotes continuous improvement and new technology innovation in Nigeria's TVET programme. The partnership between SP as AI for TVE in Nigeria enables students to gain the necessary skills and knowledge to prosper in a dynamic employment landscape or workforce (Shiohira *et al*., 2021). Furthermore, it provides educators with state of the art resources to improve academic results and effectively equip students for upcoming challenges in educational programmes. By utilizing SP as AI-driven analytics, the TVE institutions sector can guarantee that its educational programmes adapt to the changing requirements of students and industries, thereby fostering the economic growth and well-being of the region.

Abdullah *et al.,* (2023) highlights that the incorporation of SP as AI into TVET in Nigeria are a significant advancement that addresses the needs of a new technology innovation changing the economy. This integration is in line with the worldwide movement to meet the demand for a proficient workforce that can effectively navigate the digital age globally. Nigeria's TVE sector aims to improve programme efficiency and offer personalized teaching/learning experiences geared toward individual student needs through AI-assisted teaching/learning, as described by Lin *et al*, (2020). The focus on AI new technology aligns with the objective of equipping students with pertinent skills and competencies to thrive in the contemporary labour market. The combination of SP as AI advancements for TVE, as emphasized by Chikoti (2018) and Vallejo Guevara *et al*, (2019), has the potential to completely transform the educational environment in Nigeria.

Nigeria's TVE institutions can cultivate a cooperative teaching/learning atmosphere that promotes skill enhancement and new technology innovation by incorporating adaptive teaching/learning algorithms, intelligent tutoring systems, and virtual simulation package.

Incorporating AI-powered analytics, as highlighted by Saritha *et al*,(2022) and Shiohira *et al*, (2021), allows educators to obtain valuable insights into student progress and performance. This leads to ongoing enhancement and new technology innovation in TVE programmes. The symbiotic alliance between SP as AI for TVE in Nigeria not only improves educational results but also empowers students to excel in a workforce evolving job market, while positioning the region's sustainability for conclusive success in a digital and ferocious competitive global economy (Fade *et al*., 2022). Through the utilization of SP as AI new technology and data-driven methodologies, the TVE) sector has the potential to significantly contribute to the advancement of economic growth and prosperity in the society at large.

Problem Statement

1. **Bias in SP as AI algorithms**: - The presence of bias in SP as AI algorithms has the capacity to compromise the credibility of assessments and impede the prospects of students in Nigeria's job market. (H Iqbal Hussain,and Jabarullahi, 2019)

2. **Lack of access to technology**:- In Nigeria TVE institutions, the presence of high-speed bandwidth and additional facilities like virtual reality hardware and computers is crucial for the successful implementation of AI-enabled teaching/learning (Cantrell and Margeret, 2020) .

3. **Lack of training and support**. The implementation of SP as AI technology in TVE sector is particularly difficult due to its novelty and the limited resources available for training initiatives. Ensuring educators and students receive sufficient training and support is essential for empowering them to effectively utilize SP as AI-enabled systems and optimise the advantages of SP as AI integration in TVE programmes. (Valencia, 2020)

Research Objectives/Significance

1. Evaluate the current state of SP as AI-assisted teaching/learning in TVE programmes in Nigeria. It would offer valuable information about the degree to which SP as AI is being employed and its impact on educational approaches in the Nigeria.

2. Examine the effectiveness of SP as AI-driven tools in enhancing individualized teaching/learning experiences for TVE students in Nigeria: It would illuminate the tangible advantages of incorporating SP as AI into personalised teaching/learning initiatives.

3. Assess the influence of SP as AI-assisted teaching/learning on enhancing the capabilities of instructors, thereby improving the efficacy of teaching in TVE programmes.

4. Evaluate the potential of integrating SP as AI into TVE to enhance skill acquisition among students in Nigeria, thereby enhancing their employability and readiness for the requirements of the contemporary labour market.
5. Identify the barriers and benefits associated with the implementation of SP as AI-assisted TVE in Nigeria, This research would offer valuable perspectives for future approaches to implementing strategies and making policy decisions in the country.

Literature of the Research

The global growth of TVE as seen in Nigeria reflects a significant increase in the need for SP as AI support to technical, vocational and engineering experts, particularly in areas like new technology innovation and engineering. Historically, TVE courses have presented difficulties for educators and students alike because of restricted resources and time limitations. Nevertheless, the advent of SP as AI made TVE education in International Journal of Science and Research Archive, 2024, 12(01), 2061–2068

Adamopoulou and Moussiades (2020) investigate the incorporation of SP as AI in educational settings, emphasizing its capacity to improve the quality of teaching and learning. The 21st International Conference on Artificial Intelligence in Education (AIED) highlighted the growing significance of SP as AI in educational technology, providing valuable insights into its use in higher education. Jungwirth and Haluza, (2023) explore the influence of SP as AI on the process of teaching and learning, highlighting both its advantages and difficulties. The possible consequence of incorporating SP as AI in the classroom and its significance in TVE, considering both theoretical and practical aspects. (Boateng and Tindi, 2022). The above mentioned literature in SP as AI shows potential for enhancing teaching/learning outcomes in TVE through the provision of customized teaching/learning experiences and the implementation of cutting-edge teaching techniques. In general, SP as AI offers several benefits for TVE pedagogy, aiding students and educators in accomplishing teaching/learning goals more efficiently and supporting the ongoing expansion and advancement of the TVE industry.

The advantage of SP as AI in education

1. **Personalized Leaning**: The incorporation of SP as AI into TVE programmes has the potential to provide customised teaching/learning experiences that cater to the specific requirements of students. SP as AI can be employed to customise the content and tempo of education to align with the specific abilities of individual students, thereby improving their acquisition of theoretical knowledge and practical skills in TVE courses (pataranutaporn *et al*, 2021). TVET sector is experiencing rapid growth to meet the needs of an expanding economy, it programmes can provide educational content in classrooms and interactive environments (Janius *et al*., 2018). This approach allows for the customisation of instruction to meet the unique requirements of students across different age groups.

2. **Skill Assessment and Monitoring**: The integration of SP as AI technologies in TVE programmes offers numerous benefits for both instructors and students. These SP as AI-driven tools enable quick responses and provide real-time feedback, enhancing the learning process in TVE fields. By utilizing SP as AI for evaluating student achievement and growth, instructors can maintain performance standards while identifying areas for improvement. SP as AI-powered technologies can track students' progress in teaching/learning practical skills, offering immediate feedback and facilitating timely interventions to enhance teaching/learning outcomes. Moreover, SP as an AI enables educator to customize the curriculum and teaching/ learning experiences to meet the unique requirements and skill levels of each student, promoting individualized teaching/learning experiences (Janius *et al*., 2023).

3. **Virtual Reality and simulation package**: The incorporation of SP as AI-driven virtual reality (VR) and a simulation technology into TVE programmes has significant potential to transform its educational standard. These cutting-edge tools offer students

practical and interactive educational experiences, allowing for hands-on teaching and learning opportunities. VR and simulation technologies enable students to engage with 3D models of technical components and systems, replicating real-world environments. This facilitates immersive teaching/learning in subjects such as automotive, HVAC, electronics, and renewable energy. Additionally, the use of virtual reality (VR) and simulation learning can effectively decrease educational costs by offering a digital substitute for conventional practical training, while simultaneously improving competence in contemporary skills relevant to the 21st century.

Therefore, the implementation of virtual reality (VR) and simulation technology in TVE programmes in Nigeria holds the potential to improve the standard and availability of vocational education, equipping students with the necessary skills for achievement in the contemporary labour market.

4. **Reduce the Administrative duties**: The incorporation of SP as AI to mechanise administrative duties in TVE establishments' offers substantial advantages for both instructors and learners. By employing SP AI to automate tasks like assessing assignments and delivering tailored feedback to students, educators in Nigeria can conserve precious time that can be reallocated to more significant facets of their responsibilities. This is especially pertinent in TVE institutions, where students frequently participate in practical projects and assignments that demand extra time and attention from teachers. Moreover, SP as AI can aid instructors in detecting areas of student difficulty by analysing performance data and offering insights into areas of inadequate performance. This allows teachers to provide more individualised instruction and mentoring to assist students in overcoming challenges, ultimately improving the educational standards in TVE institutions. SP as AI in will relieves teachers of administrative tasks, allowing them to concentrate on guiding and coaching students to reach their maximum potential (Hassan *et al*., 2018). This contributes to enhancing TVE education in the area. Hence, the integration of SP as AI into administrative tasks within TVE institutions in Nigeria will not only simplifies procedures but also enriches the educational journey for students, ultimately equipping them for triumph in their respective areas of interest.

Discussion

The integration of SP as AI in TVE has yielded substantial benefits for students and educators, in line with the worldwide movement to utilize AI for improving teaching/learning experiences and fostering skill acquisition. The implementation of SP as AI in TVE in Nigeria shows potential for transforming the educational environment by providing students with the essential competencies needed to excel in the current employment market. The implementation of SP as AI in TVE allows students to receive customized teaching/learning experiences that cater to their specific needs. This approach enhances their ability to acquire skills more efficiently, ultimately improving their employability and preparedness for the requirements of the modern workforce. Furthermore, SP as AI enables the assessment and monitoring of students' abilities, offering educators a valuable observation on student advancement and areas requiring enhancement. The incorporation of virtual reality and simulation technologies enhanced by SP as AI enhances the educational experience in TVE programme, providing students with immersive and practical training opportunities. In general, the application of SP as AI in TVE in Nigeria will promote dedication, creativity and developing a competent workforce capable of addressing the demands of the contemporary economy.

SP as AI can assist teachers in identifying areas where students may be struggling, enabling them to provide targeted coaching and support. This personalized approach to education aligns with the goals of TVE schools to ensure that students receive the necessary guidance to succeed in their studies and future careers. By reducing the amount of administrative work that teachers must perform, SP as AI can help improve the quality of education at TVE schools. This allows instructors to focus on their strengths, which is guiding and coaching students to help them realize their maximum potential. The shift in emphasis on teaching and mentoring at TVE schools in Nigeria will improves the standard of education by allowing educators to allocate more time and attention to the specific requirements and growth of their students. In summary, the incorporation of SP as AI in TVE schools in Nigeria has the dual benefit of simplifying administrative tasks and enabling educators to effectively guide students in achieving their full potential in the ever-changing and competitive job market.

SP as AI programmes provide substantial advantages for students through the provision of customized teaching/learning experiences that are specifically tailored to their unique needs and capabilities. By adapting the content and speed of education to cater to the specific needs of individual students, AI facilitates a more efficient acquisition of skills and knowledge for students enrolled in TVE programmes. The individualized approach to learning is especially beneficial in TVE programmes, as students frequently possess varied backgrounds and teaching/learning preferences. Through the utilization of SP as AI, TVE institutions can effectively address the individual requirements of their students, guaranteeing that they receive the necessary assistance and direction for achieving academic and professional triumph. The utilization of SP as AI technology in personalized teaching/learning enhances the learning environment, resulting in increased student motivation and retention in TVE programmes.

Conclusion

In general, the incorporation of SP as AI into TVE programmes in Nigeria will offers a multitude of benefits. These benefits include the creation of personalized teaching/learning experiences, the enhancement of skill development, and the expansion of job opportunities. SP as new technology innovation and TVE institutions in Nigeria can significantly improve the quality of education and better prepare students for the evolving demands of the contemporary job market if they take advantage of the benefits of SP as AI and address the challenges that it presents. Although there are significant benefits associated with SP as AI, it is essential for all parties involved to maintain vigilance regarding the potential drawbacks of AI and to ensure that the technology is used responsibly to prevent its misuse. As the demand for skilled professionals in technical fields such as engineering and technology continues to rise, the incorporation of SP as AI into TVE holds the potential to improve the sector's efficiency and relevance in Nigeria and beyond. It is essential for individuals and society to take an active role in embracing these advancements, cultivating an atmosphere of adaptability and readiness to take advantage of the opportunities that are presented by SP as artificial intelligence technology in TVE. Nigeria can position itself at the forefront of technological innovation in vocational education by taking informed action and working together with other organisations. This will pave the way for a world that is more prosperous and competitive in the future. Therefore, the technical and vocational school and institution in Nigeria may grab this opportunity to implement the new Teaching and Learning pedagogy process by using SP as AI so that our students can be more advance and can be more competitive in real world in the vocational field.

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BETTER LIFE FOR RURAL WOMEN THROUGH THE DISSEMINATION OF INFORMATION RESOURCES, A CASE STUDY OF CHANCHAGA, LGA, NIGER STATE

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Abstract
This study examined the better life for rural women through the dissemination of information resources in Chanchaga Local Government Area (LGA) of Niger State. The study utilized a survey design and aimed to achieve four objectives, using structured interviews and questionnaires to gather information from respondents. Key findings from the 294 respondents indicated that 41% were aged 31-40, 24% were below 30, and 18% were aged 41-50. Additionally, the study found that a significant portion of the women had secondary school education, with 44% holding secondary school certificates. The primary information needs of Chanchaga women were related to their occupations (85%) and child care and family relationships (64%). Friends and family members were the major sources of information for 95% of the respondents, while 75% also relied on age groups. Information was mainly used to improve occupations (91%) and to care for children and manage family affairs (78%). The study identified the lack of library resources (98%), illiteracy (76%), and language barriers (66%) as the primary obstacles to information access. Recommendations were provided to enhance dissemination of information resources to Chanchaa women in Niger State.

Keywords: Better life; Rural women; Information dissemination; Information resources, Chanchaga

Introduction

Rural women in many parts of the world, including Nigeria, face a myriad of challenges that impede their socioeconomic development. These challenges are often exacerbated by limited access to information and resources that could otherwise enhance their quality of life. In Chanchaga Local Government Area (LGA) of Niger State, the situation is no different. Despite the global push towards gender equality and the empowerment of women, rural women in this region remain marginalized due to various factors such as poverty, lack of education, cultural norms, and inadequate infrastructural development.

Historically, rural areas in Nigeria have lagged in development compared to their urban counterparts. Chanchaga LGA, predominantly an agrarian society, relies heavily on subsistence farming and small-scale trading. The socio-economic status of women in this region is particularly precarious due to their restricted roles in the agricultural value chain and limited participation in more lucrative economic activities. Women often have less access to land ownership, financial services, and markets, which perpetuates a cycle of poverty and dependency (Fola, 2023).

Education is a critical factor in the empowerment of individuals and communities. However, educational attainment among women in rural Nigeria is significantly lower than that of men. This educational disparity is more pronounced in regions like Chanchaga, where cultural and religious norms sometimes limit the pursuit of formal education by girls and women

(UNESCO, 2018). Consequently, the lack of education hampers their ability to access, comprehend, and utilize information that could improve their living conditions.

Furthermore, cultural norms and structural barriers play a significant role in the marginalization of rural women. In many cases, traditional beliefs and practices dictate the roles and responsibilities of women, confining them to domestic spheres and limiting their engagement in public and economic life (Olawoye, 2024). Additionally, infrastructural deficits such as poor road networks, inadequate healthcare facilities, and lack of digital connectivity further isolate rural women from essential information and services.

Access to information resources is crucial for the empowerment of rural women. Information on health, education, agriculture, legal rights, and financial opportunities can significantly enhance their ability to make informed decisions and improve their livelihoods (World Bank, 2018). Libraries, community information centers, and mobile information services are pivotal in bridging the information gap. They provide rural women with access to relevant and timely information that can foster their social and economic development.

The choice of Chanchaga LGA as a case study is pertinent due to its representation of the challenges faced by rural women across Nigeria. It serves as a microcosm of the broader issues impacting rural women in similar contexts. By examining the dissemination of information resources in Chanchaga, this study aims to examine the better life for rural women through the dissemination of information resources in Chanchaga Local Government Area (LGA) of Niger State.

Statement of the Problem

Despite global and national efforts to improve the status of women, rural women in Nigeria, particularly in Chanchaga Local Government Area (LGA) of Niger State, continue to face significant barriers to their social and economic development. These barriers are multifaceted and include limited access to education, healthcare, financial services, and most critically, information resources. Information is a powerful tool that can empower individuals to make informed decisions about their lives. However, the dissemination of information resources in rural areas like Chanchaga is often inadequate, leaving women ill-equipped to overcome the challenges they face.

Objective of the Study

This study is aimed at achieving the following objectives:

1. To identify the information needs of women in Chanchaga (LGA) of Niger State;
2. To identify the sources of information the women in Chanchaga are familiar with;
3. To know how women in Chanchaga use information;
4. To identify factors that poses barrier to the access of information by rural women;

In order to guide the researchers in this study, the following questions were designed in line with the objective of the study:

1. What are the information needs of women in Chanchaga?
2. What are the sources of information the women in Chanchaga are familiar with?
3. To what use the women in Chanchaga put the information obtained?
4. What are the factors militating against the accessibility of information to meet women needs?

Literature Review

The empowerment of rural women through access to information resources has been a focal point of development initiatives globally. Various studies have highlighted the critical role of information in enhancing the socioeconomic status of women, particularly in rural areas where access to resources is limited.

Rural women have distinct information needs that span various domains including agriculture, health, education, legal rights, and financial services. Studies indicate that access to relevant and timely information can significantly improve their decision-making abilities and overall quality of life (Fola, 2023). For instance, agricultural information can help women adopt better farming practices, increase productivity, and gain access to markets (Meera, *et al.,* 2024). Health information is crucial for improving maternal and child health outcomes, as well as general well-being (World Health Organization, 2018).

Low literacy levels among rural women limit their ability to access and understand information. The United Nations Educational, Scientific and Cultural Organization, UNESCO (2022) reports that literacy rates are significantly lower among rural women compared to their urban counterparts, largely due to cultural and economic factors that deprioritize girls' education. The digital divide is pronounced in rural areas where infrastructure for internet and mobile connectivity is lacking. The International Telecommunications Union (2020) highlights that rural women are less likely to have access to digital technologies, further limiting their ability to benefit from online information resources.

Cultural norms often restrict women's roles to domestic spheres, limiting their mobility and access to community information centers or gatherings where they could acquire valuable information (Olawoye, 2024). Additionally, social norms may discourage women from seeking information or participating in community decision-making processes.
Establishing community information centers equipped with relevant resources and staffed by knowledgeable personnel can provide a focal point for information dissemination. These centers can offer training sessions, workshops, and access to print and digital materials (Fola, 2023).

Additionally, utilizing mobile technology to deliver information directly to rural women is promising. Mobile phones can be used to disseminate agricultural advice, health tips, and market information. Studies have shown that mobile information services can significantly enhance the reach and impact of information dissemination efforts (Gakuru, *et al.,* 2019).

While there is substantial literature on the benefits of information access for rural women, several gaps remain. There is a need for more context-specific studies that examine the unique challenges and opportunities in different rural settings. Additionally, there is limited research on the long-term impact of information access on rural women's lives and the effectiveness of different dissemination strategies. Addressing these gaps requires a comprehensive and multidisciplinary approach that combines insights from information science, development studies, and gender studies.

This highlights the critical role of information in empowering rural women and improving their socioeconomic status. However, significant barriers to information access remain, particularly in rural areas like Chanchaga LGA. Effective strategies for information dissemination must address these barriers and be tailored to the specific needs and contexts of rural women. This study aims to contribute to this body of knowledge by examining the dissemination of

information resources in Chanchaga and proposing actionable strategies for improving the lives of rural women through better information resources and access.

Methodology

The study utilized a descriptive survey method. A questionnaire served as the primary data collection tool, supplemented by oral interviews to clarify unclear aspects of the questionnaire. Since only a few literate women could complete the questionnaire independently, most participants were interviewed, and their responses were recorded on the questionnaires. The study population comprised individuals from Chanchaga LGA in Niger State, Nigeria. A random sample of 300 respondents was selected. Two research assistants were trained to help distribute and collect the questionnaires and conduct interviews with illiterate rural women in the Hausa and Gwari/Gbagi languages. During data collection, researchers observed the rural women in their everyday environments, including farming, trading, and performing household chores. Out of the 300 questionnaires distributed, 294 were successfully retrieved, resulting in a 98% response rate. The data collected were analyzed using tables, percentages, and frequency distributions.

Result and Discussion of findings

Table 1: Demographic Distribution of Respondents (Chanchaga Women) by Age

Age Group	Frequency	Percentage (%)
Below 30	70	24%
31-40	120	41%
41-50	54	18%
51- 60	40	14%
61 and above	10	3%
Total	294	100%

Table 1 presents the demographic details regarding the ages of the respondents. The data indicate that among the 294 respondents, 41% are between 31-40 years old, 24% are under 30 years old, 18% are aged 41-50 years, 14% are between 51-60 years old, and 3% are 61 years and above.

Level of Education	Frequency	Percentage (%)
Non Formal Education	72	25%
Primary	62	21%
Secondary	130	44%
Tertiary	30	10%
Total	294	100%

Table 2 details the educational levels of the respondents. The results show that the majority of women, 44%, have completed secondary school. Additionally, 25% of the respondents have non-formal education, 21% have primary school education, and only 10% have attained tertiary education.

Table 3: Information needs of Respondents

Information Needs	No of Respondents	Percentage (%)
Child care & family relationships	189	64%
Occupation (Farming Sewing, Trading etc.)	249	85%
Health Related	165	56%
Procedures for performing tasks	127	43%

Housekeeping and household maintenance	98	33%
About education & schooling	71	24%
Government Policies/ Politics	29	10%

Table 3 reveals that the primary information needs of rural women are occupational-related, with 85% of respondents indicating this as a top priority. Other significant information needs include child care and family relationships (64%), health-related information (56%), procedures for performing tasks (43%), housekeeping and household maintenance (33%), education and schooling (24%), and government policies/politics (10%).

Table 4: Sources of Information of Respondents

Sources of Information	No of Respondents	Percentage (%)
Friends and Family Members	279	95%
Age Group	221	75%
Health Workers	217	74%
Television/ Radio	174	59%
Churches and Mosques	127	43%
Village, Drums & Town criers & Whistling.	97	33%
Internet	61	21%
Library	10	3%

Table 4 provides a detailed breakdown of the main sources of information for respondents. The majority, 95%, rely primarily on friends and family members. Age groups are another significant source, indicated by 75% of respondents. Health workers are a key source for 74% of the respondents, while 59% depend on television and radio for information. Additionally, 43% of respondents obtain their information from churches and mosques. Traditional communication methods, such as village gatherings, drums, town criers, and whistling, are used by 33% of respondents. The internet is a source for 21% of respondents, and libraries are the least utilized, with only 3% of respondents turning to them for information.

Table 5: Information use of Respondents

Information Use by Respondents	No of Respondents	Percentage (%)
To improve my Occupation	269	91%
To care for my children and run the family	235	78%
To improve my health care	187	64%
To maintain my household better	115	39%
To improve my procedures of performing tasks	103	35%
To improve my education	71	24%
To know new government policies and understand politics	44	15%

Table 5 indicates that the primary use of information among respondents is to improve their occupation, with 91% attesting to this. Additionally, 78% use information to care for children and manage family responsibilities, while 64% utilize it to enhance health care. Maintaining the household is a use for 39% of respondents, and 35% use information to improve task procedures. Education improvement is cited by 24% of respondents, and 15% use information to stay informed about new government policies and understand politics.

Table 6: Barriers to the access to Information by Respondents

Barriers in Information Seeking	No of Respondents	Percentage (%)
No Library Resources	287	98%
Illiteracy	223	76%
Language Barriers	195	66%
Lack of Time	171	58%
High Cost of electronic Gadgets	98	33%

Table 6 demonstrates that the primary barrier to accessing information among respondents is the lack of library resources, as indicated by 98%. Additionally, 76% of respondents face illiteracy as a barrier, 66% encounter language barriers, 58% are hindered by a lack of time, and 33% are impeded by the high cost of electronic gadgets.

Discussion of Findings

Table 1 provides a detailed age distribution of Chanchaga women among the 294 respondents. The results reveal that 24% of the respondents are under 30 years of age, while the largest group, 41%, falls within the 31-40 years age range. Additionally, 18% of respondents are aged between 41 and 50 years, 14% are between 51 and 60 years old, and the smallest group, 3%, consists of those who are 61 years and older. This data indicates that the majority of respondents are within the 31-40 years age bracket.

Table 2 illustrates the educational levels of the respondents. The data reveals that the majority of Chanchaga women, 44%, have completed secondary school education. Additionally, 25% of the respondents have non-formal education, 21% hold only primary school certificates, and a small proportion, 10%, have obtained B.Sc degrees.

Table 3 confirms that the primary information need of Chanchaga women is occupation-related, as indicated by 85% of respondents. This finding aligns with the study by Hossain and Islam (2022), which found that 86.66% of rural women in Bangladesh primarily needed agricultural information, a category that also falls under occupational information needs. Other significant information needs identified include child care and family relationships (64%), health-related information (56%), procedures for performing tasks (43%), housekeeping and household maintenance (33%), education and schooling (24%), and government policies and politics (10%).

Table 4 reveals that the primary source of information for Chanchaga women is friends and family members, with 95% of respondents relying on this channel. This finding is consistent with the study by Saleh and Lasisi (2021), which noted that Chanchaga women frequently obtain information from friends, relatives, husbands, sons, daughters, and market women. Additional sources of information include age groups (75%), health workers (74%), television and radio (59%), churches and mosques (43%), village drums, town criers, and whistling (33%), the internet (21%), and libraries (3%).

Table 5 indicates that the primary reason Chanchaga women use information sources is to improve their occupation, with 91% of respondents reporting this motive. Additionally, 78% use information to care for children and manage family responsibilities, 64% to enhance health care, 39% for household maintenance, 35% to improve task performance procedures, 24% to further their education, and 15% to understand new government policies and politics. These

findings demonstrate that the main motivation for seeking information among Chanchaga women is to enhance their occupational knowledge, which in turn helps them improve their standard of living and rise above poverty.

Table 6 clearly shows that the primary barrier to accessing information for women in Chanchaga is the lack of library resources, as reported by 98% of respondents. This finding aligns with the study by Igbal, Yousaf, and Soroya (2023), which found that in Soon Valley, Pakistan, the absence of public libraries, as well as school or college libraries, significantly hindered access to information for rural women.

Conclusion and Recommendations

The study indicates that rural women in Chanchaga LGA, Niger State, recognize the importance of information, often relying on family members, friends, and relatives as their primary sources when needed. They utilize this information to enhance their understanding of their primary occupation, farming. However, a significant obstacle to information access of these rural women is the lack of adequate library or information resources. Many rural areas in Nigeria either have substandard library services or no library at all, severely limiting information accessibility for rural women.

Regardless of location, women often serve as the primary seekers of information for their children and other family members, as well as for themselves (Warner and Procaccino, 2024). In conclusion, public libraries in Nigeria need to improve their efforts in marketing their services to rural residents, especially women, to enhance their access to information resources and ultimately contribute to a more literate society.

Recommendations

In view of the foregoing, the following recommendations were made:

- Public library staff should engage more closely with rural women to educate them on available services that can meet some of their needs.
- The government should develop policies centered on rural women to improve their standard of living in Nigeria.
- Libraries should acquire books in the local languages of rural communities so that illiterate rural women can also benefit from library services.
- Libraries should collaborate with media houses and other government information agencies to package and disseminate the right information that meets the needs of rural women in different localities.
- Community outreach programs should be organized to disseminate information that would aid the socio-economic, political, and general enlightenment of rural women.
- Family members, friends, and relatives, who are the primary sources of information for rural women, should strive to provide accurate information.
- Local governments should organize adult education programs for rural women to enhance their ability to utilize information.

- Rural women should be encouraged to use electronic gadgets for recreational reading, as all newspapers published in Nigeria are available online.

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LEVERAGING ARTIFICIAL INTELLIGENCE FOR ENTREPRENEURSHIP EDUCATION IN NIGERIAN HIGHER EDUCATION

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Abstract
This article provide a review on leveraging artificial intelligence (AI) for entrepreneurship education in higher education. The article delves into various aspects, including ethical education, cultivating innovative thinking, and continuously updating curricula. Higher education institutions actively drive the transformation of entrepreneurship education by collaborating with industries, establishing incubators and mentorship programs, and participating in the integration of academia and industry. This comprehensive approach aims to equip students with a better understanding and application of AI technology, emphasizing the enhancement of practical skills, and highlighting the development of holistic capabilities, ethical perspectives, and a sense of social responsibility. This article discussed the role of AI in entrepreneurship education in higher education. The challenges hindering the integration of AI in higher education of Nigerian higher education were also identified. The study recommended that curriculum should be developed to align with the integration of AI in entrepreneurship education discipline.

Keywords: Artificial Intelligence (AI), Entrepreneur, Entrepreneurship Education, Higher Education.

Introduction
Globally, there is a need for teachers to inculcate in their students the skills that would enable them thrive in this ever changing world of innovation and cope with life challenges. With the advancement of Artificial Intelligence (AI) job roles are changing as some jobs are going into extinction to pave way for the introduction of new jobs. In Nigeria, to have sustainable workforce for future jobs and human resources experts' requirements, teachers must significantly educate their students and emphasis their acquisition of relevant skills to enable them become future entrepreneurs. This was buttressed by Tan (2020) who opined that the teacher exerts a triple role of being a content expert and creator, a knowledge spreader, and "an ethical-spiritual guide" with wisdom. The students should be able to chase trends and not just stay current with the events and environment (Elhajjar *et al.,* 2021). Hence, the demand for innovative teachers embracing change, integrating new materials, and enabling student-AI interactions in education is increasing.

AI offers numerous benefits to education as it can provide opportunity to enhance students' skills, act as an educational partner and enhance content and competencies (Tan, 2020). Elhajjar et al. (2021) added that integrating AI into education can equip students with skills essential for future jobs and digital society's demands, such as innovation, creativity, and design thinking. AI technology in education is expected to grow significantly in the coming decades, presenting new opportunities and challenges (Ouyang and Jiao, 2021; Zhang and Aslan, 2021; Khosravi et al., 2022). Researchers, policymakers, and practitioners are

integrating AI in education to enhance teaching, personalised learning, assessments, and administrative services (Zhang and Aslan, 2021; Chiu et al., 2023). AI represents progress in education, offering benefits on multiple levels, and stimulates the evolution of teaching and learning through technologies like chatbots, robots, automated assessment, digitised artefacts, and intelligent tutoring systems, despite occasional organisational challenges (Chiu et al., 2023). The demand for adaptive digital learning with AI support has surged in the past decade, driven by challenges like the Covid-19 pandemic and social conflicts in contemporary societies (Matzavela and Alepis, 2021). AI provides feasible solutions to complex societal problems, enabling students to engage closely with global challenges and develop real-life problem-solving skills (Southworth et al., 2023). Hence, AI is paving for new approaches in instructional delivery.

Artificial intelligence in entrepreneurship education

The integration of AI in entrepreneurship education requires transdisciplinary skills to enhance the learning experience (Southworth et al., 2023). AI in entrepreneurship education aids innovative ways teachers and students can teach and learn concepts of entrepreneurship and supports teachers' administrative tasks, educational services, assessments, and procedures. Giuggioli and Pellegrini (2023) conducted a systematic literature review on AI as an enabler for entrepreneurs. They identify three clusters in the literature that align as sequential phases in an "AI-enabled entrepreneurial process" opportunity, decision-making, and performance. The authors point out that these phases are compatible with the conceptual framework developed by Chalmers et al. (2021), who consider impacts of AI on antecedents of venture creation, firm-level activities (prospecting, organizational design, and exploiting), and outcomes of venture creation. In particular, opportunity relates to prospecting activities, decision-making to organizational design, and performance to exploiting activities. Gerling et al. (2022) presented a critical review of literature on AI in digital entrepreneurship from a socio-technical viewpoint. They classified their reviewed papers into three research perspectives: agency, processes, and outcomes and structured them based on three phases of opportunity, decision-making, and performance.

Opportunity is referred to as prospecting and focuses on production of new venture ideas (Giuggioli and Pellegrini, 2023). Large datasets and learning algorithms that can see otherwise imperceptible patterns or make precise predictions can be turned towards entrepreneurial opportunity and exploitation (Cockburn et al., 2019). AI as a technological breakthrough changes the business environment and has been described as an external enabler of entrepreneurial activities and success (Davidsson et al., 2020; Davidsson and Sufyan, 2023). In the opportunity phase, the entrepreneur looks for ways to reshape and enhance traditional business model approaches with AI (Giuggioli and Pellegrini, 2023). AI can assist in discovering or creating opportunities (Lupp, 2023). AI can influence the decision to start a company and how entrepreneurs develop, design and scale (Chalmers et al., 2021). The AI revolution is predicted to be in full force by 2030s and will have a great impact on industrial and digital revolutions, technological change, opening growth and profit opportunities and increased competition from venture and crowd sourced startups (Madridakis, 2017). Many of the new opportunities for entrepreneurs with AI concern vertical integration, making the design of business models fundamental to get useful technologies to the marketplace (Garbuio and Lin, 2019).

AI may positively affect the economy, entrepreneurship development, and company opportunities (Mamedov et al., 2018). A subcategory of digital entrepreneurship, sensor-based entrepreneurship, uses passively sensed Internet of Things (IoT) data to provide products or

services, changing how we interact with objects, each other, and how companies interact with their customers (Brown, 2017). IoT data also includes manufacturing process data, which enables an understanding of transaction costs for non-ownership services. This may give rise to entrepreneurial opportunities for new business models such as providing manufacturing assets, maintenance, operation, analytical services, and services targeted at the end user such as customization (Ehret and Wirtz, 2017).

Shepherd and Majchrzak (2022) demonstrated how AI is transforming four sectors of the economy which include customer service, financial, healthcare, and education through applied examples explaining how those transformations affect entrepreneurship. For the customer service sector, Facial recognition is used to respond to emotional reactions, predictive modeling for delivery speed, security through voiceprint, and multilingual chatbots. For example, a voice-enabled human-like avatar at an online store can answer questions, help navigate, highlight promotions, and make recommendations to increase customer engagement (Brown, 2021). Customer service entrepreneurial opportunities may include developing AI-based customer service products and using those products to identify customer needs, leading to additional entrepreneurial opportunities; improved venture speed, customization, quality, and reliability; and more secure payment (Shepherd and Majchrzak, 2022). For the financial sector, AI is enabling financial fraud detection and response, blockchain security improvements, financial investment identification, and customized risk assessments.

The financial entrepreneurial opportunities emphasized are product creation and using these products as verticals in ventures for fraud protection, accessing debt capital, and increased financial security for customers. For the healthcare sector, AI is used for diagnosis, recommending treatments, predicting outcomes, and robotics. Healthcare entrepreneurial opportunities include products and services, but also ownership and management of healthcare businesses. For the education sector, AI is used for virtual teaching assistants, personalizing programs and interventions, checking plagiarism, and grading. Entrepreneurial opportunities in this sector comprise products and services, and more effectively identifying and exploiting opportunities, starting organizations, and growing ventures and enterprises. AI can support innovation management by offering more systematic approaches when traditional innovation management resources are overwhelmed and hampered by information processing constraints (Haefner et al., 2021). More specifically relating to digital entrepreneurship, AI supports identifying and acquiring knowledge, customizing products and services as a competitive entrepreneurial strategy, and managing product innovation.

The role of Artificial Intelligence on entrepreneurial performance and outcomes

The advancement of AI has led to job displacement through automation and thereby potentially higher profits for innovative entrepreneurs and their capital investors. Chalmers et al. (2021) asserted that AI technologies has enabled some entrepreneurs with high technological skills and venture capital firms to gain large financial returns with comparably little effort. The rewards might often be concentrated in large corporations who control critical amounts of capital and expertise. AI technologies may also favour large firms due to their ability to accumulate big amounts of data. AI might lead to industry concentration and the rise of firms (Autor et al., 2020). A focus on access to AI algorithms and models showed that open-source technology would facilitate market entry for entrepreneurs, whereas proprietary algorithms may lead to oligopolistic or monopolistic tendencies. Open-source algorithms may form a scaffold for entrepreneurs upon which they can build their applications and tools, although open-source software may still come with conditions for use. Montes and Goertzel (2019) argue that decentralized and distributed AI can bring about more equitable development of AI.

The disadvantage of making AI open source is the concern that the open AI technologies could be misused by unauthorized personality. This may amplify risks of AI such as misinformation or bias. On the other hand, open-source technology can be scrutinized by a larger and independent community, which may decrease risks in a democratic way. OpenAI initially announced it would make its algorithms publicly available but has since retreated from that plan; Google and most other tech companies also keep their AI models closed. Meta made its trained generative AI text model Llama (the model's weights, evaluation code, and documentation) openly available, although not the training data and the code used to train it (Nolan, 2023).

Some researchers have begun to examine the causal effects of AI on performance in entrepreneurship by running field experiments. For instance, Otis et al. (2024) randomly assigned 640 Kenyan entrepreneurs into a treatment and a control group. They gave the treated participants access to an AI mentor via their smartphones powered by the LLM GPT-4. The control group received a standard business guide instead. Access to the AI advice did not influence performance on average in the full sample. However, when splitting the sample by pre-treatment performance, the authors find interesting heterogeneity. Entrepreneurs in the treatment group with above-median performance increased their business performance by 15%, whereas those with below-median performance decreased their performance relative to the respective control groups. Further analysis revealed that entrepreneurs in both groups used the AI advisor, but low performers consulted it for more challenging tasks, which may have had adverse effects. Overall, the results point to the potential that AI might lead to an increasingly unequal distribution of rewards between high and low performing entrepreneurs. Also, McKenzie and Sansone (2019) reported that machine learning (ML) did not improve the prediction of performance outcomes (business survival, employment, sales, and profits three years later) in a business plan competition in Nigeria. They compared the performance of the ML approach using more than 500 variables to simple prediction models such as logit regressions using only a handful of ad-hoc predictor variables. However, human judges performed even worse than the simple prediction models, as their scores were uncorrelated with the outcomes. Blohm et al. (2022) compare the returns from investing via an angel investment platform between 255 human business angels and an ML algorithm. On average, the algorithm achieved higher investment performance, and only experienced human business angels outperformed the machine. Further analysis revealed that experienced human business angels are particularly successful when they are able to suppress three decision biases: overconfidence, loss aversion, and local bias, that is, the tendency to make investments in close proximity to the investor's own location.

While the result of Blohm et al. (2022) seems promising for AI, the underwhelming results reported by Otis et al. (2024) and McKenzie and Sansone (2019) are consistent with the challenges brought by the large uncertainty in entrepreneurship discussed at the opening of this section. In contrast, generative AI has been shown to lead to measurable performance increases in more narrowly defined tasks such as writing tasks (Noy and Zhang, 2023) or customer support (Brynjolfsson et al., 2023), suggesting that AI might currently provide more useful support to more specialized employees than to entrepreneurs dealing with a broad range of challenging tasks in the face of uncertainty.

Artificial intelligence in entrepreneurship education of higher education

Higher education institutions play an important role in adapting to the demands of the AI era, which requires continuous adjustments to entrepreneurship education programs to nurture students capable of meeting the rapidly changing needs of this field. The use of AI in

entrepreneurship education can provide opportunity to better meet the needs of entrepreneurs in this AI era, nurture entrepreneurs with all-inclusive skills and practical capabilities of being successful (Sollosy, 2022; Liu, 2023). This not only helps students confront challenges in their professional development but also contributes to the innovative application of AI technology in society.

The first step in the transformation of entrepreneurship education in higher education is the incorporation of core AI concepts. Entrepreneurship education courses should comprise key concepts in the AI field, such as machine learning, deep learning, and natural language processing. By understanding these important concepts in more depth, students can better apply AI technology in entrepreneurship processes. The importance of this step is to ensure that entrepreneurs have the basic technical foundation to grasp and apply the latest AI technologies, thereby enhancing the innovation and competitiveness of entrepreneurial projects needs to own and use new technologies, as such enhancing the innovation and competitiveness of entrepreneurial projects. Integrating these core concepts lays a solid technological foundation for students, preparing them for future entrepreneurial activities.

To better adapt to the age of artificial intelligence, higher education business education should focus on practical projects and internships. This means that students have the opportunity to apply technical skills to a real business environment and deepen their understanding of the field by participating in problem solving. The relationship with the business world is important; by giving students the opportunity to work with the business world, they can directly face and overcome business problems. This practical education not only promotes theoretical knowledge, but also fosters the knowledge and skills students need in the real business process, helping them improve and change the business environment forever. Entrepreneurship education in higher education can provide students with more education through work and internship and improve their competitiveness in terms of skills (Johnson et al., 2016)

Another important measure of business education to adapt to the AI era is business-oriented design. This includes the relationship with the business context to ensure that the knowledge acquired by students during their studies is relevant to the real workplace. To achieve this goal, universities can invite business experts to serve as classroom teachers to teach practical knowledge and combine theoretical knowledge with practical knowledge of doing business. This business model helps students better understand the use of AI technology in business and ensure that the knowledge gained in the classroom has good recommendations. Students can gain direct knowledge of business trends and business practices through in-depth discussions with business experts and be better prepared for the future. Therefore, business-oriented design is an important concept for business education in schools to help entrepreneurs develop closer to the real needs of the business.

AI in entrepreneurship education offers aspiring entrepreneurs in higher institutions the opportunity to enhance their higher-order thinking skills. This includes encouraging students to think about how AI technology can be used to solve real-life problems. By creating new ideas, students can use technology more flexibly and effectively to solve business problems. Additionally, it encourages students to propose new business ideas and find new business opportunities by incorporating smart technology. Cultivating new thinking not only helps students better understand the business of intellectual technology, but also gives them the talent and imagination needed to find new entrants in a highly competitive market. Therefore, the development of new thinking is an important part of business education in higher education,

providing students with significant support in solving business problems in the age of intelligence.

To accelerate the development of knowledge field of entrepreneurship in higher education, there is need for constant updating of the content to be taught and learnt. Due to constant changes in technology, entrepreneurship education needs to be updated and updated to ensure students learn new skills and understand the business. This should create a flexible learning model that allows universities to respond quickly to changes in the market and incorporate the latest knowledge into the teaching content. Only through constant updating of the course can business education truly provide students with new knowledge and help them adapt for the better and lead the new wave of development in the era of wisdom. Therefore, the success of entrepreneurship education in higher education depends on the ability to instantly update the content to meet the changing needs of the skill field and this constant updating can be facilitated with the integration of AI in entrepreneurship.

The application of Artificial Intelligence in the entrepreneurial process is vital for student training. Through equipping students with relevant skills and knowledge, universities can guarantee that they can thrive in entrepreneurship in the AI era. Entrepreneurship education is designed to provide students with the skills necessary to identify opportunities, develop business models and create value. The use of artificial intelligence in education brings with it many opportunities that are especially important for the business world. Artificial intelligence provides entrepreneurs with the tools and knowledge they need to be successful. Integrating AI into entrepreneurship education can enhance these capabilities. For example, AI-powered analytics can help students understand business and customer preferences, which is critical to improving business operations. Predictive analytics tools reduce the risks associated with new ventures by allowing students to test business ideas and develop ideas based on data-driven insights. Additionally, AI can simplify project management, allowing business students to focus on innovation and sound decision-making. An AI learning platform provides effective and efficient learning programs, fosters innovation, and provides entrepreneurs with the skills they need to navigate the complexities of today's business world. The impact of AI on entrepreneurship education is deep because it provides new ways to teach, learn, and practice entrepreneurship.

Students learn the fundamental principles of machine learning and learn how to apply them to the field of entrepreneurship. This includes training students to use machine learning algorithms for data analysis to better understand market trends, user behavior, and other crucial business data. This training not only equips students with advanced technical tools but, more importantly, provides them with the ability to apply data science in entrepreneurial decision making. Through machine learning and data analysis, students will be able to identify business opportunities more accurately, predict market demands, and provide strong support for the entrepreneurial process. Education in this field establishes a solid technological foundation for students in entrepreneurship in the AI era, making them more competitive and innovative. Therefore, education in machine learning and data analysis becomes a key element in entrepreneurship education at universities, providing students with essential tools and knowledge for their entrepreneurial journey in the AI era.

Entrepreneurship education in higher education also emphasizes developing students' skills in natural language processing and intelligent product development. Students learn how to leverage natural language processing technology to develop intelligent products and services, including virtual assistants, speech recognition systems, and intelligent chatbots. Through

training, students gain the ability to integrate natural language processing technology into entrepreneurial projects, thereby enhancing the level of product intelligence. This education not only enables students to understand and proficiently apply the latest language processing technologies but, more importantly, cultivates their ability to transform these technologies into practical products in entrepreneurship.

Computer vision and image recognition enables students to fully utilize computer vision technology in entrepreneurial projects. This technology has widespread applications in product design, security monitoring, virtual reality, and more. Through training in computer vision and image recognition, students will understand and apply these advanced technologies, creating innovative products with visual perception capabilities. This not only expands students' technological horizons but also brings more possibilities to them in the entrepreneurial process, enabling them to stay at the forefront of innovation with advanced visual technology.

Deep learning, as an essential branch of the AI field, requires students to learn how to build, train, and optimize deep learning models. Training courses enable students to understand the fundamental principles of deep learning technology and teach them how to apply it to solve real entrepreneurial problems, such as image recognition and speech generation. This training not only provides students with the technical tools needed for entrepreneurship in the AI era but also nurtures their ability to apply deep learning technology in practice. In the rapidly evolving landscape of entrepreneurial opportunities, the application of deep learning has become a powerful engine driving innovation.

Entrepreneurship education in higher education focused on providing learning opportunities through practical projects and entrepreneurial case studies. On one hand, this allows students to experience firsthand the application of AI technology in entrepreneurship, gaining a deeper understanding of how technology operates in real scenarios through involvement in actual projects. These practical projects aim to liberate students from purely theoretical learning, deepening their understanding of acquired knowledge through hands-on experience, enabling them to better tackle challenges in entrepreneurship. Through the combination of practical projects and entrepreneurial case studies, entrepreneurship education in higher education not only develops students' practical skills but also enhances their abilities to solve problems and cope with challenges in real situations, laying a solid foundation for their successful entry into the entrepreneurial stage of the AI era.

AI-Powered Design Tools like Canva and Adobe Sensei uses AI to assist entrepreneurs in creating professional designs, logos, and branding materials. Innovation Platforms uses AI to help identify emerging trends and potential areas for innovation by analyzing large datasets, enabling entrepreneurs to stay ahead of the curve. These AI applications not only streamline the educational journey for entrepreneurs, they also provides practical tools and resources that supports the growth and success of entrepreneurs' businesses. In addition to that the application can provide entrepreneurs with tailored learning experiences, critical business insights, and essential resources to foster innovation and growth. This makes entrepreneurs gain a competitive edge, make informed decisions, and efficiently manage their ventures.

AI applications also streamline administrative tasks, allowing entrepreneurs to focus on strategic activities. Financial management tools like QuickBooks and Xero automate bookkeeping, financial reporting, and expense tracking. These AI-driven platforms reduce the time and effort required to manage finances, ensuring accuracy and compliance (Marr 2020). Customer Relationship Management (CRM) systems like Salesforce Einstein and HubSpot

uses AI to enhance customer interactions and predict customer needs. These platforms automate follow-up tasks, segment customers based on behavior, and personalize marketing efforts. By optimizing customer relationships, entrepreneurs can improve customer satisfaction and retention, driving business growth (Batra et al., 2021).

AI-powered mentorship programs and networking tools play a crucial role in supporting entrepreneurial education. Platforms like MentorNet use AI to match entrepreneurs with mentors who have relevant industry experience and expertise. These algorithms consider factors such as the entrepreneur's goals, learning preferences, and mentor availability to create effective and supportive mentor-mentee relationships (McWilliams, 2021). Access to experienced mentors can provide entrepreneurs with valuable guidance, advice, and encouragement. Networking platforms like Shapr and LinkedIn leverage AI to recommend potential business connections based on the entrepreneur's profile and interests. These tools facilitate the building of professional networks, enabling entrepreneurs to connect with potential partners, investors, and collaborators. Effective networking is essential for business growth, and AI makes it easier for entrepreneurs to find and engage with the right people (Van Alstyne et al., 2016).

AI significantly enhances market research and business intelligence which provides entrepreneurs with critical insights for making informed decisions. Platforms like Crayon and Crystalknows use AI algorithms to analyze vast amounts of data, identifying market trends, competitor strategies, and consumer behavior patterns (Davenport and Ronanki, 2018). This information enables entrepreneurs to understand their market landscape better and develop strategies that align with current trends and customer preferences. Predictive analytics, another AI application, helps entrepreneurs anticipate future market conditions. By analyzing historical data and identifying patterns, AI can forecast demand, optimize inventory levels, and suggest pricing strategies. These insights allow entrepreneurs to be proactive rather than reactive, positioning their businesses for long-term success (Siebel, 2019).

Challenges in Integrating AI into Entrepreneurship Education of Nigeria Higher Education

Integrating AI into entrepreneurship education presents numerous challenges despite its potential to revolutionize the field. While AI can enhance personalized learning, automate administrative tasks, and provide advanced data analytics, several significant barriers hinders its seamless integration into Nigerian educational systems among which are:

Limited technological infrastructure and accessibility: One of the primary challenges is the disparity in technological infrastructure. Many educational institutions, particularly in underfunded or rural areas, lack the necessary hardware, software, and stable internet connections required to implement AI solutions. This digital divide exacerbates educational inequities, limiting access to AI-enhanced learning tools for students who could benefit the most. Addressing these disparities is essential for equitable AI education.

Inadequate teacher training and professional development: Effective integration of AI into entrepreneurship education requires teachers to be well-versed in AI concepts and technologies which allows them to possess a robust understanding of AI technologies and their applications. However, many educators lack the necessary training and professional development opportunities to gain proficiency in these areas. This skills gap makes it difficult for teachers to confidently incorporate AI tools into their curricula, hindering the potential benefits of these

technologies. Investing in professional development and training programs is crucial to empower teachers to deliver high-quality AI education.

Rigid curriculum: Designing and implementing an AI-integrated curriculum poses another significant challenge. Existing entrepreneurship education curricula may not align with AI tools and methods, requiring substantial modifications. Curriculum developers must ensure that AI concepts are introduced at appropriate educational levels must balance foundational AI concepts with practical applications while ensuring that the content is accessible and engaging for students at different levels.

Financial constraints: Implementing AI technologies in education can be expensive, encompassing costs for software, hardware, training, and ongoing maintenance. Many educational institutions, especially those already struggling with limited budgets, find it challenging to allocate sufficient funds for these purposes. Securing financial resources and demonstrating the long-term return on investment is crucial for the sustainable integration of AI.

Resistance to change: Nigerian educational systems are traditionally slow to adopt new technologies, often due to institutional inertia and resistance to change. Stakeholders, including educators, administrators, and policymakers, may be skeptical about the efficacy of AI in education or concerned about the potential displacement of traditional teaching roles. Overcoming this resistance requires clear evidence of AI's benefits and a strategic approach to change management.

Conclusions

The transformative changes in entrepreneurial education at universities in the era of AI exhibit various characteristics. These changes range from integrating core concepts of AI, emphasizing practical projects and internship opportunities, to fostering interdisciplinary collaboration, designing courses aligned with industry needs, and emphasizing ethical and social responsibility education while cultivating innovative thinking. This transformation aims to better prepare students for the entrepreneurial environment of the AI era. It not only emphasizes training at the technical level but also focuses on developing practical skills and enhancing overall competence. Through initiatives such as expanding course content, establishing entrepreneurial ecosystems, emphasizing team diversity, and advocating for continuous curriculum updates, universities are committed to nurturing entrepreneurs with comprehensive abilities, innovative thinking, and a sense of social responsibility. This approach aims to better guide and address the entrepreneurial challenges of the AI era. This transformation not only concerns technological advancement but also addresses the decision-making skills of entrepreneurs when facing complex ethical issues. It is dedicated to cultivating well-rounded innovative talents and injecting new vitality into the field of innovation and entrepreneurship.

Recommendations

From the foregoing, the following recommendations were made

i. Curriculum should be developed to align with the integration of AI in entrepreneurship education discipline.

ii. Professional development programmes that focus on both technical AI skills and pedagogical strategies for integrating AI into the classroom should be organized equip lecturers with the knowledge needed to effectively teach AI concepts and use AI tools.

iii. Lecturers of entrepreneurship departments should collaborate with AI experts to support ongoing professional growth and encourage the sharing of best practices among them.

iv. Hands-on learning and project-based approaches should be encouraged so that students can work on real-world projects that apply AI tools to solve practical problems. This hands-on experience helps develop critical thinking, collaboration, and technical skills.

v. AI-powered tools and platforms should be made available and accessible to students for them to experiment with coding, data analysis, and machine learning.

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TECHNOLOGICAL SKILLS TRAINING NEEDS FOR YOUNG ENTREPRENEURS IN IMPROVING DIGITAL LITERACY FOR EMBRACING TVET

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Abstract
The success of young entrepreneurs in technological training in any country can be considered as a key factor of the country's growth, wealth creation, youth's empowerment and technological development. For a country to achieved business growth, its entrepreneurial sector must play a vital role. A country like Nigeria which its population is rapidly growing, youth engagement into technological skill acquisition is very vital. The paper focused on Technological Skills Training Needs for Young Entrepreneurs in Improving Digital Literacy for embracing TVET, which could address the problems of youth unemployment, some technological skills were identified such as Data Management, Social Media Marketing, Programming/ Website Development, Graphics, Artificial Intelligence Programming, among others which requires training, implications for improving Digital Literacy and youths empowerment. Also some challenges facing young entrepreneurs were recognized among others: Taking the First Step, Cash Crunch, Lack of Experience and Business Knowledge, Attracting and Retaining the Right Talent, Time Management, implication for business sustainability. It was concluded that, technological skills training are highly needed for enhancing young entrepreneurs to improve their digital literacy. It was therefore, recommended that, Nigerian youth should equip themselves with technological skills identified that are align with entrepreneurship for youth employment and wealth generation which can be achieved through research, seminars and conferences

Keywords: Technological Skills, Training Needs, Young Entrepreneurs and Digital Literacy

INTRODUCTION
Digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship. The ability to use, access, evaluate and communicate through digital platforms like Internet, data bases and other electronic platforms so that decision could be made based on the result of the digital contents accessed, retrieved, evaluated and communicated as well. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy and media literacy (Nancy, *et al.*, 2018). It was these range of abilities that made the digital literate to have skills that will enable him navigate the digital technologies available. Digital literacy, frequently referred to as digital capability, is the aptitude or skill of an individual in correcting to fast technological advances, in addition to entrepreneurship education (Mulyati, 2023). According to a study by Rizqi, *et al*., (2022), digital literacy is a person's ability to read and realize facts in the digital world. With the

mastery of digital literacy, it will help the community, especially the younger generation, in developing their potential, especially in terms of entrepreneurship (Salisu *et al*., 2022).

In celebration of 2021 World Youth Skills Day, the role of digital technologies cannot be undermined in solving the challenges of unemployment and under skilled labor faced by youth today. One significant advantage of digital technologies is that it can help to mitigate the effects of the unemployment and underpayment crises on youth labor. Recent findings published on World bank Blog ascertain that digital platforms are enabling students to pursue online learning, entrepreneurs to engage in e-commerce, and workers to earn income through online freelancing and micro work. These remote opportunities are particularly beneficial for young women and other vulnerable youth who have been disproportionately affected by the crisis.

Technical training is one variety of training a learning management system can facilitate. There are multiple types of technical training, but in general, technical training develops skills related to the design development, implementation, operation, maintenance and support of a technology product. Youth Digital Skill Accelerator (YODA) Program is a skill development program introduced by "BE THE CHANGE AFRICA INITITIAVE" aimed at closing the gap in digital skill facing the vulnerable young men and women today. The program cover five major area of interest in today's digital skill. Each of them to taken by subject matter experts and professionals. These are; Data Management, Social Media Marketing, Programming/ Website Development, Graphics, Artificial Intelligence Programming, Artificial Intelligence, Data Analysis, Machine Learning, Cybersecurity, Web Development, Cloud Computing, Mobile App Development, Software Testing, Network Administration, CAD Software and Situation Analysis (Alphabeta, 2021).

Mankind has witnessed an unprecedented growth in the number and variety of information products, services, systems and sources available. There have been rapid innovations in electronic technologies for creating, processing, communicating and using information. This emerging development raises concerns about the technology used in handling information because of the associated increased workload. This is especially the case in entrepreneurship, where quality improvement depends on the quality of documentation, security of information and prompt retrieval of information (Mulyati, 2023). These goals can largely be accomplished through the deployment of IT, which facilitates the use of technology to supports decision making processes.

Technical skills are typically "hard skills," which you acquire through training or education and use to accomplish a given task. Most professionals need to have some degree of technical skill knowledge, thanks to the nature of today's work environment (Ozili & Arun, 2020). Consider how often things like social media, email, cloud-based applications like Microsoft Office, bank cards and barcode scanners, and wireless devices pop up in our everyday lives, either at work or at home. It looks like no one can navigate through today's high-tech working world without possessing at least some rudimentary technological skills.

Youth entrepreneurship is becoming increasingly beneficial to economic development in today's world. One of the most direct ways in which youth entrepreneurship contributes to economic development is through job creation. Young entrepreneur is any youth who establish or startups a business which require skilled labor, thereby reducing unemployment rates in their communities, as these businesses expand, they continue to hire more employees, stimulating economic growth and providing a stable income source for many. Also, youth entrepreneurs often bring fresh perspectives and innovative ideas to the market (Mulyati, 2023). Their

willingness to take risks and experiment with new concepts results in the development of new products and services. This innovation is essential for economic progress, as it can disrupt existing industries and create new markets, ultimately fostering competition and productivity. Youth-led startups diversify the economy by introducing a wider range of products and services. Economic diversification is crucial for a nation's stability and resilience, as it reduces dependence on a single industry or sector. By nurturing an environment where young entrepreneurs can thrive, countries can bolster their economic resilience.

Digitalisation, transition towards a greener economy and demographic changes will continue to increase digital skills gap. Thus, digital literacy is the most audacious enabler of lifting 100 million Nigerians out of poverty as targeted by the Federal Government. Despite all the entrepreneurship training possed by Nigerian youths, technological skills training can successfully tackle level of unemployment and restiveness at the same time produce more raw materials for industries, more businesses for our country and more products for exportation. Based on the aforementioned issues the researchers assessed Technological Skills Training Needs for Young Entrepreneurs in Improving Digital Literacy in Nigeria.

Literature Review

2.1 Digital Literacy Skills

Digital literacy means abilities one have to access the internet, find, manage and edit digital information, join in communications, and otherwise engage in online information and communication network Glisters (1997) in (Lavelle, 2021). Digital literacy as a proficiency in utilizing and manipulating information in online-format and to process information from a variety of sources and formats so that one can create one's own knowledge path. These skills, that will make one to find, access, manage and communication information in an online environment from the digital technologies require tracing which brings about digital literacy. Digital literacy skills are defined as the skills necessary to use computers, digital communication, online applications, and other digital devices. These skills are needed in many of today's jobs. Digital transformation is the process of adopting digital technology. A good number of SMEs are increasing their use of digital technology. According to Statista, spending on global digital transformation is forecast to reach $3.4 trillion by 2026 (Education & Skills, 2020). In addition to this, jobs that require a bachelor's degree and pay a living wage require applicants to have baseline digital skills. At the most basic level, improving the digital literacy will likely increase the chances of getting hired because the market has a great need for workers with strong digital skills, and in fact, half the global workforce will require reskilling by 2025 as the adoption of technology increases, according to the World Economic Forum's Future of Jobs report. (Ojeomogha, 2019).

Digital skills training is not just beneficial for tech workers, it is important for non-tech workers too. Digital skills training bring important benefits to all workers, regardless of whether they are in technology-related roles (Alphabeta, 2021). He further reported that, the most common benefits include: greater efficiency in doing their jobs (indicated by 86 percent of Both tech and non-tech workers in this study report similar benefits from undergoing digital skills training tech workers and 88 percent of non tech workers); greater personal satisfaction (85 and 83 percent); improved employability (83 and 76 percent); and greater job satisfaction (82 and 76 percent). This is consistent with other studies which find that workers in non-tech roles increasingly need basic technological skills – at a minimum – in order to cope with the fast-changing nature of their jobs. Recent research by Gartner demonstrates that "the Information Technology (IT) department is no longer the only go-to place for digital talent." Gartner's study finds that 40 percent of job postings in the US (Hassan *et al*., 2022).

2.2 Technological Skills

Nigerians stand on the periphery of a technological revolution, the Fourth Industrial Revolution (4IR), which has fundamentally altered the way we live, work, and relate to one another2. This revolution was built on the digital or 3rd Industrial Revolution (3IR) that has expanded into disruptive technologies and trends such as the Internet of Things (IoT), Virtual Reality (VR), Artificial Intelligence (AI), robotics, autonomous driving vehicles, 3D printing, nanotechnology, biotechnology, materials science, energy storage, quantum computing, and much more that will require more technical capabilities than career practices formerly demanded. For Nigeria to improve its digital advantage and build sustainable prosperity, it must prepare for the challenges of a 21st century dynamic work environment. Building a digitally skilled workforce will accelerate Nigeria's economic growth and development. The future of Nigeria is clearly hinged on the development of capacity of citizens, and how swiftly a strategy for digital literacy and skills integration can be put in place (Doanh, 2021). As Nigeria aspires to become a regional hub for providing human capital resource support to Africa, with the implementation of the African Continental Free Trade Area (AfCFTA), the need for technology skills is growing in every sector of the Nigerian digital economy.

2.3 Digital Literacy Skill and the Youth

Forming the younger generation to have the intention and interest in starting a business should prioritize the knowledge and provision of human resources so that it is the right step to increase economic competitiveness and reduce unemployment (Rizqi *et al*, 2022). Several previous studies have proven the close relationship between entrepreneurial intention and students. Thus, the role of students is very important in efforts to grow the number of entrepreneurs in Indonesia, considering that entrepreneurs can support the economy, especially after the pandemic season. Intention is a sign or driver of someone doing a certain thing (Ajzen, 2020). The entrepreneurial intention of the millennial generation is influenced by internet support as a digital medium that facilitates business activities (Ajzen, 2020). The potential of digital business is very promising, and the development of this digital business is growing rapidly.

To be able to produce young entrepreneurs who can compete in the digital era, it is very important to train students both in technical skills and non-technical skills through entrepreneurship education. Entrepreneurship education in Indonesia is considered important and needed, so entrepreneurship education is included in the curriculum (Tahir *et al.*, 2021). They further define entrepreneurship education as a type of education and provision of practical information about business, skill development, and self-confidence that are closely related to achieving business success. With entrepreneurship education, SMK is expected to be able to produce graduates who have technical skills following certain midwives, and not only that; they must also have non-technical skills, in the form of good character as a workforce.

2.4 The Need for Digital Literacy

Given that people around the world have the same human potential, every job and career, every field of study and even social and personal lives are increasingly impacted by technology. And as nations compete in today's global world, those economies who have invested in the human capital and digital skills of their citizens are best prepared to grow. To level the playing field, Nigeria must move its citizens to a greater competitive position in the global economic marketplace. Equipping Nigerians with relevant digital literacy skills to keep up with best global practices will put the current workers, youths, and other professionals in ready mode for opportunities that may open within and beyond the shores of Nigeria. This will diversify the economy, significantly reduce unemployment and enhance labour productivity and mobility

(Lavelle, 2021). In turn, this will improve investment and transform Nigeria into a country well known for technology, problem solving and critical thinking.

The evolution of technology has also led to the stratification of countries depending on how they adopt digital technologies. The economic and social development of digitally literate countries has outstripped those of countries that have failed to embrace digital literacy (Stalmachova et al, 2021). Unfortunately, Nigeria currently falls under the latter category. The purpose of this document is to create a National Digital Literacy Framework that would serve as a guide, aimed at reversing this trend. The skills deficits in human capital that hinder Nigeria from thriving in the global digital economy will be, once and for all, overcome.

2.5 Importance of Digital Literacy to an Entrepreneur

Nigerians, current workforce, students, graduates, and professionals need to be prepared for successful adulthood in a world increasingly saturated with digital technologies;
Nigerians are already engaging with digital technologies and digital media and using them to find information and communicate meaning in different modes and formats, which provides significant opportunities and challenges that are important to address; Not all Nigerians are equally equipped with the skills, knowledge and understanding that will allow them to critically engage with technology and to use it well; Developing digital literacy can help students to access subject knowledge at a time when digital technologies are changing the way knowledge is created and communicated; Digital literacy will help schools to engage with students' lived experiences and existing knowledge as well as extending and diversifying these experiences and knowledge to make learning more relevant and purposeful; and There is need to create a pool of knowledgeable and skilled manpower that will facilitate technology acquisition, assimilation, diffusion, mobility and raise productivity. Digital Literacy is a global priority and criterion for employment with over 1.5 billion current virtual workforce vacancies across the world (IDC). Competence in English language is no longer the primary indicator of literacy and job readiness; it is now digital literacy. Digital Literacy is critical to immediate empowerment of our population to enable Nigerians to develop the skills necessary to achieve more, to be distinguished and advance in the digital era and to truly solve the conundrum around education, unemployment, low productivity, and economic diversification (NTDF, 2023).

2.6 Business Case and Potential Impact

According to NBS The development of a National Digital Literacy Framework will further increase the contribution and will: Create a rich and vibrant local industry of digital training service providers; content creators and publishers, marketers, assessment, and certification bodies aligned with globally recognised standards; Create a large value chain that will facilitate youth engagement, entrepreneurship development, MSME development, and women empowerment in line with the best global practice; Motivate Nigerians to achieve globally accepted certifications that will increase job opportunities and mobility across the world, and yield billions of dollars of economic value to Nigeria; Enhance the civil service by improving efficiency, productivity, and increasing service-delivery orientation; Encourage establishment of local Original Equipment Manufacturers (OEM's) to meet increased local demand for IT tools and equipment; and
Increase demand for ICT and broadband, thus helping implementation of broadband and ICT policies (NITDA, 2021).

2.7 Youths and Entrepreneurship

Youth entrepreneurs offer fresh ideas and perspectives. Youth entrepreneurship is linked to increased productivity levels. Young entrepreneurs are often driven by passion, and their energy can lead to more efficient and streamlined processes. With the advent of technology, youth entrepreneurs are also more likely to adopt innovative tools and practices, which can significantly boost productivity in various sectors. Youth entrepreneurs often evolve into future business leaders due to their dynamic approaches, resilience, and adaptability (Wardana *et al.*, 2020). By initially taking risks, learning from challenges, and leveraging their innovative ideas, they acquire invaluable experience and leadership skills. Over time, they build successful enterprises, and their entrepreneurial journeys equip them with the knowledge necessary to guide and inspire others. Youth entrepreneurs play a pivotal role in boosting the economy by efficiently utilizing all three factors of production: land, labor, and capital. Their innovative solutions and business models enhance productivity, leading to economic growth (Flowers & Meyer, 2020). Entrepreneurs also invest capital to fund their ideas, which, in turn, drives economic development. Moreover, they often make efficient use of available resources and land, leading to increased production and economic diversification. As entrepreneurs foster competition and fuel economic activity, they become the driving force behind a thriving and prosperous economy. Ultimately, youth entrepreneurs often go on to become business leaders across various industries.

Challenges faced by Young Entrepreneur

Entrepreneurship is a challenging road to pave. Especially, when you see the established players in the market, you often need clarification on whether it will be possible or not to compete. Here are some challenges that young entrepreneur may faced in accomplishing his venture. As identified by YODA (2021):

1. Taking the First Step

Taking the first step is the most challenging for young entrepreneurs. There can be multiple reasons behind that but a major one is young entrepreneurs try to master perfection before they start. They want everything right in its place: plan, situation, finance, and opportunity.

2. Cash Crunch

Every entrepreneur struggles with money. No entrepreneur will say I have enough cash and can spend as much as I want. You will have to deal with the cash crunch. You have to work within the limited resources.

3. Lack of Experience and Business Knowledge

It is good to be excited about launching a new venture, but experienced candidates know that more than 90% of new businesses fail. This is because most new business owners need to gain the right business knowledge

4. Attracting and Retaining the Right Talent

If you have the plan ready, saved some money for the venture, and analyzed the business risks, it still does not guarantee the beginning of your entrepreneurial journey. It is because you need people to work on the things you have planned.

5. Time Management

According to a poll of readers of the New York Enterprise Report, 70% of respondents also worked at least one weekend on a regular basis. Almost all young entrepreneurs work more than 50 hours a week.

6. Delegation

It is natural to be controlling as an entrepreneur because you want to take responsibility for every action that happens in your organization. But it does not mean you should not delegate. Young entrepreneurs have challenges delegating tasks. They are not able to let go of control and rely on others to do the job.

3.0 Conclusion and Recommendations

There are numerous strategies on ground that have been put in place to improve business startup in Nigeria. Looking at the level of importance attached to entrepreneurship which ought to be one of the utmost priorities of the country to venturing into to reducing the level of crimes, unemployment and improve economic development and the livelihood of individuals/ citizens. Therefore, technological skills training such as social media, email, A I, cloud-based applications like Microsoft Office, bank cards among others are highly needed in other to enhances young entrepreneurs to improve their digital literacy. Based on evidences from the research the following recommendations were made;

1. Nigerian youth should equip themselves with technological skills identified that are align with entrepreneurship for youth employment and wealth generation which can be achieved through research, seminars, conferences and workshops organized by the government and other stakeholders.

2. The higher institutions of learning should include concepts technological skills in entrepreneurship training centers across the country, where training and techniques are provided to the teaming unemployed youths particularly on technological skills for digital literacy.

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A REVIEW ON THE USE OF AUTOMATED ATTENDANCE MANAGEMENT SYSTEM FOR NIGERIAN TERTIARY INSTITUTIONS

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Abstract
This paper presents a review on the use of automated attendance management system for Nigerian tertiary institutions. The review discussed the importance of students' attendance to lectures in tertiary institutions and the role of attendance management system. Common methods used in attendance tracking were highlighted which include: Manual attendance, Roll call software, Biometric attendance system, Radio Frequency Identification (RFID) or smart card systems and Mobile applications. The review also underscore the advantages of attendance tracking system which include: accuracy and time efficiency, data analysis, compliance, communication and report generation. The impact of information technology on attendance management system and importance of quick response were discussed in the review. The paper concluded by advocating further researches on the development of automated attendance system at different levels of education, allocation of more funds to conduct researches on automated attendance system in Nigeria by Government organisations, agencies and Non-Governmental Organisations, procurement of technologies that can enhance the use of automated attendance system in schools. More conferences, seminars and workshops should be organised for Nigerian educational stakeholders to keep them abreast with the global emerging technologies on automated attendance system. Research institutes in Nigeria should consider designing and development of more automated attendance system for lecturers and students.

Keywords: Automated Attendance Management System, Information Technology, Nigeria, Performance, Tertiary Institutions

Introduction
Globally, Information Technology (IT) has played a significant role in developing several aspects in academic sectors and domains such as student monitoring and management systems (Rjeib *et al*., 2018). New technologies such as AI, machine learning, and educational software are not only changing the field of study, they also augment the role of a teacher, create philosophical shifts in approaches to teaching, and redesign the classroom. IT can be integrated to the management and maintenance of student information to ensure monitoring of students' performance and progress which can result in the development of automated attendance management system.

Importance of Students Attendance to Lectures in Nigerian Tertiary Institutions
Attendance to lectures in tertiary institutions in Nigeria is a policy issue and its importance is specified in the students' information handbooks which is made available to all bona-fide students, as they complete their registration exercise. In most cases, the information on the importance of lecture attendance is included in the lectures delivered to fresh students during orientation programmes. An extract of such statements on lecture attendance, from the students' information handbook of the College of Education (C.O.E), Agbor is as follows: "A registered student for NCE (Nigeria Certificate in Education) programme must attain 75% attendance to be allowed to write the end of semester examination" (Amukahara & Asabor, 2020). A similar statement in the students' information handbook of the faculty of Education

of Delta State University (DELSU), Abraka is as follows. "To be eligible for any examination, a student is required to have attained 80% minimum contact hours before he/she is allowed to take the examination for the particular course" (DELSU, 2018). In the same vein, Amukahara and Asabor, (2020) reported that the minimum attendance which students must attain to qualify in writing examination in the University of Ibadan is 75%. This policy makes the keeping and use of records of students' attendance to lectures a mandatory activity, so as to implement it during examinations. However, some lecturers have noted that the policy has not been strictly implemented in all situations, due to various challenges involved in the ways that attendance is been taken, which is mainly manual with paper and pens.

Where the students' populations are large, taking attendance manually reduced the actual lecture period from the normal. At times impersonation at lectures could occur if the lecturer was not able to recognize all students. Hence, students easily skip lectures unnoticed. At present a record of average attendance ranging from 50% to 70% is a common phenomenon observed in tertiary institutions. Consequently, overall performances of students in various courses are adversely affected (Amukahara & Asabor, 2020). Students' absenteeism from lectures has also attracted a wide range of studies in which stakeholders have sought explanations to the challenging trend by describing the factors responsible for it in various academic environments and possible solutions to it using various approaches (Ada *et al.*, 2019; Dommeryer, 2017; Edwards & Clinton, 2019; Khan *et al.*, 2019).

Absenteeism is viewed as a poor motivation for learning which has adverse impact on students' final academic performance. Consequently, it poses a serious challenge to the successful implementation of the curriculum of tertiary institutions which is a tool for the production of high- level manpower in the society. Sequel to these, lecturers and administrators in most developing countries have had to come up with ways to ensure a healthy participation from students, and make sure that the student-lecturer interactive relationship is kept intact. This in some cases have come in simple forms like roll calls, while in more interesting cases, can be formats like surprise quizzes, extra credit in class and so on. These strategies are however time consuming, stressful and laborious because the valuable lecture time that could otherwise been used for lectures is dedicated to student attendance taking and sometimes not accurate (Shete, *et al.*, 2018).

Attendance Management System

Attendance capture and recording plays a huge part in the academic success of students. Low attendance in class most times leads to underperformance by students. By knowing these realities, attendance of a student ought to be given higher priority irrespective of the school's categories (Khan, 2022). The increasing number of students in school nowadays makes attendance taking more tedious and therefore traditional method for taking attendance will not be relevant any longer. Producing reports (on daily, weekly or monthly basis) could be very tedious on the part of the teachers hence, the need for automated attendance system in institutions. The "Attendance Management System" refers to a system or process implemented in educational institutions to track and monitor the attendance of students and faculty members. It is a tool that helps in maintaining accurate records of attendance for various purposes, such as assessing student performance, ensuring compliance with attendance policies, and generating reports. The implementation of an Attendance System can vary depending on the institution's requirements and available resources (Kabir *et al*., 2021). Some common methods used in attendance tracking include:

Manual attendance: This traditional method involves taking attendance by calling out names or using a paper-based attendance sheet. The lecturer or faculty member marks the presence or absence of each student manually. The existing conventional attendance system requires students to manually sign the attendance sheet every time they attend a class. As common as it seems, such system lacks of automation, where a number of problems may arise. This include the time unnecessarily consumed by the students to find and sign their name on the attendance sheet, some students may mistakenly or purposely signed another student's name and the attendance sheet may got lost (Akinola *et al.,* 2021).

Roll call software: Some institutions use specialized software or applications that allow lecturers to take attendance using a digital platform. The software may have features like student lists, check-in buttons, and options for generating reports. The digital roll call system refers to the ability to provide students with online sign-in, automatic, or manual roll call during teaching activities. This system can help teachers grasp students' attendance and absence in real-time. Teachers can use various roll call methods on the digital learning platform. In addition to the methods mentioned above, teachers can also use an APP with a roll call function to assist in obtaining students' attendance. The primary purpose of implementing roll call is to enable teachers to grasp students' attendance and understand their learning status instantly (Liao *et al.,* 2022). According to Ademola *et al*. (2018) attendance management system was meant to serve as a substitute for conventional attendance system to lessen the processing time and paper cost. Moreover, attendance is being taken daily at workplaces and in schools in developing and developed countries and this has made attendance recording an interesting research area; this has led to the different development and implementation of the student attendance system using various methods. Attendance capture and recording plays a huge part in the academic success of students. Low attendance in class most times leads to underperformance by students.

Biometric attendance system: utilizes biometric information such as fingerprints, facial recognition, or iris scans to accurately identify and record attendance. This method is considered more secure and eliminates the possibility of proxy attendance. Many industries and institutions are already using biometric in monitoring the attendance of employees which really saves time and prevents time theft that leads to cost saving. According to Zhang (2018) Biometric technology offers advanced verification of individual because it identifies people through measurements of unique human characteristics such as fingerprints. The use of biometrics for patient identification in the developing world has been explored in other contexts, including health clinics in South Africa, anti-retroviral therapy in Malawi, clinical trials in Vietnam, and tracking of nomadic pastoralists in Chad (Bhatnagar *et al.,* 2021). Furthermore, biometric is the tool which measures individual's unique physical or behavioral characteristics to recognize or authenticate their identity and it is most secure and convenient authentication tool. Individual's unique physical or behavioral characteristics cannot be borrowed, stolen, or forgotten and forging on the other hand is practically impossible. Common physical biometrics includes fingerprints, hand or palm geometry, retina, iris, and facial characteristics. Moreover, biometric technologies capitalize on unique, permanent, and scan-able human characteristics that is unique and no one can share it. All biometric devices take a number of measurements from an individual then digitally process the result of these measurements and save this representation of the individual's traits into a template. Templates are then stored in a database associated with the device or in a smartcard given to the individual.
***Radio Frequency Identification (RFID) or smart card systems*:** This systems use ID cards with embedded RFID chips. Students or faculty members can swipe or tap their cards on a reader to register their attendance. RFID refers to a wireless system comprised of two

components: tags and readers. The reader is a device that has one or more antennas that emit radio waves and receive signals back from the RFID tag. RFID technology is superior to other identification technologies, because in reading or rewriting data on the RFID tag it does not require direct contact between the RFID tag and the reader, has the ability to send clean and reliable data needed as input for software on the attendance system, data can be read accurately in the reading range, and the design costs are low. Technology is currently needed by the campus; technology involvement is to reduce manual human activity in every activity on the campus. One of the activities on campus that needs to be involved with technology is teacher and student attendance activities. Radio Frequency Identification (RFID) technology is one technology that is able to identify certain objects (Kaur, *et al*., 2021).

However, administrator may register every student with specific RFID card ID and finger ID to attend the lecture. Whenever a new student is registered to attend the lecture, an RFID tag is attacked into the student ID card and his/her fingerprint is registered and saved in database, and the information of students such as student name, his/her card ID and finger ID, and personalities of student are also captured in the computer database. All information of teachers/students in that attendance lecture is stored in the computer database. Each teacher is registered and supplied with a username and password by the administrator as identification data for them. In this system, if teachers want to calculate students' attendance, they don't need to use manual roll call calculation. System will automatically calculate students' attendance by reading students' unique ID card with RFID tag number and finger ID number and comparing this RFID card ID number and finger ID number with information stored on the DBMS according to their ID's that we have assigned to them.

The student bio data (Matriculation number, Name, Gender and Date of Birth), card ID number and finger ID number are enrolled first into the database. Our aim is to create a system with one sever to which PC's are connected, so all data will be saved in one data base, marking the monitoring of the information effortless. All classes must have a PC with a connected RFID reader that can read student RFID-cards, as well as a fingerprint reader that take their fingerprints. The fingerprint reader is meant to prevent a student form giving his/her RFID-card to classmate who attends the lecture, scanning the other student's RFID-card to make it appear as if he/she had also attended. When a student enters class, this RFID reader reads his/her student ID, and his/her finger must press on fingerprint reader. These RFID tag and fingerprint data send to a PC with a connected RFID-reader and fingerprint reader (Thein & Cmnhm, 2018).

Mobile applications: With the widespread use of smartphones, many institutions have developed attendance tracking apps. Students or faculty members can use these apps to mark their attendance, and the data is synced with the institution's database.

Advantages of Attendance Tracking System

All of these modes of attendance tracking system have their own advantages which include:

Accuracy and time efficiency: An automated attendance system reduces errors and saves time compared to manual methods. It eliminates the need for paperwork, manual calculations, and data entry.

***Data Analysis*:** Attendance systems provide data that can be used for various analyses, such as identifying patterns of attendance, monitoring trends, and assessing the impact of attendance on academic performance.

Compliance: An attendance system helps institutions ensure compliance with attendance policies and regulations. It allows lecturers to identify students with poor attendance and take appropriate actions to address the issue.

***Communication*:** Some attendance systems can send automated notifications to parents or guardians if a student is absent without permission. This improves communication and enables timely intervention when necessary.

Report Generation: Attendance systems often include reporting features that can generate attendance reports for individual students, classes, or even the entire institution. These reports can be used for administrative purposes, evaluations, or audits. However among many technologies, such as WiFi, wireless sensor networks (WSNs), ultrasound, infrared, and video camera, have been proposed or used as the mechanism for localization and tracking. Radio frequency identification (RFID) is a promising technology for the purpose of identification and tracking of objects using RF signals. Among its many applications, RFID is widely used in enterprise supply chain management to improve the efficiency of inventory tracking and management.

Impact of Information Technology on Attendance Management System

Information technology has had a significant impact on classroom attendance management systems, transforming traditional manual processes into efficient, accurate, and automated systems. Information technology allows for the automation of attendance tracking processes. Instead of taking roll calls manually, lecturers can use digital attendance systems to mark attendance quickly and accurately. This saves time and reduces the administrative burden on teachers (Ardebili *et al*., 2022). With technology-enabled attendance management systems, attendance data is available in real-time. Lecturers and administrators can access up-to-date attendance records instantly, making it easier to identify patterns of absenteeism and take appropriate actions promptly.

Automated attendance systems minimize the chances of errors and discrepancies in attendance records. Manual recording can lead to mistakes, such as incorrect data entry or lost attendance sheets, but technology ensures data accuracy and integrity. However, many attendance management systems can integrate seamlessly with the school's Student Information System. This integration streamlines data management and ensures that attendance data is available alongside other student information, facilitating a comprehensive view of each student's academic progress. With technology-based attendance management, parents can receive instant notifications regarding their child's attendance status. Automated messages can be sent to parents when their child is absent, ensuring better communication between the school and parents. Information technology allows for the generation of detailed attendance reports and analytics. Schools can analyze attendance trends, identify patterns of chronic absenteeism, and devise strategies to improve overall attendance rates.

Similarly, automated attendance systems can help identify students who have a consistent pattern of absenteeism. This early warning system enables lectures and administrators to intervene and provide support to students who may be facing challenges that affect their attendance and academic performance. Technology-based attendance management promotes transparency and accountability. It helps schools to maintain a clear audit trail of attendance records, ensuring that accurate data is available for reporting and compliance purposes. Mobile applications and cloud-based attendance systems allow lecturers and administrators to access attendance data from anywhere, making it convenient for them to manage attendance even

outside the classroom (Ardebili *et al*., 2022). Also by streamlining attendance management processes, schools can optimize resources, such as time and personnel, allowing educators to focus more on teaching and supporting students' academic needs.

Importance of Quick Response (QR) Coding

QR code Attendance Management System is a combination of two applications. One is Mobile application and the other is Desktop application for taking and storing the attendance of the students on the daily basis in the faculty (Elbehiery, 2019). Here the Instructor, who is handling the subjects, will be responsible to generate the QR code of the subject. Each student will get a free mobile application that is used for taking attendance by him. The main objective of the automated attendance system is to computerize the traditional way of recording attendance and provide an efficient and automated method to track attendance in institutions. Using the QR code attendance system gives advanced features like: Providing better security, Maintenance of the system become easy and cost effective, Generating quick statistical results, Providing accurate and efficient data, and the system will be user friendly (Elbehiery, 2019).

Conclusion and Recommendation

The use of automated attendance system in tertiary institutions offers tremendous benefits to lecturers and students as it also eases the demanding tasks of managing and maintaining of students information by lecturers and administrators of Nigerian tertiary institutions. Hence, need for further researches on the development of automated attendance system at different levels of education, allocation of more funds to conduct researches on automated attendance system in Nigeria by Government organisations, agencies and Non-Governmental Organisations, procurement of technologies that can enhance the use of automated attendance system in schools. More conferences, seminars and workshops should be organised for Nigerian educational stakeholders to keep them abreast with the global emerging technologies on automated attendance system. Research institutes in Nigeria should consider designing and development of more automated attendance system for lecturers and students.

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A REVIEW ON DEVELOPMENT AND ASSESSMENT OF VIRTUAL LABORATORY PACKAGE FOR BIOLOGY PRACTICAL AT SENIOR SECONDARY SCHOOLS IN NIGER STATE, NIGERIA

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Abstract
This paper presents a review on Development and Assessment of Virtual Laboratory Package for Biology Practical at Senior Secondary Schools in Niger State, Nigeria. Virtual laboratory is a computer or online based environment that consists of packaged experiment simulations and videos that enable students to perform experiment virtually and has the components to support and enhance face-to-face or traditional-practical based learning. This review summarises relevant research on the meaning of virtual laboratory, traditional laboratory, application and used cases of virtual laboratories. The paper also underscores recent advances and innovations in virtual laboratories which includes Augmented Reality (AR), Internet of Things (IoT), Artificial Intelligence (AI) and key factors that contributed to enhance retention and engagement of students in virtual laboratories were also identified in the study. The study concluded that the use of virtual laboratory for Biology practical will aid students' better performance in Biology practical. It will create awareness for Biology teachers about how the innovation would help to enhance their job performance, this will enable them to adapt it and use it for classroom instruction to promote and enhance active involvement of students and also reduce the stress of limited and unavailability of laboratory facilities. Hence, Government organizations, agencies and non-governmental organisations (NGOs) should provide assistance to senior secondary schools by training teachers on the development and use of virtual laboratory packages and purchasing the packages in order to promote effective and efficient learning of practical in senior secondary schools.

Keywords: Virtual Laboratory, Traditional Laboratory, Biology

Introduction
In Nigeria, the integration of science and technology in the school curriculum and level of awareness in the use of computer for learning as well as promoting education among teachers and students in the learning communities has strengthened. Since time immemorial Science development has significant impact and influence on every aspect of human achievement, its significance has made it virtually impossible to survive in 21st century without the knowledge of science. Science and technology have drastically taken a new dimension, specialists in the field of education discovered that new technology will bring us new educational intellectual, resolve the problems we could not solve before and brings a series of most important changes to our education (Zang, 2022). The use of technology in our daily lives has transformed the way we communicate, work and live.

In science education, the learning process is usually considered more important than the acquisition of factual knowledge (Edson, 2017). In schools, laboratory experiments and activities play a vital role in learning science and it develops students' creativity and scientific attitudes. Learning science in schools becomes essential for all science students; the learning

becomes easier and more concrete for the students if the teaching becomes effective. There is unanimous agreement among educationist universally that for students to better understand natural phenomena, science teachers should afford students opportunities to engage and fully participate in practical work (Gott and Duggan, 2017). Students should understand processes and structures develop skills in manipulation, processing of science information and conducting scientific investigation. The improvement of students' learning about science may not have much bearing if practical investigations are not well prepared (Miller, 2017).

Overview of Virtual Laboratory

Virtual laboratory (VL) is a learning environment in which students convert their theoretical knowledge into practical knowledge by conducting experiments. Virtual laboratories simulate a real laboratory environment and processes. They provide students with meaningful virtual experiences and present important concepts, principles, and processes. Employing virtual laboratories, students have the opportunity of repeating any incorrect experiment or deepen the intended experiences. It provides students with opportunities such as enriching their learning experiences; conducting experiments as if they were in real laboratories; and improving their experiment related skills such as manipulating materials and equipment, collecting data, interactively completing the experimental process, and preparing experiment reports. Virtual environments allow students to observe the process in more detail, compared to board and chalk activities of the traditional classroom or partially completed experiments of the real laboratory environment. Also, virtual environments foster attention and motivation towards the course by supporting a discussion platform among partners, peers, and students and teachers (Dobson, 2019).

Virtual laboratory (VL) is a learning environment in which students convert their theoretical knowledge into practical knowledge by conducting experiments. Furthermore, some researchers even argue that performing experiments within a virtual environment is more effective than performing experiments in real laboratories (Gambari, et al., 2018). In contrast, virtual learning environments enable learners to repeat the events several times without hesitation, to zoom in and out, and to watch in slow motion (Tuyuz, 2020). Virtual laboratory can be seen as a "laboratory experiment without real laboratory with its walls and doors. It enables the learner to link between the theoretical aspect and the practical one, without papers and pens. It is electronically programmed in computer in order to simulate the real experiments inside the real laboratories (Harry & Edward, 2019). Through the above-mentioned definitions, the virtual lab can be defined as virtual studying and learning environment that stimulates the real lab. It provides the students with tools, materials and lab sets on computer in order to perform experiments subjectively or within a group at anywhere and anytime, these experiments are saved on CDS or on web site.

Virtual Laboratory Packages (VLPs) offer an alternative approach, providing a simulated practical experience. Several studies have shown that students exhibit increased interest and engagement in biology practical when using VLPs. The ability to manipulate virtual equipment and variables allows students to actively participate in the experiments, fostering a sense of ownership and control over their learning process (Abrahamsson, et al., 2021). Virtual Laboratories provide simulated versions of traditional laboratories referring to a learner-centered approach in which the learner is provided with objects that are virtual representations of real objects used in traditional laboratories.

Virtual laboratories are web-based platforms that offer interactive simulations and experiments, allowing users to engage in scientific activities remotely. They consist of various elements, including:

(a) Virtualized Experiments: These are computer-based simulations that replicate real-world laboratory environments, enabling users to perform experiments virtually.

(b) Data Analysis Tools: Virtual labs provide tools for analyzing experimental data, facilitating thorough observations and measurements.

(c) Collaboration Features: Users can collaborate with peers and mentors in virtual laboratories through chat functions, discussion boards, or video conferencing.

Applications and Use Cases of Virtual Laboratories:

Virtual laboratories find applications in diverse scientific domains, including:

(a) STEM Education: Virtual labs provide educational institutions with an effective and scalable means to introduce and reinforce scientific concepts. Students can engage in hands-on experimentation, enhancing their understanding and skills.

(b) Training and Certification: Virtual laboratories are utilized in professional training programs where learners can practice procedures, acquire new techniques, and assess their performance in a controlled environment.

(c) Research and Development: Researchers benefit from virtual labs for prototyping, testing hypotheses, and refining experiments before proceeding to physical implementations. This reduces costs and accelerates the research process.

Recent Advances and Innovations in Virtual Laboratories:

(a) Augmented Reality (AR): AR technologies are being integrated into virtual laboratories, allowing users to overlay virtual elements onto the real world, enhancing immersion and interaction.

(b) Internet of Things (IoT): Integration of IoT devices in virtual labs enables real-time data collection from physical sensors, providing more authentic and engaging experiences to users.

(c) Artificial Intelligence (AI): AI is being leveraged to simulate human-like behaviour in virtual laboratories, creating more interactive and adaptive learning environments.

Advantages of virtual labs compared to traditional labs.

Virtual labs offer several advantages over traditional labs. Firstly, they provide a cost-effective solution, eliminating the need for expensive equipment and materials. Additionally, virtual labs allow students to conduct experiments remotely, which can be especially beneficial for distance learning or in situations where physical access to labs is limited. Moreover, virtual labs offer a safe environment for experimentation, reducing the risks associated with handling hazardous chemicals or equipment. This can enhance student confidence and encourage exploration without fear of accidents. Furthermore, virtual labs can simulate a wide range of scenarios and experiments that might be difficult to replicate in a traditional lab setting. This opens up opportunities for students to explore complex concepts and phenomena that might otherwise be challenging to demonstrate practically.

designed and tailored to accommodate a wide range of impairments, such as visual, auditory, or mobility challenges. For visually impaired students, virtual labs can incorporate screen readers and text-to-speech technologies, providing auditory cues and descriptions of visual elements. Similarly, students with hearing impairments can benefit from captioning and visual indicators. Moreover, virtual labs can offer customizable interfaces and input methods, allowing students with mobility issues to interact effectively with the experiments. By prioritizing inclusivity, virtual labs empower all students to engage fully in scientific learning, fostering a more equitable and diverse educational experience.

Students' achievement in Biology

Achievement is one of the variables of this study; student achievement in biology is a key indicator of educational success and holds great significance in fostering scientific understanding and interest among students. Several research studies have investigated students' academic performance in biology and revealed interesting insights. A meta-analysis conducted by Hussain et al. (2019) highlighted the positive impact of practical laboratory experiences on students' biology achievement. The findings revealed that students who effectively utilized self-regulated learning techniques, such as setting goals, managing time, and monitoring their understanding, exhibited higher levels of biology achievement. Various factors have been identified as influential in students' achievement in biology. Socio-demographic factors, including gender and socioeconomic status, play a significant role. Additionally, a study by Adeyemo et al. (2020) highlighted the impact of socioeconomic status on students' biology achievement, revealing that students from higher socioeconomic backgrounds tend to achieve higher biology scores. Furthermore, the integration of technology in biology education has gained significant attention.

Students' retention in Biology

Student retention, refers to the ability to keep students enrolled in a course or program until completion, is a crucial factor in ensuring educational success. Retention rates in biology have been a subject of concern due to the rigorous nature of the subject and the potential for students to face difficulties. Biology practical plays a critical role in secondary school education as they enhance students' understanding of scientific concepts and foster the development of important laboratory skills. However, despite the benefits of hands-on laboratory activities, students often struggle to retain the knowledge and skills obtained from these practical sessions. However, conducting regular practical sessions often poses logistical challenges, such as limited resources, safety concerns, and time constraints. As a result, the use of virtual laboratories has gained popularity as an alternative approach to overcome these challenges while maintaining student engagement. There are various strategies and interventions that have been proven effective in improving student retention in biology, based on relevant research studies and sources, these includes;

Providing early academic support: One significant determinant of student retention is the provision of early academic support. Research indicates that early intervention strategies, such as tutoring programs, mentorship initiatives, and supplemental instruction, can positively influence student engagement and retention. For instance, a study by Drew et al. (2020) found that biology students who participated in peer tutoring programs exhibited higher retention rates compared to those who did not receive the same support.

Factors influencing students' retention in biology practical.

Secondary school students' retention in biology practical is influenced by various factors, which includes;

Learning environment: The learning environment in which biology practical takes place can significantly impact students' retention. Research suggests that a well-equipped laboratory, sufficient resources, and suitable instructional materials promote engagement and improve retention (Khoshinani, 2020). An environment where students are encouraged to explore, ask questions, and actively participate in the practical enhances their understanding and retention.
Relevance to real-life applications: Connecting biology practical to real-life applications can enhance students' motivation and improve retention. When students understand the practical implications of what they are learning, they are more likely to retain the information for a longer period. Incorporating real-life examples and case studies into biology practical helps students contextualize their learning, making it more meaningful and memorable.

Inquiry-based learning: Inquiry-based learning is an effective pedagogical approach that allows students to develop critical thinking skills and fosters deep understanding and retention of concepts (Banchi & Bell, 2018). By engaging in hands-on investigations and problem-solving, students actively construct their knowledge, leading to better retention in biology practical.
Teacher-student interaction and guidance: The role of the teacher in biology practical cannot be overstated. Effective teacher-student interaction and guidance during practical sessions positively impact students' learning and retention. Teachers who provide feedback, ask probing questions, and encourage reflection help students solidify their understanding and retain the acquired knowledge.

Prior knowledge and interest: Students' prior knowledge and interest in biology can influence their retention in practical sessions. Students who already possess a foundation of biological concepts and have a genuine interest in the subject tend to retain information more effectively (Megowan-Romanowicz et al., 2018). Teachers should consider differentiating instruction, allowing students to build upon their existing knowledge, and cater to individual interests to enhance retention.

Continuous assessment and feedback: Regular assessment and timely feedback provide students with opportunities to reflect on their learning progress and reinforce concepts covered in practical sessions. Research suggests that well-designed formative assessments, along with constructive feedback, can lead to better retention of knowledge and skills acquired during biology practical. By addressing these factors, educators can create an environment that promotes active learning, engagement, and long-term knowledge retention.

Key factors that contribute to enhanced retention and engagement of students in virtual laboratory

Virtual laboratories offer unique advantages that contribute to improved retention rates among secondary school students in biology practical. The following are key factors that contribute to enhanced retention and engagement;
Enhanced Visualization and Interactivity: Virtual laboratories provide students with the ability to visualize complex biological processes and interact with virtual specimens or simulations in a more immersive manner than traditional methods. This enables students to grasp abstract concepts more easily and reinforces their understanding of practical techniques.

Flexibility and Accessibility: Virtual laboratories offer flexibility in terms of time and location. Students can access virtual labs at their convenience, allowing for repeated practice and review. This flexibility leads to increased engagement and retention. Similar findings were reported in a study by Jebet et al. (2019), which revealed that students who used virtual labs had better retention rates compared to those who relied solely on traditional methods.

Error-Free Learning Environment: In virtual laboratories, students can conduct experiments without the risk of making mistakes that may lead to inaccurate results. This error-free environment allows students to focus on understanding concepts and techniques, promoting deeper learning and improving long-term retention.

Personalized Learning Experience: Virtual laboratories can be customized to meet individual student needs by adjusting the difficulty level or providing scaffolding. This personalized approach enhances student motivation and engagement, thus positively influencing long-term retention. A study by Rodgers et al. (2017) found that students who used virtual labs personalized to their learning style had higher retention rates as compared to those using generic virtual labs.

The use of virtual laboratories in biology practical within secondary school settings has shown promising results in enhancing student engagement and improving long-term retention. As technology continues to advance, the integration of virtual laboratories should be further promoted to support biology education at the secondary school level.

Conclusion

The use of Virtual Laboratory for Biology practical will enable the learners to actively engage their selves in learning and build their own knowledge structures by investigating, inquiring and discovering since learning practical through virtual laboratory is students centered. It will also aid students' better performance in Biology practical. It will create awareness for Biology teachers about how the innovation would help to enhance their job performance, this will enable them to adapt it and use it for classroom instruction to promote and enhance active involvement of students and also reduce the stress of limited and unavailability of laboratory facilities. Hence, school authorities and managements should provide enabling environment for students and teachers to effectively use virtual laboratory for their teaching and learning processes.

Government organizations, agencies and non-governmental organisations (NGOs) should provide assistance to senior secondary schools by training teachers on the development and use of virtual laboratory packages and purchasing the packages in order to promote effective and efficient learning of practical in senior secondary schools.

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SYSTEMATIC REVIEW ON THE ROLE OF EDUCATIONAL TECHNOLOGY IN PROMOTING INCLUSIVE EDUCATION FOR STUDENTS WITH DISABILITIES

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Abstract
The inclusion of students with disabilities in mainstream educational settings remains a critical goal for many educational systems worldwide, thus, the study was carried out to examine the educational technology in promoting inclusive education for students with disabilities. Systematic review was adopted and all the relevant documents (research articles and book chapters) were sorted according to laid-down eligibility criteria access, forty-five research articles were used for the review. It revealed how assistive tools like screen readers and voice recognition software enhance accessibility for students with visual, auditory, and physical impairments. Adaptive learning technologies, which personalize instruction, are also explored for their impact on improving learning outcomes for students with cognitive challenges. Despite these advancements, barriers such as limited funding, inadequate teacher training, and lack of infrastructure hinder widespread implementation. The paper calls for strong policy frameworks, teacher training, and collaboration to ensure equitable access to educational technology for students with disabilities. The study recommended that governments and educational institutions should invest in the necessary infrastructure to ensure all students, regardless of geographical location or socio-economic status, can access educational technology

Keywords: Inclusive, Technology, Education, Disability and Student

1.1 Introduction

Inclusive education advocates for the full participation of all students, including those with disabilities, in regular educational settings. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2020), inclusive education aims to transform schools to accommodate diverse learners, ensuring equity and social justice. This philosophy stresses that every learner, regardless of their physical, cognitive, or emotional differences, deserves equal opportunities to access and benefit from quality education. However, achieving inclusive education is far from straightforward, as significant barriers must be overcome to make mainstream classrooms accessible to all. Inaccessible learning environments, lack of teacher preparedness, and limited resources represent persistent challenges to creating inclusive schools (Florian, 2015). These obstacles hinder students with disabilities from fully engaging in learning and participating alongside their peers. To address these challenges, educational technology is increasingly seen as a vital tool for creating more inclusive environments, offering innovative solutions that cater to diverse learning needs (Seale, 2013). Through personalized learning, assistive devices, and digital resources, educational technology can provide avenues for students with disabilities to engage meaningfully in educational activities.

Educational technology has evolved to become a key enabler of inclusive education, offering tools and strategies to enhance accessibility and engagement for students with disabilities. Assistive technology (AT), a significant component of educational technology, refers to any device, equipment, or system that supports the learning needs of individuals with disabilities. AT tools can range from low-tech solutions like magnifying glasses to high-tech devices such

as speech recognition software, creating opportunities for students to overcome barriers to learning (McKnight & Davies, 2012). By integrating AT into the classroom, educators can provide personalized learning experiences that accommodate students' diverse abilities, thereby fostering an inclusive learning environment. For instance, ATs, like Braille displays and screen readers, allow students with visual impairments to access written materials, while speech-generating devices support students with communication challenges in expressing themselves (Muradyan, 2023).

Research has shown that the use of AT improves the academic performance and functional abilities of students with disabilities. Students who use AT often demonstrate significant progress in areas such as reading, writing, and communication, as these tools enable them to interact with the learning material in ways that are accessible to them (Alnahdi, 2014). In fact, assistive technologies for reading and writing—such as screen readers for visually impaired students and word prediction software for those with motor disabilities—have been pivotal in supporting students' academic success (Day et al., 2011). For students with hearing impairments, auditory aids such as hearing aids or FM systems help amplify sound, allowing them to follow classroom discussions and participate more fully in lessons (Hersh, 2020). Similarly, mobility aids like specialized seating and wheelchairs provide students with physical disabilities the support needed to navigate the classroom and engage in activities.

However, despite the clear benefits of AT in fostering inclusive education, its implementation remains uneven across different regions and educational contexts. In many low-income countries, the adoption of assistive technologies is hindered by limited financial resources, making it difficult for schools to acquire and maintain the necessary tools (Bouck, 2020). Even in high-income countries, where resources may be more readily available, schools often face challenges related to teacher preparedness and infrastructure. Many teachers lack the training required to effectively integrate AT into their teaching practices, leading to underutilization of these tools (Flanagan, Bouck, & Richardson, 2020). This points to a critical gap between the availability of assistive technologies and their effective use in educational settings, which can limit the potential of AT to promote truly inclusive learning environments.

Furthermore, the success of assistive technologies in promoting inclusive education depends on more than just their availability; effective implementation requires a well-coordinated approach involving adequate training, resource allocation, and support systems. For AT to be fully effective, teachers must be trained in its use and given the knowledge and tools to select appropriate technologies for their students (Dell *et al*., 2017). Research has highlighted the importance of teacher preparedness in the success of AT initiatives, with well-trained teachers more likely to utilize AT effectively and adapt it to the specific needs of their students (Alnahdi, 2014). Additionally, schools need adequate funding not only to acquire AT tools but also to provide ongoing support, including maintenance of devices and technical assistance (Bozkurt, 2019). This highlights the importance of a systemic approach to AT implementation, where educational institutions, policymakers, and technology providers work together to ensure that all students benefit from these tools.

The potential of educational technology to foster inclusive education is widely recognized, but there is still much work to be done to bridge the gap between availability and access to AT tools. The World Health Organization (WHO) estimates that more than one billion people live with some form of disability, and a significant proportion of this population consists of children and adolescents who require special accommodations to access education (World Health Organization, 2019). Despite this growing need, many students with disabilities continue to

face significant challenges related to unequal access to assistive technologies, insufficient teacher preparedness, and inadequate infrastructure. In regions where resources are scarce, schools struggle to acquire the necessary AT tools, while those in better-resourced areas may still lack the training and support systems needed for effective implementation (Bouck, 2020). Given these challenges, a comprehensive understanding of the types of assistive technologies available, their utilization in educational settings, and the measures that can ensure their successful implementation is critical. Educational technology holds significant promise in addressing the barriers faced by students with disabilities, but realizing its full potential requires a concerted effort to improve access, increase teacher training, and ensure that the necessary infrastructure is in place. With the right strategies and resources, educational technology can play a transformative role in promoting inclusive education and ensuring that all students, regardless of their abilities, have the opportunity to succeed. The primary aim of this systematic review is to analyze the role of educational technology in promoting inclusive education for students with disabilities. The specific objectives of this study are as follows:

1. To review on the assistive technologies available for students with disabilities.
2. To describe the measures necessary for the effective implementation of assistive technologies for students with disabilities.

2.1 Methodology

This review adopt systematic review following the guidelines outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), ensuring transparency, reproducibility, and rigor throughout the research process. The PRISMA framework was chosen for its comprehensive approach to reporting systematic reviews, allowing for clear documentation of the methods used for literature selection, data extraction, and analysis. The objective of this review was to explore the role of educational technology in promoting inclusive education for students with disabilities, focusing on the types of assistive technologies available, their utilization in educational contexts, and the strategies that ensure their effective implementation.

A comprehensive search of academic databases was performed to gather relevant peer-reviewed literature. The databases utilized for this review included Google Scholar, JSTOR, and PubMed. These platforms were selected due to their extensive repository of articles in education, technology, disability studies, and related fields. The search was limited to studies published between 2010 and 2023 to ensure the review captured contemporary research in educational technology and its applications to inclusive education. To retrieve relevant studies, search terms and Boolean operators were strategically used to broaden and refine the search. Keywords included “educational technology,” “inclusive education,” “students with disabilities,” “assistive technology,” “inclusion strategies,” and “special education.” These terms were used individually and in combination to cover a wide array of studies that could contribute to the review's objectives. The search strategy was iteratively refined to ensure relevant literature was captured across various disability categories and educational contexts.

2.2 Inclusion Criteria

Studies were selected based on the inclusion criteria designed in line with the research objectives. The criteria were as follows:

Focus on Educational Technology and Inclusion: Only studies that explicitly addressed the use of educational technology to promote inclusion in educational settings were considered.

The review aimed to investigate the impact of technology on creating inclusive learning environments for students with disabilities.

Disability Categories: The review included studies involving students with a range of disabilities, such as cognitive, physical, and sensory impairments. This ensured that the review provided a comprehensive understanding of how technology supports diverse student needs.

Time Frame: Only studies published between 2010 and 2023 were included to capture the most recent advancements and trends in educational technology and its role in inclusive education.

Language: All studies selected for review were published in English to maintain consistency and avoid issues related to translation and interpretation.

Peer-reviewed Articles: The review focused on peer-reviewed journal articles to ensure the reliability and credibility of the sources. Peer-reviewed articles undergo rigorous evaluation by experts in the field, providing a higher level of academic quality and trustworthiness.

Exclusion Criteria: To maintain focus and relevance, studies were excluded based on the following criteria:

General Educational Technology without Disability Focus: Studies that solely focused on the general use of educational technology without addressing its role in supporting students with disabilities were excluded. The review aimed to specifically understand how technology promotes inclusion for students with disabilities.

Non-peer-reviewed Articles or Reports: Non-peer-reviewed sources such as reports, conference papers, and opinion pieces were excluded to maintain a high standard of academic rigor.

Studies with Limited or No Educational Context: Studies that explored the use of assistive technologies in non-educational settings (e.g., healthcare, workplace) without a direct connection to inclusive education were excluded from the analysis.

2.3 Search and Selection Process

The initial search across the three databases yielded a total of 450 articles. Following the initial retrieval, duplicates were removed using citation management software. This reduced the number of articles to 350. To further refine the selection, the titles and abstracts of these articles were screened for relevance based on the inclusion and exclusion criteria. Articles that did not meet the criteria were excluded, leaving 80 articles for full-text review. The full-text articles were then carefully examined to assess their relevance to the research objectives. During this phase, articles were evaluated for their focus on educational technology, inclusion, and assistive technology for students with disabilities. After this in-depth review, a total of 45 studies were selected for detailed analysis and inclusion in the final systematic review.

Data Extraction and Analysis: A data extraction form was developed to systematically capture information from each study. The key information extracted included:

Author(s) and Year of Publication: The date and authorship of each study were recorded to provide context for the timing and source of the research.

Study Objectives and Research Questions: Each study's purpose and research questions were documented to ensure alignment with the review's objectives.

Population and Disability Category: The specific population of students with disabilities (e.g., students with visual impairments, students with autism) targeted by the study was noted to understand the scope of each study.

Type of Educational Technology or Assistive Technology: The particular educational or assistive technologies examined in each study were identified, ranging from low-tech aids (e.g., Braille, magnifying glasses) to high-tech solutions (e.g., screen readers, speech-generating devices).

2.4 Quality Assessment

To ensure the reliability of the findings, a quality assessment was conducted on the selected studies using the Critical Appraisal Skills Programme (CASP) checklist. This tool provided a structured approach for evaluating the methodological quality of the studies, including aspects such as clarity of research aims, appropriateness of study design, rigor in data collection and analysis, and relevance of conclusions. Only studies that met the minimum quality thresholds were included in the final analysis, ensuring that the systematic review drew upon high-quality research.

3.0 Key Findings

3.1 Educational Technology and Accessibility

One of the primary roles of educational technology in promoting inclusion is enhancing the accessibility of learning environments. Assistive technologies, such as screen readers, voice recognition software, and tactile displays, have significantly improved access to educational materials for students with disabilities (Kelly and Smith, 2011). These tools have been particularly useful for students with visual, auditory, and physical impairments, enabling them to engage with digital content on equal footing with their peers.

A study by Alper and Raharinirina (2021) highlighted the importance of integrating Universal Design for Learning (UDL) principles in EdTech solutions. UDL promotes the creation of flexible learning environments that accommodate diverse learning needs. EdTech can play a pivotal role by providing customizable resources, allowing students to access content in different formats, such as text, audio, and video. However, despite these advancements, barriers remain. Many schools, particularly in low-income areas, lack the infrastructure to support these technologies, leaving students with disabilities at a disadvantage (Adebisi *et al*., 2015). Additionally, the cost of high-tech assistive devices can be prohibitive for some schools and families, limiting the impact of EdTech on inclusion efforts.

3.2. Personalization and Adaptive Learning

Personalized learning through adaptive technology is another area where educational technology has made significant contributions to inclusive education. Adaptive learning systems adjust the pace and difficulty of instruction based on the learner's needs, providing personalized support to students with cognitive and learning disabilities (Smith *et al*., 2018). For example, intelligent tutoring systems (ITS) use algorithms to tailor feedback and instruction, helping students with learning disabilities master complex concepts at their own pace.

A meta-analysis by Okolo and Bouck (2019) found that adaptive learning technologies improved educational outcomes for students with disabilities by providing differentiated instruction. The authors emphasized that such systems are particularly effective for students with dyslexia, attention deficit hyperactivity disorder (ADHD), and other learning challenges. Nonetheless, concerns have been raised about the potential for over-reliance on technology, where teachers may become less involved in direct instruction. Research suggests that a balanced approach, where educational technology complements rather than replaces teacher support, is most effective in promoting inclusive education (Edyburn, 2013).

3.3 Assistive technologies available for students with disabilities

Numerous studies have explored the availability and effectiveness of assistive technologies (AT) in enhancing the educational experiences of students with disabilities. These technologies serve to reduce or eliminate barriers to learning by providing tools that assist in areas such as communication, mobility, vision, hearing, and cognitive processing. Research in this domain highlights both the diverse range of assistive technologies available and the challenges in their widespread adoption and implementation.

Assistive technologies for students with disabilities can be categorized into high-tech and low-tech solutions, depending on their complexity and level of integration with digital tools. These technologies aim to cater to the varied needs of students with physical, sensory, cognitive, or learning disabilities. Low-tech ATs are typically simple tools that do not require electronic components or extensive technical knowledge to use. Examples include Braille textbooks, magnifying glasses, writing aids, and graphic organizers. For instance, Muradyan (2023) examined the use of Braille and audio texts as effective tools for visually impaired students. The research showed that Braille significantly improved reading comprehension for blind students, while magnifiers and screen-reading software helped those with low vision to access written content. Graphic organizers, as highlighted by Coleman (2011), serve as visual aids that help students with learning disabilities organize information, making it easier to grasp complex concepts and complete assignments independently.

High-tech assistive technologies are more advanced, typically involving digital and electronic devices such as computers, software applications, and specialized hardware. Seale (2013) highlighted the role of screen readers, which enable students with visual impairments to navigate computers and have digital text read aloud to them. Speech recognition software, such as Dragon NaturallySpeaking, has also proven highly effective for students with physical disabilities who have difficulty typing, as it allows them to dictate assignments and navigate software using voice commands. Similarly, augmentative and alternative communication (AAC) devices, such as speech-generating devices, have been pivotal in helping students with speech impairments communicate effectively in classroom settings. Dell *et al*. (2017) revealed that these devices not only fostered inclusion in classroom discussions but also enhanced social interactions among students with speech difficulties. Furthermore, learning management systems (LMS), as investigated by Bouck (2020), have contributed to inclusion by offering platforms where teachers can customize lessons with accessibility features, such as closed captions, alternative text for images, and adjustable font sizes, making educational content more accessible to students with diverse learning needs.

While the range of available assistive technologies has expanded over the past decade, the accessibility and implementation of these tools vary significantly based on factors such as geographical location, school funding, and teacher preparedness. In high-income countries, assistive technologies are generally more accessible. For example, Hersh (2020) found that

schools in the United States and parts of Europe typically provide students with access to AT through government programs or educational grants. However, even in these regions, there are gaps in teacher training that affect the successful integration of these technologies into daily classroom activities. On the other hand, Dell *et al*. (2017) noted that in low- and middle-income countries, access to assistive technologies is often limited due to financial constraints. This lack of funding impedes the adoption of even basic assistive technologies, leaving many students with disabilities marginalized and without adequate support.

Several studies have pointed to the barriers that prevent the widespread adoption of assistive technologies. Financial constraints remain a significant issue. Florian (2015) noted that many schools, particularly those in underfunded districts, struggle to afford even basic AT tools such as Braille machines, let alone more advanced options like speech-generating devices or specialized software. Inadequate teacher training is another major barrier. The World Health Organization (2006) highlighted that while AT tools exist, many educators are not adequately trained to implement them effectively. This lack of knowledge often leads to the underutilization of available technologies, diminishing their potential to promote inclusion. Additionally, inadequate infrastructure, particularly in rural and low-income areas, hampers the effective use of high-tech AT solutions. Bozkurt (2019) identified this as a critical issue, noting that many schools lack the necessary digital infrastructure, such as stable internet connections or up-to-date computers, to support technologies like learning management systems or cloud-based applications.

3.4 Measures necessary for the effective implementation of assistive technologies for students with disabilities

Research on the measures necessary for the effective implementation of assistive technologies (AT) for students with disabilities has highlighted several critical areas of focus. These include policy frameworks, teacher training, accessibility, funding, collaboration among stakeholders, and continuous assessment of technological needs. Over the years, numerous studies have examined how these factors contribute to the successful integration of AT in educational settings, addressing the challenges and proposing actionable solutions.

One key measure emphasized in past research is the development of strong policy frameworks to support the implementation of assistive technologies. According to Alnahdi (2014), the creation of inclusive education policies that mandate the use of AT in schools is critical to ensuring that students with disabilities have access to the necessary tools. These policies must also address issues related to equal access, funding, and compliance, making AT an integral part of the educational system rather than an optional or supplemental resource. Bozkurt (2019) echoes this point, arguing that policy directives at the national and local levels can provide schools with the guidance needed to implement AT effectively. Policies should also emphasize equity, ensuring that students from low-income backgrounds or rural areas are not left behind due to financial constraints.

Teacher training has emerged as one of the most critical factors in the successful implementation of assistive technologies. Numerous studies have underscored the importance of equipping educators with the skills and knowledge necessary to effectively use AT in the classroom. For example, Florian (2015) found that while many schools possess the necessary tools, the lack of teacher preparedness often leads to underutilization or ineffective use of these technologies. Teachers who are not familiar with how to operate specific devices, such as screen readers or speech recognition software, may struggle to integrate them into their lesson plans, diminishing the potential benefits for students with disabilities. Similarly, Seale (2013)

stressed that teacher training programs should include specialized modules on the use of assistive technologies, ensuring that educators can provide tailored support for students with diverse needs. In addition to technical training, Bouck (2020) highlighted the need for professional development programs that focus on the pedagogical implications of AT, helping teachers understand how these tools can be used to foster inclusive learning environments.

Accessibility is another major factor influencing the effective implementation of AT. Past studies have shown that many schools, particularly in low-income or rural areas, lack the necessary infrastructure to support the use of advanced technologies. Hersh (2020) emphasized that without reliable internet access or up-to-date computers, schools may find it difficult to integrate AT tools such as cloud-based learning platforms or AI-powered tutoring systems. In these cases, it is important for schools to invest in the necessary infrastructure upgrades to support the seamless use of assistive technologies. Moreover, accessibility goes beyond just the availability of hardware; it also includes the usability of these tools for students with disabilities. Dell et al. (2017) pointed out that while many AT devices are available on the market, not all of them are designed with the user in mind. For example, some speech-generating devices may be too complex for young children or students with cognitive disabilities to use effectively. Therefore, ensuring that AT tools are user-friendly and cater to the specific needs of students is essential for their successful implementation.

Funding is another significant measure that has been widely discussed in the literature. Without adequate financial resources, schools may struggle to procure the necessary assistive technologies or maintain existing ones. According to Bozkurt (2019), government funding plays a crucial role in bridging the gap between policy directives and practical implementation. In many countries, special education budgets are often insufficient to cover the high costs associated with AT, such as the purchase of devices, software licenses, and ongoing maintenance. Bouck (2020) also noted that financial constraints often lead to disparities in AT access, with wealthier schools being able to afford more advanced tools, while underfunded schools may rely on outdated or low-tech solutions. As such, increasing funding for special education and assistive technology programs is essential to ensure that all students with disabilities have access to the tools they need to succeed.

Collaboration among stakeholders is another critical measure for the successful implementation of assistive technologies. Past studies have highlighted the importance of involving a range of stakeholders, including educators, parents, policymakers, and technology developers, in the decision-making process. Flanagan, Bouck, and Richardson (2020) argued that a collaborative approach ensures that the needs of students with disabilities are understood and addressed from multiple perspectives. For example, educators can provide insights into how AT can be integrated into the curriculum, while parents can offer feedback on how these tools impact their children's learning experiences at home. Furthermore, collaboration with technology developers is essential to ensure that the tools being designed are aligned with the needs of students and educators. Hersh (2020) stressed that ongoing dialogue between schools and developers can lead to the creation of more effective, user-friendly AT solutions that cater to the diverse needs of students with disabilities.

Finally, the continuous assessment of technological needs is a measure that has been consistently emphasized in the literature. According to Seale (2013), the needs of students with disabilities are not static; they may change as students progress through their education or as new technologies emerge. Therefore, schools must regularly assess the effectiveness of the AT tools they use and make adjustments as necessary. This involves not only evaluating the

academic performance of students using AT but also gathering feedback from students, teachers, and parents on the usability and impact of these tools. Bozkurt (2019) suggested that schools establish AT committees that are responsible for monitoring the use of assistive technologies, identifying areas for improvement, and recommending new tools or strategies as needed. Such continuous evaluation ensures that AT remains responsive to the evolving needs of students and contributes to their academic and social success.

3.5 Teacher Preparedness for Inclusive education

One of the challenges in achieving inclusive education is the lack of preparedness among teachers to meet the needs of students with disabilities. Educational technology can address this issue by offering professional development programs and digital tools that assist teachers in implementing inclusive practices (Florian and Spratt, 2013). A study by Fernández-Batanero *et al*. (2022) showed that teacher training programs that incorporate educational technology can significantly enhance teachers' ability to support students with disabilities. Online platforms that provide resources, tutorials, and real-time collaboration among educators have proven effective in building teacher capacity for inclusive education. However, successful integration of technology in the classroom requires ongoing professional development and institutional support. In many cases, teachers struggle with the dual challenge of learning new technologies while addressing the diverse needs of their students (Seale, 2013). Without sufficient training, teachers may underutilize the full potential of educational technology, limiting its impact on inclusive education.

3.6. Addressing Barriers to Inclusion

Educational technology has the potential to address many barriers to inclusion, such as geographical isolation, social stigma, and limited resources. Online learning platforms, for example, provide students with disabilities access to quality education regardless of location, promoting equity (Oliver and Stallard, 2016). Moreover, digital tools can reduce the social stigma associated with disabilities by normalizing the use of assistive technologies in everyday learning.

A study by Lindsey and Hughes (2020) found that students with disabilities who used educational technology in inclusive classrooms experienced greater social integration. The use of collaborative tools, such as online discussion forums and shared digital workspaces, helped foster interaction between students with and without disabilities, improving social outcomes.
Despite these successes, challenges remain. The digital divide persists, with students from lower-income families and rural areas having limited access to high-quality educational technology (Adebisi *et al*., 2015). This disparity can exacerbate existing inequalities, making it more difficult for students with disabilities to benefit from EdTech interventions.

4. Discussion of the review

The review reveals significant strides in the use of assistive technologies (AT) for students with disabilities, emphasizing the transformative role of educational technology in promoting accessibility and inclusion. Tools such as screen readers, speech recognition software, and adaptive learning systems have improved learning experiences for students with diverse impairments. Studies underscore the importance of Universal Design for Learning (UDL) in creating flexible learning environments, but highlight barriers such as inadequate infrastructure, high costs, and insufficient teacher training, particularly in low-income regions. Teacher preparedness is identified as a key factor, with research showing that ongoing professional development is essential for effective AT integration. The review also emphasizes the importance of collaboration among stakeholders, including educators, policymakers, and

developers, to ensure the successful adoption of AT. Funding constraints remain a major obstacle, limiting access to high-tech solutions in underfunded schools. Lastly, continuous assessment of AT needs is crucial to keep pace with evolving student requirements and technological advancements. Despite these challenges, AT has shown potential to address geographical isolation, reduce social stigma and enhance social integration among students with and without disabilities, contributing positively to inclusive education efforts.

5. Conclusion and Recommendations

This systematic review highlights the potential of educational technology to promote inclusive education for students with disabilities. While significant progress has been made in terms of accessibility and personalization, challenges related to infrastructure, teacher training, and equity persist. To maximize the impact of EdTech on inclusive education, the following recommendations are made:

i. Governments and educational institutions should invest in the necessary infrastructure to ensure all students, regardless of geographical location or socio-economic status, can access educational technology.

ii. Teachers require continuous training to effectively integrate educational technology into inclusive classrooms. Professional development programs should focus on both technical skills and inclusive pedagogies.

iii. Further research is needed to explore the long-term impact of educational technology on inclusive education, particularly in low-resource settings. Developers should focus on creating affordable and scalable EdTech solutions that can be implemented across diverse educational contexts.

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UNTANGLING THE WEB OF CHALLENGES: ARTIFICIAL INTELLIGENCE (AI) AND ETHICS IN JOURNALISM

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ABSTRACT
Recent advances in technology has led to the emergence of Artificial Intelligence (AI) with the potential to profoundly affect all facets of modern life and living as we know it. Already, the impact of AI technology is being felt, and in journalism it has impacted on news production, personalization, and distribution among others. This paper explores a fundamental aspect of the profession of journalism, its ethics, without which the practice will lack credibility and therefore be unsustainable. As managers of information, journalism must be anchored on ethical principles otherwise it will lose the trust of the public and its own relevance. The emergence and adaption of AI into journalism practice has thrown up important issues regarding its ethics. The paper examines key ethical issues arising from the adoption of AI in journalism, closely looking at the impact of AI on major areas such as truth, accuracy, bias, transparency, and accountability. It looks at the consequences of automated content generation on the ethical issue of integrity and how an algorithmic bias can perpetuate existing inequalities and prejudices. The paper also examines the transparency of AI-driven systems and the challenges of maintaining accountability in the face of automated decision-making. By reviewing current research, the paper also provides a good understanding of ethical challenges thrown up by the adaption of AI in our newsrooms and propose ways to mitigating their impact, ensuring that AI advancements support rather than undermine the ethics of journalism.

Keywords: Artificial Intelligence, Computational Journalism, Ethics, Journalism

INTRODUCTION
The profession of journalism, like other professions, is founded and guided by a strong code of ethical principles that undergird its practice. Journalism performs an important function, especially in developing and democratic societies by keeping the public informed, ensuring that those in government are answerable to the people, and providing a medium for diverse sections of the society to be heard among others. The carrying out of these responsibilities can only be done successfully if it is anchored on strong ethics which McCoy (2004) describes as the values an individual hold that guides his behaviour and moral choices in specific situations. It is about an individual's convictions about right and wrong. Ward (2009), states that ethics has to do with the analysing, assessing and promotion of what is regarded as good and appropriate conduct and character in light of the best available principles in a profession. The effectiveness and credibility of journalism are largely contingent upon adherence to ethical principles. The ethics of journalism encompass a range of guidelines and practices designed to uphold truth, accuracy, fairness, and integrity. How journalists carry out their duties is of utmost interest to the general population and citizens particularly those that consume their products because of the fact that journalists provide information and knowledge which the general population needs to participate and function effectively in the society. Osho, *et al.*, (2024) make the point that consumers of media products look and ask for the truth as a matter of course, especially in journalism which prides itself as a truth-seeking enterprise.

The International Federation of Journalists, IFJ, (2019) in its global charter of ethics for journalists emphasized that the right of everyone to have access to information and ideas underpins the underlying mission of journalists and stressed that their responsibility to the public overrides any other responsibility even those to their employers or the authorities. This code of conduct to journalists provides guidance in the gathering, editing, conveyance and commentary of news and information, and in the description of events, in any media whatsoever. Other principles include respect for the facts and for the right of the public to truth as the first duty of journalists; defending the principle of freedom and clearly distinguish facts from opinion; reporting according to facts whose origins are known and not suppress or falsify information; not obtaining information through subterfuge but fair methods; verifying facts and sources always taking key precedence over immediacy or urgency in publishing news; protecting sources of information obtained in confidence; and not engaging in plagiarism, libel, slander, distortion of facts, defamation and unfounded accusations. These are some the key principles contained in the charter.

The emergence of Artificial Intelligence (AI) brought with it new challenges and opportunities in all spheres of modern life, including journalism. Noain-Sánchez (2022) explains that although the idea of AI has been associated to Alan Turing, the term was actually created by John McCarthy, Marvin Minsky, Claude Shannon and Nathan Rochester in the 1950s. He explained that they defined it as the science of making a machine behave in a manner that would be considered intelligent, that is similar to human behaviour. The collection of technologies, techniques and ideas that makes a computer or its software perform works and tasks that usually require human intelligence is another way of defining AI (Beckett, 2019). In fulfilling these tasks or works, these cognitive computer systems and software use two basic attributes, namely autonomy and the capacity to learn from experience. As it seems to imitate human intelligence, use of AI provokes distrust and hostility. The openness and ambiguity of the term ‘AI’ has given rise to more doubts than certainties. The fact that ‘AI’ covers such subfields as machine learning, supervised learning, unsupervised learning, natural language generation (NLG) or natural language processing (NLP) contributes to the uncertainty. All the subfields draw on different attributes and show different capacities. AI provides tools for the codification of tasks and routines in algorithms, creating outputs similar to those produced by humans. The growing use of AI has led to discussions about the implications on different areas of journalism, especially ethics.

Undoubtedly, the use of AI has impacted on the practice of journalism in a number of ways including in the production of news, storage of information, the dissemination of news and interaction with the audience. One of fields it has impacted on is the automated production of content. This is already happening in areas based on structured data, such as sports results, financial earnings and weather forecasts. Algorithms can convert data into informative and narrative texts, leading to the production of thousands of stories with little or no human intervention other than the initial programming (Graefe, 2016).

The significant influence of AI on journalism is such that new terms to describe variants of journalistic practice associated with the new technology has been coined. Noain-Sánchez (2022:107) has outlined some of those terms. When the focus is on how AI generates content and it is produced automatically by an algorithm, it is called “automated journalism” or “algorithm journalism” which is defined as "the (semi)-automated process of natural language generation by the selection of electronic data from private or public databases (input), the assignment of relevance of pre-selected or non-selected data characteristics, the processing and structuring of the relevant data sets to a semantic structure (throughput), and the publishing of

the final text on an online or offline platform with a certain reach (output)". Other coinages to describe types of journalism associated with the new technology include "robot journalism"; "augmented journalism"; "computational journalism"; "machine written journalism"; and "exo-journalism" or "artificial journalism". Other scholars compare AI tools to "data journalism" or "data driven journalism". Similarly, Gutiérrez-Caneda, *et al.,* (2023) highlighted how the trend of high-tech journalism has given rise to new names such as, exo-journalism, robot journalism, computational journalism, artificial journalism or automated journalism.

Ethical Issues in Journalism

Ward (2019) discussed ethics as a practical normative activity that aims to solve problems, integrate values and help humans live rightly, as individuals and as societies, and journalism ethics as a species of applied ethics that examines what journalists and news organizations should do, given their role in society. Ethics has to do with proper behaviour, what is considered good and acceptable and what is regarded as improper. Applied to professions, it has to do with the core principles that should guide professionals in carrying out their duties. In journalism, the core principles of ethics include truthfulness and accuracy- Journalists should report the truth and provide accurate information, verifying facts through multiple reliable sources; Independence- Journalists should maintain independence from outside influences, including government, corporate, or personal interests, to avoid conflicts of interest; and Fairness and Impartiality- Journalists should be balanced and fair in their reporting, featuring diverse viewpoints and avoiding bias. Others include; Accountability- Journalists should be accountable for their work, admitting errors when they are found and immediately effecting correction being transparent about their processes; and minimizing harm- Reporting should consider the potential harm to individuals and communities and strive to avoid unnecessary harm. Tracing the history of journalism ethics, Ward (2019) outlined five periods. The first is when serious discussion started on journalism ethics in Western Europe during the sixteenth and seventeenth centuries. With the invention of the Gutenberg's press in the mid-fifteenth century, printer-editors created what was called "newssheets" and "newsbooks" under state control. Their newsgathering was crude, and the nature of the time was sectarian, but editors assured readers that they printed the impartial truth based on "matters of fact." The second period was when "public ethic" as the creed for the growing newspaper press was propounded. Journalists saw themselves as defenders of the public, protecting their liberty against government and pushing for reform. This public ethic was the basis for the idea of a Fourth Estate- the press as one of the governing institutions of society. By the end of the eighteenth century, the press was a socially recognized institution. The expansion of the idea of the press as the fourth estate into the liberal theory of the press during the nineteenth century marks the third stage. Liberal theory began on the premise that a free and independent press was necessary for the protection of public liberties and for the promotion of reform in the society.

The twentieth century which can be regarded as the fourth period in the development of journalism ethics witnessed further development of the liberal theory although it also faced criticisms. Journalists and ethicists who were focused on developing the liberal theory of the press constructed a professional ethics of objective journalism, bolstered by social responsibility theory. Objective journalism insists on reporting only facts and remaining neutral and nonpartisan in reporting politics to restrain a free press that was increasingly sensational (or "yellow") and dominated by business interests (Baldasty, 1992; Campbell, 2001). On the other hand, some journalists rejected the straightjacket of objective professional reporting, preferring a more interpretive, partisan journalism such as investigative reporting and activist (or advocacy) journalism. By the end of the twentieth century, the liberal and objective

journalistic ethics model was under attack as journalism entered its fifth stage, a stage of "mixed media." This stage marks an explosive expansion in the numbers of non-professional citizen journalists and bloggers engaging in journalism; it also marks an era where communicators use interactive multi-media that challenged the ideas of cautious verification and gate-keeping (Ward, 2009).

These developments in journalism led to emphasis on different aspects of journalistic ethical principles from the Gutenberg's press in the mid-fifteenth century with its respect for facts, through the time when the press was regarded as the tribune of the public and tagged the fourth estate and newspaper publication was becoming widespread, to the development of the liberal theory with its insistence on a free and independent press and its later evolution espousing objectivity, to the development of investigative, activist journalism. For liberal theory, journalism practice should be independent and free of any interference, holding government accountable and checking abuses of power. This approach still persists, and is employed to support the advocacy for a free press against media restrictions, such as censorship of offensive views, and the abuse of libel laws to curtail publication. Liberalism goal was focused on individual liberties and the elimination of the privileges of birth and religion that marked non-liberal, hierarchical society.

There are two principles in journalistic professional code of ethics that arose from the liberal social contract of the liberal theory that are relevant to any discussion of journalism ethics. These are the proactive and the restraining principles which were translated into specific guidelines and rules. Proactive principles deal with the freedom of journalists to publish but most importantly, their duty to publish only authentic and comprehensive truth on issues of public interest, and to report news in non-partisan manner without bias. "Seek truth and report it" and "act independently" are primary pro-active principles of most Western codes of ethics. Restraining principles caution journalists to exercise care in the discharge of their duties so as not to inadvertently cause harm. These include the duty to minimize harm to disadvantaged groups in the society such as the disabled, the poor and minorities; and the duty to be accountable to the public for editorial decisions (Ward, 2019).

Liberal press theory supported a free marketplace of ideas where the press is educator to the public and defender of its interest. In actual practice, this was not realised leading to criticisms of the theory and the development of another important ethic of journalism, namely objectivity and the social responsibility theory (Ward, 2019). The ethic of objectivity in journalism was popular in the beginning of the twentieth century with its adoption in journalists' code of conduct alongside the practice of independent journalism free from government and business interference and the separation news from opinion in reporting. This resulted into the drawing up of a set of newsroom rules to make sure that journalists reported "just the facts" (Schudson, 1978; Mindich, 1998).

Social responsibility theory of journalism, developed by scholars and journalists in the United States of America (US), emphasized the positive role that journalism should play in the society to promote development and social harmony was. The Hutchins Commission into the Freedom of the Press in the late 1940s in the US gave the theory a clear and popular formulation. The commission emphasized the major role of journalism as the provision of true, intelligent and comprehensive account of news and events, and the facilitation of comments and criticisms in the society. The press should reflect the constituent diversities in the society in which it is operating. It should also help in defining and promoting the values of the society. The theory warns about the importance of the press regulating itself so as not to give room for

government's interference. Today, the ideas of social responsibility theory have "won global recognition over the last 50 years," such as in European public broadcasting (Christians & Nordenstreng, 2004, p. 4) and as far afield as Japan (Tsukamoto, 2006). Moreover, the theory continues to provide a basic vocabulary for new ethical approaches, such as feminist and communitarian theories, while providing standards by which press councils and the public can evaluate media performance. We also have the interpretive and activist journalism under the tradition of social responsibility theory. The liberal ideal that a free press should inform citizens carried over to the social responsibility theory has been adapted by interpretive journalism which explains and provides context to the events it is reporting. Activist journalism vigorously seeks to promote development of society however defined and to fight social ills. Both interpretive and activist traditions believe that journalists have a duty to be more than recorders of fact (Ward, 2019).

Two other approaches that have influenced journalism ethics is the application of communitarian ethics and a feminist ethics of care to the practices of journalism. The approaches are a reaction to the liberal theory to which they provide an improvement. The approaches both stress the restraining principles of minimizing harm and being accountable we earlier discussed, while deemphasizing the pro-active principles of seeking truth and reporting it. The liberal perspective stress individual freedoms and rights; the communitarian and care perspectives stress the impact of journalism on the society through communal values and caring relationships (Ward, 2019).

Communitarians' focus is the collective good of the community as a whole with a stress on how human beings are social in nature. Their thesis is that no single theory can capture what is good as there is no universal consensus on what good is as it applies to all societies. Journalists should support their community's consensus of what it considers as good and promote them. They argue that the role of journalists should not be concentrated on information about facts and events, but the presentation of a rich, interpretive dialogue with and among citizens that aims at "civic transformation" (Christians, 2006). This approach is similar to theories of care developed by feminists and other scholars. Feminists promoted an ethics of care founded on notions of community rather than in the rights-based tradition (Patterson & Wilkins, 2002). This ethics of care tries to check the propensity of the media to ignore the feelings and humanity of their sources and those it is reporting about. As Black (2006:99) pointed out, feminist scholars have argued that by paying attention to the tenets of an ethics of care, "a fuller, richer media system may emerge, one that can and will consider such concepts as compassion, subjectivity, and need".

Use of AI in Journalism

Ogola (2023:7) provides several definition of AI drawn from several sources, two of which are as follows: AI as "smart machines that learn from experiences and perform humanlike tasks"; as "the activity of computationally simulating human activities and skills in narrowly defined domains, most commonly through the application of machine learning approaches, a subfield of AI, in which machines learn from data or their own performance". This 'learning' is an important feature: outcomes are 'learned' and iteratively optimised from (new) data or past performance, thus (ideally) improving the system's quality and efficiency at certain tasks over time. In the context of news journalism, the most commonly used types of AI are Machine Learning (ML) and forms of Natural Language Processing (NLP). ML is employed to develop various AI tools used, for example, fact-checking and verification, automated transcription and translation, data visualisation, sentiment analysis and opinion mining, among others. Natural

language processing (NLP) is a branch of artificial intelligence (AI) that enables computers to comprehend, generate, and manipulate human language.

Similarly, Mausam et al (2024) discussed AI in gathering as allowing the use of several features such as machine learning, computer vision, speech recognition to convert voice data into text data, natural language processing (NLP) to understand and respond to text or voice data, and robotics that refer to enabling computers and systems to perform regular human tasks. Other than generating contents, AI tools provide instant data analysis and content suggestions. This capability greatly accelerates the delivery of news, ensuring that audiences receive timely and relevant information. AI algorithms can quickly interpret vast and complex data sets, revealing trends and patterns that might be invisible or difficult to discern for the human eye. This capability not only enriches journalistic content but also brings an unprecedented depth to investigative journalism. Reporters can now uncover stories hidden within layers of data, offering their audiences insights and perspectives that are backed by a robust analysis of information.

Verma (2024) provides an excellent summary of the expansion in the use of AI in journalism by tracing how the 1980s- 1990s marks the beginning of application of AI into journalism when the focus was on AI use to assist in reporting. Databases and digital tools were utilized to efficiently gather and organize large quantities of information. This period marked the technological foundation of AI in journalism. By the beginning of the 2000, automated content generation in journalism emerged.

The early 2000s witnessed the birth of automate content generation in journalism. Algorithms were developed to produce simple reports, such as weather updates, sports summaries, and financial news. The introduction of Natural Language Generation (NLG) technologies was a significant step forward. NLG allowed for data conversion into readable narratives, a rudimentary form of automated journalism… From the mid-2000s to the 2010s, machine learning algorithms became integral to journalism. These algorithms could sift through large datasets, identify patterns, and even predict trends, proving particularly useful for investigative journalism… In the late 2010s, personalization became a key focus in journalism, driven by AI. News platforms started using AI algorithms to tailor content distribution to individual users, enhancing engagement and content relevancy… In recent years, the advancement of AI technologies, especially deep learning, has further enhanced journalistic capabilities. Sophisticated sentiment analysis, real-time reporting assistance, and the generation of complex articles have become possible. Concurrently, AI tools have been increasingly used for fact-checking, helping combat misinformation and deep fakes (Verma, 2024:151)

The regular application of AI in newsrooms goes back to 2013, when Associated Press (AP) automated the production of narrative text stories directly from data related to sports and, soon thereafter, for corporate earnings reports, using the technology of Automated Insights. After AP, news agencies such as France Press and Reuters began to increase their news production thanks to algorithms and media such as the *Los Angeles Times* launched the first bot. Since then, a myriad of examples from news agencies, to public and private media verifies that AI tools can work at various levels and phases of the production process, providing media companies with competitive advantages. (Noain-Sánchez, 2022).

AI is revolutionising journalism "by transforming the way news is gathered, edited, and presented. It empowers robots to generate genuine news articles, while AI algorithms simplify intricate information into easily comprehensible news pieces for the general audience. One

such program, WordSmith, is capable of converting data and complex texts into persuasive sentences that closely resemble articles written by human journalists." (Al-Zoubi, Ahmad & Hamid, 2024:401). It is becoming common to use computation and innovative digital tools to support journalists in their work. These tools help them generate news at higher speeds using huge amounts of data. In news gathering, features of AI such as machine learning, computer vision, speech recognition to convert voice data into text data, natural language processing (NLP) to understand and respond to text or voice data, and robotics enabling computer systems to perform regular human tasks are now used by journalists.

There is also computational journalism which mines and analyses big data, and identifies patterns and trends. These tools can also track audience sentiments. Fully automated and semi-automated forms of gathering, filtering, composing, and sharing news now occupies a greater place in a growing number of newsrooms. AI tools is used in newsrooms to perform tasks such as finding and contacting sources, adjusting objects, faces or colours, converting speech into text, editing audio and video, and identifying the sentiment of readers on different platforms (Mausam et al, 2024). Implementing AI in newsrooms increases the speed and efficiency of reporters, algorithms relieve journalists from their daily routine work, providing them with the time to devote to in-depth analysis and reporting, and fulfilling requirements of their work- like checking multiple news sources, giving more attention to human dignity and respecting privacy.

Ethics and AI

The use of AI in journalism is now a fact of life. According to studies, journalism experts and professionals in the field believe that AI technology will play an important role in the industry, with three main lines of application: the automation of content, both textual and audio-visual, the verification and improvement of access to information and monetization including subscription and loyalty systems and the personalization of content. The recent emergence of the so-called synthetic media- media that lack journalists and where all work routines depend on AI- highlights the dizzying speed at which it continues to develop. (Gutiérrez-Canedan et al, 2023). Accordingly, there is a need to interrogate how AI will impact on journalism ethics on which the profession is built and sustained.

Al-Zoubi, *et al.,* (2024:402) Al-Zoubi, *et al.,* (2024:401) discussing the challenges of AI in journalism explain:

The use of AI technology to gather, store, and share large data sets raises ethical concerns regarding governance, quality, security, standards, privacy, and data ownership... Automated journalism encounters ethical hurdles, including data exploitation, due to the absence of clear norms and standards. This poses potential data security and privacy risks for developers, governments, and consumers... Monti (2019) argued that using correct, unbiased, and accurate data is an ethical imperative in automated journalism. Data quality is also crucial, as it can lead to erroneous results in AI usage, including the source and accuracy of data.

Ward (2009) righty made the point that a major task of journalism ethics is to determine how existing norms apply to the main ethical issues of the day. He listed some current ethical challenges facing journalism to include how much verification and context is required to publish a story, the amount of editing and gatekeeping to be applied; the challenge of journalists maintaining independence but preserving good relations with employers, editors, advertisers, sources, police and the public and whether journalists should use deception in getting a story.

Other issues are how journalists should deal with images and graphics; the confidentiality of sources and ethics across media types.

Noain-Sánchez (2022) also mentioned some of the ethical issues thrown up by the use of AI in journalism such as the need to protect freedom of speech, transparency and accountability, and the risks of disinformation and lack of plurality and diversity in news recommendations systems which might show biased information to users, thus reinforcing preconceived ideas by limiting exposure to content diversity.

A central plank of journalism ethics is the need to seek for and report the truth to the public as accurately and comprehensively as possible. Information passed to the public should be based on facts which should be distinguishable from opinion. Qureshi & Tekin, (2020) discuss the risks associated with AI's proficiency in generating content that are false and not based on the real world, particularly in creating deep fakes and synthetic media. While it is true that AI facilitates efficient news generation, it is also true that it is a threat to the integrity of news and information through misinformation. The ability to produce highly realistic, manipulated audio and video content (deep fakes) underscores the urgent need to ensure that AI-generated content remains accurate and is not employed to deceive or mislead users. Safeguards should be developed to protect users of AI products from misinformation and falsehood which are antithetical to journalism ethics. Sultan, *et al.*, (2024) state that the most pressing concern of the integration of AI into journalism is the potential for AI to be weaponized as a tool for misinformation and propaganda. AI-generated content can be manipulated to propagate falsehoods, for example through deep fake videos, indistinguishable from reality, and this raises the stakes in the battle against misinformation.

Personalizing content to suit target user's preferences might lead to lack of diversity and reinforce users' prior beliefs by creating filter bubbles and echo chambers. This personalisation occurs through AI analysing user behaviour, preferences, and past interactions to generate news feeds and recommend articles that align with individual users' interests thus creating echo chambers. In addition, algorithms might erode the editorial control of the media, provoking bias at various levels of production (input, throughput and output). As AI can also be used to create highly convincing fake contents, editorial supervision and control of AI programmes are of critical importance, although the immense volume of content generated by AI technology makes these tasks of supervision and control difficult. There is also the challenge of accountability and transparency. Due to the fact that the use of AI in news production at all stages also involves other professionals such as programmers and information technologists, the matter of the demarcation of responsibilities poses a serious challenge. Still on accountability and transparency, taking the Chat GPT application as an example, AI has raised concerns among journalists and writers regarding the potential impact of its generated content production without human involvement. Should users be informed when AI produces a piece wholly or partially, and who takes responsibility for pieces produced by AI? As noted by Al-Zoubi, *et al.*, (2024:402), the "introduction of the first automated "journalist" at the Associated Press in 2014 immediately sparked ethical questions. Should readers be informed that a machine authored the article, or should this information be withheld? From a legal standpoint, who is considered to be the author of the content? Who should be held accountable for the accuracy of the facts, especially considering potential data flaws? How can we teach journalistic ethics to a robot?".

Discussing these ethical issues thrown up by AI use in journalism, Verma (2024:152) opines that the use of AI algorithms personalization of news stories "raises critical concerns regarding

bias and transparency. These algorithms, often shrouded in opacity, may inadvertently perpetuate existing biases present in their training data, leading to questions about the impartiality and accountability of AI-driven journalism. Additionally, the issue of authorship and credibility becomes prominent, as readers often consume AI-generated content without awareness, sparking debates about trust and authenticity in journalism."

To recap, journalism ethics stress the duty of journalists to seek and report the truth in the most accurate and comprehensive manner to the public, to do no harm and to take responsibility for editorial decisions; to distinguish between facts and comments and report only facts of known origin; to not supress or falsify information and to not obtain information under false premises; to respect privacy of individuals and protect sources; and to rectify any published errors promptly and transparently (Ward, 2019; IFJ, 2019).

Researchers have noted that the generation of content through AI in news gathering have implications on the ethics accountability, transparency, and bias which in turn impacts on public trust in the media. In generating content, there may be issues such as the dataset itself and how it was collected, the property of the data and whether privacy rules were followed. Datasets are almost always biased as the AI systems used in mining them are shaped by their input data and training processes, and so prone to reflecting these biases, which can lead to skewed reporting and the potential underrepresentation or misrepresentation of certain groups or topics. The design of the algorithm for personalisation could thus lead to bias, echo chambers and filter bubbles. Personalising content negates diversity and plurality of information and can lead to a distorted view of reality. As Verma (2024) notes, the use of AI algorithms in personalizing contentment through the selection and prioritizing of news stories raises questions about bias and transparency. The algorithms, often shrouded in opacity, may inadvertently perpetuate existing biases. Users of personalized content might also find themselves stuck in a filter bubble: without any exposure to contrary opinion. Producers of journalism content must always be conscious of the fact that editorial tools and algorithms might distort user understanding of reality and may hamper their ability to make balanced decisions. In terms of media accountability, transparency and plurality, experts point out that ethical principles should be embedded by design. Additionally, media organizations ought to supervise AI outputs, to ensure they promote diversity and plurality, and in order to minimize the risk of bias (Noain-Sánchez, 2022). All these impact on the ethics of fairness, speaking the truth accurately and in a comprehensive manner and the right of the public to be informed along these lines.

Further discussions on accountability and responsibility by Verma, (2024), Sultan, Bhuiyan and Amir. (2024) and Forja-Pena, García-Orosa, & López-García, (2024) make the point that it is very important that news organizations clearly state the methodologies used in their AI systems, their origins, type of the data used by the AI programme and the extent to which AI influences editorial decisions. Users should also be informed when the content is generated by AI or created using AI algorithms. Additionally, the use of AI in newsrooms have thrown up the question of who exactly is responsible for content generated when it is used. When AI algorithms play a role in news reporting, who should be held responsible for any errors or biases in AI-driven content? The AI developers? The journalists utilizing these tools, or the news organizations themselves? To effectively tackle this challenge, there should be a well-defined and shared accountability system.

As to the issue of privacy violation, Al-Zoubi et al (2024) found that there is concern among journalists that AI applications do not respect privacy. They use personal content as part of the

content it generates and this exposes news organisations to accountability and privacy violations. Also, data relied upon by AI applications can be exploited for other purposes, contradicting the principles of journalistic integrity. AI can collect sensitive information about individuals and use it unethically. This point was also emphasized by Sultan, *et al.,* (2024).

CONCLUSION

From the foregoing discussions, it is clear that the emergence of AI poses ethical challenges to the practice of the journalism profession. These challenges include those to the cardinal journalism ethic of fidelity to truth as captured in the journalist's duty to seek and report the truth with accuracy; fairness in reporting as in reflecting all sides to an issue and all views; importance of knowing sources of news before publication; avoiding bias and accountability in taking editorial responsibility for all publications. However, AI has also positively impacted on news gathering, production and dissemination to such an extent that its influence is irreversible. The crucial issue is how the enormous positive transformation AI has brought into the newsrooms can be anchored on journalism ethics in such a way that it complements journalism work rather than replace or supplant journalists. As noted by Sultan et al (2024), while AI offers major efficiency and accuracy benefits, it is necessary to underscore the point that it should complement, rather than replace core journalistic values of critical thinking, editorial judgment, and ethical reporting. Striking a balance between AI-driven automation and the central role of journalist should be the focus if ethics of journalism is to continue to play its role in journalism practice. Forja-Pena, *et al.,* (2024) also stress the importance of determining a set of fundamental ethical principles to protect the integrity of the news and govern the technological options within the media.

The Paris Charter on AI and Journalism (2023) produced by stakeholders in journalism including practitioners and scholars, pointed to the fact that technology has always played a role in the development of news and information and noted that the emergence of AI represents a major shift in journalism from news collection to dissemination of ideas. This has the potential to profoundly affect the conditions of journalism. Arising from the adjudged impact AI has on journalism, the charter made far reaching recommendations on the use of AI in journalism practice. It stresses that AI development and use in journalism must be anchored on journalism ethics including truthfulness and accuracy, fairness, impartiality, independence, non-harm, non-discrimination, accountability, respect for privacy and for the confidentiality of sources. Human journalists must remain in charge of all editorial decisions and AI tools should only be deployed on clearly stated parameters with editors retaining the ability to deactivate any AI system. AI systems should be independently assessed and evaluated by journalists to ensure adherence to the core values of journalistic ethics of privacy, intellectual property and data protection laws before being deployed. Systems that operate predictably and can be simply explained are preferred.

The charter also emphasised that media houses must take editorial responsibility in their use of AI tools and should be liable and accountable for all the contents they publish. Editors should anticipate, outline and assign to human journalists the monitoring of the use of AI tools to ensure adherence to journalism ethics and editorial guidelines. Media houses should be transparent and communicate all use of AI in the production of content; they should also be sure about the origins and authenticity of all the contents they publish and disclose any subsequent changes it may have undergone. Of crucial importance is the need to distinguish between content derived from the physical capture of the real world (such as photographs, and audio and video recordings) and that which is created or significantly altered using AI systems.

This should be clearly communicated. Use of authentic footage and recordings to depict actual events should be preferred.

Design and use of AI systems for automatic content personalization and recommendation should be guided by journalistic ethics. It is also necessary that journalism stakeholders play an active role in the governance of AI systems. They should be included in any global or international institutional oversight of AI governance and regulation. Finally, the charter recommends that access to journalistic content by AI systems should be governed by formal agreements that ensure the sustainability of journalism and uphold the long-term shared interests of the media and journalists. AI system owners must credit sources, respect intellectual property rights, and provide just compensation to rights holders. Rights holders must make the reuse of their content by AI systems conditional on respect for the integrity of the information and the fundamental principles of journalistic ethics.

There is a no doubt that AI will continue to play a major role in journalism just as in other professions, and in many aspects of modern life. Its impact has become so encompassing that there is apprehension that it may surpass and/or dominate human intelligence and possibly supplant it. In Journalism, the central role of human being must be emphasized and maintained, most crucially in the editorial control of the newsroom. The use of AI in the collection, editing and presentation of news must be guided by ethics. This is, perhaps, the best way that ethics- which is dynamic and must adapt to changing situations- can continue to play its foundational role in Journalism so that the profession can remain relevant, credible and sustainable.

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INFORMATION AND COMMUNICATION TECHNOLOGY PROFICIENCIES, ACCESS AND USE OF NON-ENGLISH COLLECTIONS FOR RESEARCH ACTIVITIES OF POSTGRADUATE STUDENTS IN UNIVERSITIES IN SOUTH-WEST, NIGERIA.

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Abstract
This study was focused on Information and Communication Technology (ICT) proficiencies, access and use of non-English collections for research activities of postgraduate students in universities in South-west, Nigeria. The study was guided by two research objectives with corresponding research questions and one hypothesis. The study adopted a descriptive survey research design. A sample size of 380 was drawn out of a population of 52,358 postgraduate students. Copies of questionnaire were distributed to the respondents out of which 278 were returned and used for the study. Descriptive and inferential statistics were used to analyse the data collected. The study also established that the most germane factors affecting Information and Communication Technology proficiencies, access and use of non-English collections for research activities of post-graduate students in the study area are limited language proficiency, exorbitant cost of procuring ICT facilities, and sluggish Internet connectivity. The null hypothesis formulated in the study showed that there is high correlation and the relationship is highly significant (rho = 0.493, p-value <.001). It is among other recommendations that university libraries put up a series of periodic training on emerging ICT skills needed to access the electronic information resources and should provide access to online resources with multilingual interfaces.

Keyword: Information and Communication Technology (ICT), access and use of non-English collections, research activities, postgraduate students, university libraries, South-west, Nigeria.

Introduction
Universities are established to promote scholarly research, teaching and learning in various fields of knowledge and also play a major role in the development of libraries. Tom-George (2022) asserted that university libraries are indispensable nerve centres or hubs, which serve as instruments for intellectual development and they are social institutions to which clienteles (faculty members and students) may turn to for accessing information. In essence, no university in Nigeria is established without a library.

The role of university library matters a lot on how postgraduate students perceive the libraries' contribution on their research activities. This is very important because research activities of post-graduate students, demand a lot of independent studies, irrespective of the nature of the discipline

therefore, access and use of library collections, especially non-English collections and services is thus, indispensable to the postgraduate students in order to achieve their academic objectives.

Research activities of postgraduate students in university libraries become iterative and more refined and organised as they become more knowledgeable in their respective fields of study, and their information use varies among disciplines and by programmes. Postgraduate students like other clienteles of the university library make use of both print and non-print (electronic) library materials available and their research activities are also influenced by convenience, speed and ease of access. The importance of Information and Communication Technology proficiency cannot be over emphasised. Onyebinama (2021) emphasised that Information and Communication Technology proficiencies range from basic level to advanced level. Opportunities offered in advances of Information and Communication Technology, with regard to universal and limitless access to information cannot be fully exploited in university libraries if users especially postgraduate students are not sufficiently conversant with Information and Communication Technologies (ICTs), hence the urgent need for postgraduate students to improve their Information and Communication Technology (ICT) proficiencies.

Going by our colonial history, English language has been Nigeria's lingua franca, hence the medium of communicating instructions in institutions of learning in the country. As a result of this, a great deal of library collections is written or presented in English language despite having significant population of users of non-English language collections in disciplines such as arts and humanities, natural sciences and social sciences.

Non-English collections or multilingual collections are library materials written in any other language other than English language. These include African studies, Yoruba, Igbo, Hausa, French, Chinese, and Arabic languages in print and electronic formats. These materials have to be acquired, processed, preserved and organised for use the same way as English collections. Librarians as custodians of information must therefore consciously make every effort to ensure that various facets of non-English collections are available in the library and they get to the users at the shortest time possible. It is against this background that the researcher attempts to examine Information and Communication Technology proficiencies, access and use of non-English collections for research activities of postgraduate students in universities in South-west, Nigeria.

Statement of the Research Problem

In an ideal situation, university library collections that are available to faculty members, students and other users should not be restricted to collections solely in English Language and printed formats such as books and journals. The actual situation is that university libraries place more priority on acquisition and management of English Language collections for the purpose of teaching, learning and research in their various institutions. Non-English collections are important information resources just like English Language collections.

A pilot study carried out by the researcher revealed that disciplines in non-English do not have adequate information resources in university libraries resulting to students having difficulty in accessing non-English collections for research. It has equally been observed that despite the increment in the number of non-English programmes in the Nigerian universities, there has not been a significant development in their collections in the libraries thus, a matter of concern.
Information and Communication Technology proficiency is an important requirement for successful postgraduate studies. However, many postgraduate students do not have the requisite digital and research skills to search and obtain current empirical information to aid

their research projects (Bako & Odigie, 2021). If this situation persists, funds invested in procuring, digitizing and web-hosting information in e-libraries would have been wasted.

This study intends to determine the relationships of Information and Communication Technology proficiencies, access and use of non-English collections for research activities of postgraduate students in universities in South-west, Nigeria.

Research Questions

The following research questions were asked and answered in the study:

1. What are the non-English collections available in various formats for research activities of postgraduate students in university libraries in South-West, Nigeria?

2. What are the factors affecting Information and Communication Technology proficiencies, access and use of non-English collections for research activities of post-graduate students in university libraries in South-west Nigeria?

Research Hypothesis

H_{01}: There is no statistically significant relationship between availability of non-English collections in various formats and research activities of postgraduate students in university libraries in South-west, Nigeria.

Methodology

The study adopted a descriptive survey research method. The population of the study comprised fifty-two thousand, three hundred and fifty-eight (52,358) postgraduate students in universities in South-west, Nigeria as at 2021/2022 academic session. A cluster sampling was adopted for this study and also using the Krejcie and Morgan (1970) Table to select a sample size of three hundred and eighty (380) postgraduate students from five (5) universities that offers postgraduate programmes in non-English specialties in South-west, Nigeria.

Questionnaire was used for data collection. Mean, standard deviation and Spearman's Ranking Correlation were used to analyse the research questions and test the null hypothesis.

Data Analysis

Response Rate

According to Luo (2020), a response rate of 50% - 60% constitutes to fairly good representation. Thus, a response rate of 73% is deemed acceptable and reliable for the study. The response rate is provided in Table 1.

Table 1: Response Rate

S/No	Universities	Total Administered	Total Retrieved and Usable (%)
1	Obafemi Awolowo University, Ile-Ife, Osun State	120	81 (67.5%)
2	Olabisi Onabanjo University, Ago Iwoye, Ogun State	20	20 (100%)
3	Osun State University, Osogbo, Osun State	10	10 (100%)
4	University of Ibadan, Ibadan, Oyo State	140	104 (74.3%)

5	University of Lagos, Lagos State	90	63 (70%)
Total		380	278 (73%)

Table 2: Descriptive statistics of non-English collections that are available in various formats for research activities of postgraduate students in university libraries in south-west, Nigeria

S/N	STATEMENT	SA	A	N	D	SD	FX	N	X	StD	Decision
1	The university library has online databases that comprise non-English (Yoruba, Igbo, Hausa, French, Chinese, Arabic and Africana) collections.	39	135	68	34	2	1009	278	3.63	0.89	Agreed
2	The university library has a robust collection of theses and dissertations written in non-English languages by graduate students to aid my research work and contribute to global scholarship.	86	133	44	13	2	1122	278	4.04	0.85	Agreed
3	E-journals and e-books in foreign and indigenous languages are available in the university library.	72	148	47	11	-	1115	278	4.01	0.77	Agreed
4	The university library has adequate non-English textbooks and journals to aid my research.	95	137	31	11	4	1142	278	4.11	0.86	Agreed
5	The university library has non-English language films, documentaries, and educational videos in DVD or digital formats to satisfy my research curiosity.	23	77	111	63	4	886	278	3.19	0.93	Agreed
6	The university library subscribes to	22	64	112	55	25	837	278	3.01	1.05	Agreed

	multilingual electronic databases, offering access to articles, research papers, and resources in multiple languages.										
7	The university library has language learning resources designed to teach non-English languages, such as multimedia content and self-paced language learning.	29	137	61	46	5	973	278	3.5	0.95	Agreed
8	The university library has government publications such as legal documents, reports, and statistical publications in non-English languages	27	85	110	55	1	916	278	3.29	0.91	Agreed
9	The university library has adequate newspapers and magazines in languages other than English with coverage of current events, cultural trends, and regional perspectives to help me in my research work.	29	74	115	56	4	902	278	3.24	0.94	Agreed
10	The university library contains cultural and religious texts, sacred texts, philosophical treatises, and historical writings.	55	97	81	39	6	990	278	3.56	1.03	Agreed
	Average Weighted Mean								3.15		

Key: SA = Strongly Agreed, A = Agreed, N= Neutral, D =Disagreed, SD = Strongly Disagreed, $\bar{X}$=Mean, FX = Sum and StD = Standard Deviation (Benchmark mean = 2.50)

Table 3: Descriptive statistics on factors that affect Information and Communication Technology proficiencies, access and use of non-English collections for research activities of post-graduate students in the university libraries in South-west, Nigeria

S/N	STATEMENT	SA	A	N	D	SD	FX	N	X	StD	Dec.
1	Inadequate infrastructure or limited access to ICT tools hinders the effective use of digital resources in the university library	90	115	57	13	3	1110	278	3.99	0.9	Agreed
2	The exorbitant cost of procuring ICT facilities also limits my proficiency in ICT.	81	158	31	8	-	1146	278	4.12	0.71	Agreed
3	Sluggish Internet connectivity hampers my information retrieval skills.	100	126	35	15	2	1141	278	4.10	0.87	Agreed
4	I have limited digital literacy skills, which may result in difficulties in navigating digital repositories and assessing the credibility of non-English materials.	62	100	71	26	19	994	278	3.58	1.14	Agreed
5	Limited availability or poor organization of non-English collections restricts my ability to find relevant materials in the university library	74	111	64	20	9	1055	278	3.79	1.02	Agreed
6	Lack of training or support services may leave postgraduate students without the necessary skills to effectively use ICT tools and leverage non-English resources	76	119	57	21	5	1074	278	3.86	0.96	Agreed

	in the university library.										
7	Lack of cultural awareness may lead to misinterpretation or misunderstanding of non-English resources in the university library.	75	123	61	11	8	1080	278	3.88	0.95	Agreed
8	Limited language proficiency poses a barrier to understanding and utilising non-English resources effectively in the university library.	114	117	38	5	4	1166	278	4.19	0.84	Agreed
9	Limited supportive government policies and funding for language education, research, and library resources can negatively impact the availability and use of non-English collections in university libraries in South-west, Nigeria.	58	145	56	17	2	1074	278	3.86	0.84	Agreed
10	Technological barriers or a lack of user-friendly digital tools and technologies that facilitate translation, text analysis, and comprehension of non-English materials hinders the effective use of non-English resources in the university library.	113	102	45	14	4	1140	278	4.10	0.94	Agreed
	Average Weighted Mean								3.95		

Key: SA = Strongly Agreed, A = Agreed, N= Neutral, D =Disagreed, SD = Strongly Disagreed, $\overline{X}$=Mean, FX = Sum and StD = Standard Deviation (Benchmark mean = 2.5)

Hypothesis Testing

Table 4: Relationship between research activities of postgraduate students and availability of non-English collections in various formats in university libraries in South-West, Nigeria.

Correlation Matrix

		Research activities of PG students	Availability of non-English collections in various formats
Research activities of PG students	Spearman's rho	—	
	Df	—	
	p-value	—	
Availability of non-English collections in various formats	Spearman's rho	0.493	—
	Df	276	—
	p-value	< .001	—

Correlation is significant at 0.05 level (2-tailed)

Discussion of Findings

Findings showed that university libraries under study have all the non-English collection listed for the study. Top among the list of information resources available for research activities of postgraduate students are non-English textbooks and journals, theses and dissertations written in non-English languages, e-journals and e-books in foreign and indigenous languages. This is obvious as they constitute materials often used for postgraduate research because postgraduate students basically concentrate on journals, theses and dissertations since they serve as guide for academic discourse. Probably, the availability of these resources in these institutions could be as a result of the acquisition of information resources made because of the accreditation exercise that the university just had. The availability and accessibility of information resources will lead to the use and satisfaction of information needs of the users.

The analysis on research question two revealed that postgraduate students were in agreement with all the items listed to ascertain the factors affecting Information and Communication Technology proficiencies, access and use of non-English collections for research activities of post-graduate students in university libraries in south-west Nigeria. This finding is similar to that of Adejo (2020) who uncovered that epileptic power supply, poor reading culture amongst postgraduate students on language immersion, lack of modern facilities in the library, attitudinal behavior of library staff to researchers, non-acquisition of current resources and poor organization on non-English information resources as the factors that hinders postgraduate students to utilise the information resources and services effectively.

The result of null hypothesis two revealed that there is a statistically significant relationship between research activities of postgraduate students and availability of non-English collections in various formats in university libraries in South-west, Nigeria. It is imperative to mention that a unit increase in research activities of postgraduate students will have more effect on the

availability of non-English collections in various formats in university libraries in South-west, Nigeria. This is similar to the findings of Adamu and Maidabino (2020) in which they found out that availability of information resources, library facilities, and services rendered has great impact on library clienteles' perceptions. Hence, it expected that university libraries should be able to provide different types of information resources that are current, adequate and relevant to the users; provide functioning facilities; and render befitting services for effective utilisation by the users.

Conclusion

It could be concluded that Information and Communication Technology, access and use of non-English collections are correlates of research activities of postgraduate students in university libraries in South-west, Nigeria. The findings from the study revealed that the university libraries have both print and electronic non-English resources. Top among the list of information resources available for research activities of postgraduate students are non-English textbooks and journals, theses and dissertations, e-journals and e-books in foreign and indigenous languages. As a result, the information resources will be paramount to learning, teaching and research to postgraduate students, faculty members and the community.

However, limited language proficiency and utilisation of non-English, exorbitant cost of procuring Information and Communication Technology facilities, sluggish Internet connectivity, and technological barriers or a lack of user-friendly digital tools are factors affecting Information and Communication Technology proficiencies, access and use of non-English collections for research activities of post-graduate students in university libraries in south-west Nigeria. Therefore, for university libraries to succeed, there is the need for them to acquire information resources that is current and relevant to their users' needs in order to improve information services.

Recommendations

1. University libraries in South-west, Nigeria should ensure the acquisition and provision of up-to-date non-English collections in various formats such as print, digital, audio-visual, and braille. The libraries should give priority to collection of materials in Nigerian and international languages such as Yoruba, Igbo, Hausa, French, Arabic, Chinese, German, and other local languages. University library management should also ensure organisation and cataloguing of non-English collections using standardised classification schemes.

2. There is need for university libraries in South-west, Nigeria to put up a series of periodic training on emerging Information and Communication Technology skills needed to access the electronic information resources. University libraries should provide access to machine translation tools help postgraduate students to translate texts. Furthermore, university libraries should provide access to online resources with multilingual interfaces.

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A STUDY ON THE EFFECT OF ARTIFICIAL INTELLIGENCE FOR PREDICTIVE ANALYTICS IN PATIENT HEALTHCARE AND MANAGEMENT

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Abstract

The Healthcare industry is undergoing a transformative shift driven by the integration of Artificial Intelligence (AI) technologies. Predictive analytics powered by AI offers significant potential to enhance patient care, streamline management processes and optimize healthcare outcomes. This paper explores the role of AI in predictive analytics within the health care sector highlighting its applications, benefits, challenges and future prospects. By leveraging large datasets machine learning models and advance analytics, healthcare providers can make more informed decisions to improve patients' outcomes and reduce costs. This study aims to provide insight into the on-going revolution in healthcare driven by AI technologies.

***Keywords*:** Artificial Intelligence (AI), Machine Learning (ML), Deep Learning (DL), Predictive Analytics, Model, Datasets and Algorithm.

Introduction

Globally, the integration of artificial intelligence has brought about a paradigm shift in healthcare delivery services. This has heightened innovative solutions to medical challenges and opportunities to meet individual needs of patients. Predictive analytics, a subset of AI involves the use of statistical algorithm and machine learning techniques to analyse historical data and identify patterns of patients. It is an advanced data analytics techniques that uses data to predict future outcomes (Anik, 2024). In healthcare, predictive analytics can determine the patients outcomes disease progression and the treatment that is responsible to enable proactive interventions. In general, AI systems work by consuming large amount of labelled training data analysing that data for equivalency and patterns and using this patterns to make predictions about the future outcome (Lev *et al*., 2024). The system is applied to a range of tasks in healthcare domain with the primary goal of improving patient outcomes and reducing structural cost. One major application of AI is the machine learning models which are trained on large medical datasets to assist healthcare professionals to make better and faster diagnoses. Lev *et al* (2024) added that online virtual health assistants and chatbots can provide general medical information, schedule appointment, and explain billing processes for patients and also automate administrative tasks for medical staff.

Related Works

Recently, the field of predictive analytics in healthcare has experienced a gush in inventive research and applications. The following consist of a sketch of some of the most recent studies and their contributions to this field:

Mental health has achieved eminence in healthcare, and predictive analytics has found application to recognise individuals at risk of mental health jumbles. The recent studies, such

as the one by Johnson *et al*. (2023), explore the use of predictive analytics in early mental health diagnosis and treatment planning.

As well as the adoption of AI in healthcare continues, concerns about been fair and bias increased. Recent studies, such as the research by *Zhang et al*. (2023), examine the advancement of ethical AI models and tools that alleviate bias and make sure that predictive analytics in healthcare remains decent and just.

Patel *et al*. (2021), utilizes predictive analytics to explore the patient-generated health data produced by the proliferation of wearable devices and mobile apps, also to monitor chronic conditions, and empower patients to take a more active role in their healthcare.

Wang *et al*. (2021) explored how genomic data, combined with predictive analytics, can guide clinicians in prescribing tailored therapies, particularly in the field of cancer treatment. Genomic data has become increasingly accessible, and predictive analytics plays a pivotal role in translating this information into personalized treatment plans. The global shift toward telehealth services has generated interest in predictive analytics for remote patient monitoring.

A study by Smith *et al*. (2022) showcases the application of predictive analytics in remote patient monitoring, enabling healthcare providers to proactively address patient needs and prevent hospital admissions.

Methodology

The first thing one should consider before the methodological process of predictive analytics is how to choose the right machine learning algorithm for the model as this is going to determine the effectiveness of the model. A model refers to a mathematical representation or algorithm designed to recognize patterns or make decisions based on data. It is trained using a dataset allowing it to learn and make predictions or classifications on new unseen data. The following highlights describes the facts to consider when choosing a machine learning algorithm for a predictive model.

***UNDERSTANDING DATA*:** It is crucial for one to have a solid understanding of their data before diving into the world of machine learning algorithm. Firstly consider the type of data one is working with. Is it structured or unstructured? Structured data is highly organised and can be easily represented in tables or spreadsheets, while unstructured data does not have a predefined format and may include text documents, images, or videos. Secondly, the assessment of whether the dataset is labelled or unlabelled. Labelled data has a pre-assigned target variables that indicate the desired outcome or prediction. On the other hand, unlabelled data lacks the predefined labels. Thirdly, the consideration of the size of the dataset. Some algorithms performs better with large datasets due to their ability to generalize patterns accurately. Others may work well with small datasets but struggle when given large amounts of information.

***CHOOSING THE RIGHT ALGORITHM*:** Once one has a good understanding of their data, the next step is to choose an algorithm that aligns with its characteristics and requirements. For structured datasets with labelled outcomes, classification algorithms such as logistic regression or decision trees may be suitable choices. Logistic regression models relationships between input variables and binary outcomes while decision trees uses a tree-like model to make decisions based on multiple input variables. If one have labelled structured datasets and wants to predict numerical values, regression algorithms such as linear regression or support vector

regression (SVR) can be considered. The algorithms analyse the relationship between input variables and continuous outcomes.

For unstructured data such as text document or images, algorithms like natural language processing (NLP) or Convolution Neural Network (CNN) may be appropriate. NLP algorithms process and analyse human language, enabling task such as sentiment analysis or language translation. CNNs on the other hand, are particularly effective for image recognition and classification tasks.

Steps Involved in Developing a Predictive Analytics Model

Understanding the Basics of Machine Learning: The three types of learning in machine learning were supervised learning, unsupervised learning and reinforcement learning. Supervised learning is where models are trained by using labelled data, while unsupervised learning is where models discovered pattern in unlabelled data and reinforcement learning is where models learn through trial and error. It is very important to understand the difference between regression (predicting continuous value) and classification (predicting categorical values).

Identify the Problem*:* Clearly articulate the health problem or goal you want to address with predictive analytics. For instance you may want to articulate the cause of heart diseases in men that are above sixty (60) years of age. Writing down a distinct problem statement will help to gather relevant data and scope out the details.

Collect and Organize Data*:* Gather data that is relevant to the outcome one is trying to predict. This can include patient's information, historical data and more. There are online repository data and there are local data. The type and size of data collected will determine the algorithm to use.

Prepare and Explore Data: This involves various processes such as data cleaning and data transformation to ensure that it is ready for modelling. It is very essential for optimal accuracy of the model.

Choose the Right Machine Learning Algorithm: It is very important to consider factors like size of dataset, complexity of features, interpretability requirements and computational resources when selecting an algorithm. (see the previous page)

Build and Evaluate Models: This involves splitting data into training and testing sets to access how well the model generalizes to data. The training set is used to teach the model by adjusting its internal parameters based on known outputs (labels). The testing set is then used to evaluate how well the trained model performs on new data. During model training, tune hyper parameters (settings that influence model behaviour) using techniques like grid search or random search. This process helps optimize model performance without over fitting (when a model memorizes training examples instead of generalizing). Once one has trained their models, they will evaluate their performance by using appropriate metrics.

Results And Discussion

The integration of AI into predictive analytics for patient care and management has resulted into the following benefits:

Improving Patient Outcomes: AI authorise the early detection of diseases and timely medical intervention which is important in improving the outcome of patients. Predictive analytics has the ability to identify high-risk patients and predict diseases progression, it allows healthcare providers to take preventive actions before symptoms becomes serious. For example early detection of cancer by using AI algorithms can significantly reduce mortality rates by enabling immediate treatment (Ahmad *et al*., 2021).

Personalizing Treatment Plans: The ability of AI to analyse sophisticated datasets allows for the personalized of treatment plans, customized to individual patient profiles with consideration of some factors like genetics lifestyles and medical history. This personalized approach improves treatment effectiveness and reduces the risk of adverse effects that leads to better patient contentment and health outcomes (Reddy *et al*., 2022).

***Reducing Healthcare* Cost:** Through predicting and averting disease progression and hospital readmission, AI-driven predictive analytics could be of help to reduce avoidable healthcare expenses. For example, predictive models can recognize patients at high risk of readmission and this will allow healthcare providers to implement intended arbitrations which can reduce readmission rates and associated costs (Shameer *et al*., 2020).

***Enhancing Operational Efficiency*:** Predictive analytics helps the healthcare sector to enhance resources allocation and manage tasks profitably. AI can predict the rate of patient admission and hospital resource needs to allow better plans and ensure that healthcare providers were properly prepared to deliver care consequently improving the overall efficacy (Zhou *et al*., 2021).

***Managing the Data Deluge*:** Health practioners are facing challenges and difficulties to extract applicable insights manually because the health sector produces numerous amount of data. The data processing capabilities of AI can handle this volume and challenge, transforming raw data into meaningful information that supports clinical decision-making and improve patient care (Esteva *et al*., 2021).

Healthcare system worldwide are tussling with increasing loads of patients, rising costs and the need for improved care quality. The conventional way of patient care and management mostly rely on reactive measures, which can lead to incompetence and poor outcomes. The motivation behind leveraging AI for predictive analytics is to shift from a reactive to proactive approach where potential health issues can be identified and addressed before they escalate. Artificial intelligence is rapidly transforming the healthcare sector by enabling more accurate and efficient methods of patient care and management. A key area where AI is making a remarkable impact is in predictive analytics which refers to using data analysis and machine learning techniques to predict the future states of health based on historical and real-time data. Predictive analytics has the capability to transform health by enabling early disease detection, personalized treatment plans and proactive management of chronic diseases ultimately leading to improved patient outcomes and more structured healthcare systems.

Conclusion

Predictive analytics has the potential to revolutionize patient care and management by enabling early detection, personalized treatments, and more efficient healthcare delivery. As data from electronic health records, genomics, wearables and IoT devices becomes more accessible, predictive models will continue to evolve and offer deeper insights, ultimately improving patient outcomes and reducing healthcare costs. However, challenges remain, particularly

around data privacy and the integration of predictive analytics into legacy healthcare systems. Overcoming this barriers wil require ongoing innovation, better data governance and collaboration between AI systems and human healthcare providers, careful consideration must be given to ethical concerns and model tranparency to ensure responsible implementation. In summary, predictive analytics promises a future of more personalized, efficient and cost-effective healthcare, As technology evolves, its role in both patient care and hospital operations is likely to expand significantly. The future of predictive analytics in patient care and management holds immense potential to transform healthcare by improving outcomes, reducing cost and enabling personalized proactive care.

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AWARENESS AND UTILUZATION OF MODERN TECHNOLOGIES FOR AQUACULTURE INSTRUCTION AMONGST TERTIARY INSTITUTION TEACHERS IN NIGER STATE, NIGERIA

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Abstract
The paper examined awareness and utilization of modern technologies for aquaculture instruction amongst tertiary institution teachers in Niger State, Nigeria. The researchers adopted a descriptive survey design. The total population of Lecturers is 72, in the 6 tertiary institutions under study in Niger State. The sample size for this study was 52. The study used a purposive sampling technique to select participants which included Aquaculture Lecturers. An online questionnaire was the instrument used for data collection. The findings revealed that lecturers generally view modern technologies in aquaculture instruction positively, with mean scores from 3.38 to 3.58, and low standard deviations between 0.50 and 0.70, indicating strong and consistent agreement on the importance of technologies such as Virtual Reality and AI-based systems, reflected in a grand mean of 3.51. Also, the overall utilisation of modern technologies for aquaculture instruction, with a grand mean score of 2.55, highlights that while gamification tools and E-learning platforms are used more frequently (means of 2.94 and 2.77), Augmented Reality and Artificial Intelligence (AI) based systems are less commonly utilised (means of 2.15 and 2.21), suggesting varied adoption rates depending on technology complexity and infrastructure needs. The findings revealed no significant gender differences in the utilisation of modern technologies for aquaculture instruction, with a p-value of 0.13. In conclusion, the study revealed that teachers in tertiary institutions in Niger State, Nigeria have a generally positive awareness of modern technologies for aquaculture instruction, particularly appreciating tools like E-learning platforms and simulation softwares. Based on the findings, the researchers recommended that: Targeted training and support should be provided for teachers on using advanced technologies like Biotechnology techniques and usage of IOT devices to improve their utilisation in aquaculture instruction, while also implementing gender-inclusive strategies, such as tailored workshops and mentorship programs, to ensure equal access and utilization of modern technologies amongst male and female lecturers.

Keywords: *Awareness, Utilization, Modern Technologies, Aquaculture.*

Introduction
The integration of modern technologies with the teaching of aquaculture in tertiary institutions in Nigeria has the capacity to transform the way students learn and understand difficult concepts in aquaculture. Meanwhile, the success of this integration is hinged on the awareness and utilisation of these novel technologies by lecturers and students too. Aquaculture plays a very crucial role in food security as well as economic development in Niger State and in Nigeria in general, therefore, there is a pressing need for technology enhanced instruction of aquaculture in tertiary institutions in Niger State. This study is aimed at investigating the current level of awareness and utilisation of modern technologies for aquaculture instruction in tertiary institutions in Niger State of Nigeria, seeking to identify means for improvements and strategies for enhancing the quality of aquaculture education in the aforementioned state.

Fisheries is one of the important aspects of aquaculture and advancements in modern technologies have transformed various aspects of aquaculture. These include, but not limited to breeding, disease management, water quality monitoring, and feed formulation. (Sundaray et al, 2022). However, the successful adoption and utilization of these technologies in Nigeria's tertiary aquaculture Institutions depend on the awareness and understanding of these innovations amongst students and lecturers.

Aquaculture is the deliberate rearing/raising and harvesting of aquatic organisms to serve as food. It includes the propagation, cultivation and marketing of aquatic animals such as catfish, tilapia, molluscs, crustaceans, algae, ornamental fish and other organisms in all types of water environment like ponds, lakes, rivers or ocean enclosures (Umunna et al, 2020). It has gained a considerable attention in recent years due to its potential to meet the growing demand for seafood and alleviate pressure on wild fish populations. As the demand for seafood is increasing, technology is making it possible to grow food in marine and freshwaters. (Tom et al, 2021). The importance of Aquaculture in the economy of Nigeria can never be over emphasized, from providing a source of income to nourishing the population. The meaningful teaching and learning of aquaculture require the integration of modern technologies and a comprehensive understanding of the different aspects of aquatic organisms.

Aquaculture instruction and technology intersect to enhance efficiency in the teaching and learning of some difficult aquaculture concepts through innovative technologies like Virtual and Augmented Reality (Walakira et al., 2023; Montgomery et al., 2022). The merging of aquaculture education with novel technologies helps students to prepare for careers in modern aquaculture where they can make use of cutting-edge technologies to improve efficiency and sustainability (Rahimi-Midani, 2023; Fabris *et al.,* 2023). These advancements help optimize production yields while minimizing environmental impact, driving innovation in the aquaculture industry.

Tertiary institutions in Nigeria play a crucial role in advancing the aquaculture industry by providing specialized education and training (Ogwu, 2017; Kolawole-Jimoh, 2021). These institutions are responsible for equipping students with the necessary knowledge and practical skills to innovate and improve the efficiency of aquaculture practices. The integration of modern technologies into the curriculum can help students visualize complex aquaculture concepts like water recirculatory systems, fish behaviour and pond ecology (Fishman et al., 2016; Grimus, 2020). Advanced tools such as automated feeding systems, water quality monitoring devices, and genetic selection techniques can also significantly enhance the learning experience and prepare students for the practical skills that are needed in the industry. Moreover, tertiary institutions in Nigeria and those in Niger State particularly, serve as key centres for research and development in aquaculture (Kolawole-Jimoh, 2021; Ajayi et al., 2022).

New technologies such as simulation softwares can provide students with practical, hands-on experience in a controlled environment, enhancing their understanding and skills without the need for extensive physical resources. Additionally, online learning platforms can facilitate access to up-to-date information and global best practices (Liu et al., 2020). In Nigerian and by extension, tertiary institutions in Niger State, the utilization of these technologies could bridge the gap between theoretical knowledge and practical application, thereby producing more competent graduates.

Awareness of modern technologies for teaching aquaculture in Nigeria's tertiary institutions has been gradually increasing, though it remains inconsistent across regions and institutions. Technology awareness encompasses more than simply acknowledging the presence of particular technologies, it also entails comprehending their intended functions, advantages, constraints, and potential hazards. (Pandey et al, 2021). Technology awareness refers to the skill of an individual to be aware and mindful of new, popular and useful technology that has been gaining widespread acceptance across concerned professions, industries or markets. This may also include an individual's ability to recognize and understand the utilities as well as benefits of these technologies for successful endeavours like teaching and other areas like business and health (Rahimah et al., 2018)

The utilisation of modern technologies for teaching aquaculture in Nigerian tertiary institutions presents a transformative opportunity to enhance learning outcomes. With Nigeria's rich aquatic resources and growing demand for skilled professionals in aquaculture, integrating advanced technologies like remote sensors, drones for water quality monitoring, and digital simulation tools can significantly enrich the educational experience (Oruma et al., 2021; Ibrahim et al., 2023). The utilization of modern technologies in aquaculture education addresses critical gaps in traditional teaching methods by providing students with up-to-date knowledge and skills (Obiero et al., 2016). Virtual laboratories and Augmented Reality for instance, offer immersive learning environments where students can experiment with diverse aquaculture scenarios without physical constraints. Therefore, embracing modern technologies in aquaculture education will not only elevate learning standards, but can also propel Nigeria towards a more resilient and knowledge-driven aquaculture industry.

Statement of the Research Problem

Effective instruction in aquaculture within tertiary institutions in Nigeria should ideally incorporate modern technologies that enhance learning experiences and outcomes. Some of these technologies which include, but not limited to Artificial Intelligence systems, online learning platforms that provide up-to-date information and practical skills necessary for the aquaculture industry. Despite the ideal scenario, several challenges impede the effective instruction of aquaculture in Nigerian tertiary institutions. Firstly, the use of teacher centred methodologies with its attendant limitations impacts negatively on effective instruction of aquaculture. Traditional teaching methods, which are still prevalent, may not be as effective in delivering comprehensive aquaculture education like a technologically enhanced one. Even when technologies are available, their underutilization is common due to inadequate training and understanding of the technologies by the teacher. This could be attributed to their level of awareness and utilisation of new technologies for instruction which can result to graduates that are not fully prepared for the professional demands of the aquaculture industry.

This study aims to address these critical issues. By identifying gaps in awareness and utilization of modern technologies for instruction of aquaculture in tertiary institutions in Niger State, proposing strategies to enhance knowledge of modern technologies, that can help educators and students stay abreast of current advancements. The research will advocate for training programs to ensure effective utilization of available technologies.

Aim and Objectives of the Study

The study is aimed at evaluating the level of awareness and utilization of modern technologies for aquaculture instruction amongst tertiary institution teachers in Niger state, Nigeria. Specifically, this study intends to achieve the following objectives:

i. To assess teachers' level of awareness of modern technologies for aquaculture instruction in tertiary institutions in Niger State, Nigeria.
ii. To examine teachers' level of utilization of these modern technologies for aquaculture instruction in tertiary institutions in Niger State.
iii. To investigate if there is a gender difference in the utilization of modern technologies for aquaculture instruction in tertiary institutions in Niger State.

Research Questions

Accordingly, 3 research questions were formulated as follows;

i. What is the level of awareness amongst teachers of modern technologies for aquaculture instruction in tertiary institutions in Niger State, Nigeria?
ii. What is the level of utilization of modern technologies for aquaculture instruction amongst teachers in Niger State, Nigeria?
iii. Is gender a factor in the utilization of modern technologies for aquaculture instruction amongst tertiary institution teachers in Niger state, Nigeria?

Research Hypothesis

A Null hypothesis was formulated based on the research questions to be tested at a 0.05 level of significance.

$H0_1$: There are no significant gender differences in the awareness and utilisation of modern technologies for aquaculture instruction amongst tertiary institution teachers in Niger state, Nigeria

Methodology

The research adopted a descriptive research design, which involved the collection of data, analysis and inference in order to explore an in depth understanding of the study. The population of this study are aquaculture Lecturers. The total population of Lecturers is 72, in the 6 tertiary institutions under study in Niger State. The sample size for this study was 52. The study used a purposive sampling technique to select participants which were Aquaculture Lecturers. Six tertiary institutions were purposively selected for this study and these include Federal University of Technology Minna, Ibrahim Badamasi Babangida University Lapai, Federal College of Freshwater Fisheries Technology, New Bussa, Niger State College of Agriculture, Mokwa. Others are, Federal College of Wildlife Management New Bussa and The Federal polytechnic, Bida. Lecturers were selected in each of the schools irrespective of gender. The research instrument used to collect data was an adapted and well-structured questionnaire titled (AUMTIATIN). Section A has 5 items which requires the bio-data or demographic data of the respondents. Section B comprises the awareness of the Modern Technologies considered in the study; it has 12 items. Section C is about the level of Utilization of the Modern Technologies considered in B with 12 items also. Participants were instructed to assess these items using a four-point rating scale of Very aware, Aware, Unaware and Very unaware for section B. While highly utilized, often utilized, rarely utilized and not utilized was required for section C. The data obtained from the researcher-designed questionnaire was analysed using descriptive statistics, where mean scores and standard deviations were used to answer research questions. Independent samples t-test was used for the hypothesis. The collected data was coded and processed using Statistical Package for Social Solutions (SPSS 23) for Windows, with the level of significance set at 0.05.

Results

Demographic characteristics.

Table 1: Demographic Characteristics of Aquaculture Lecturers by Gender

S/N	Gender	Frequency	Percent
1	Male	35	67.3
2	Female	17	32.7
	Total	52	100.0

Table 1: presents the demographic characteristics of aquaculture lecturers in the study sample, categorized by gender. The data reveals that out of a total of 52 lecturers, 35 are male, representing 67.3% of the sample. This indicates that males constitute the majority of the aquaculture lecturers in the institutions surveyed. On the other hand, female lecturers make up 32.7% of the sample, with a total frequency of 17.

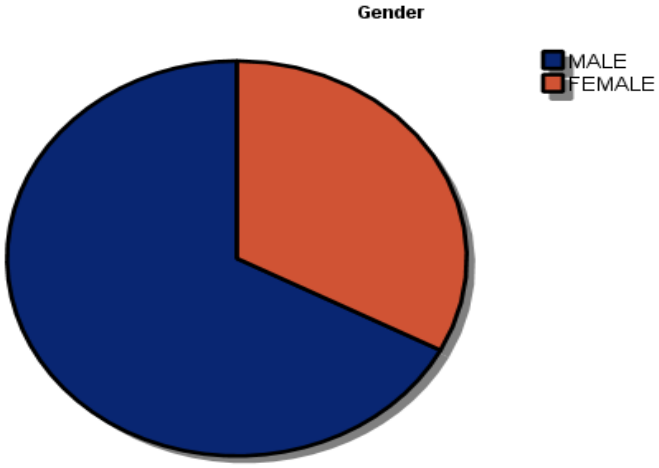

Figure 1. Demographic Characteristics of Aquaculture Lecturers by Gender

Research Question One: What is the level of awareness among lecturers and instructors of modern technologies for aquaculture instruction in tertiary institutions in Niger State?

Table 2: Mean and Standard deviation of the level of awareness among lecturers of modern technologies for aquaculture instruction in tertiary institutions in Niger State.

S/N	Items	Mean	S. D	Remark
1	Modern technologies such as Virtual Reality (VR). The use of simulated, immersive and interactive environment used for aquaculture instruction.	3.58	0.67	Aware
2	Simulation Software like fish farming Applications for example, Aquaculture Hub and Fish Culture used in aquaculture education.	3.58	0.70	Aware
3	Gamification like Aquaponics puzzle in aquaculture instruction	3.50	0.51	Aware
4	The use of Augmented Reality (AR) to simulate aquaculture environments for teaching and learning purposes.	3.40	0.69	Aware

5	E-learning platforms, like Moodle, Learning Management Systems (LMS) and Google Classroom to manage my aquaculture courses.	3.58	0.57	Aware
6	Online courseware like Coursera, EdX, and Udemy for specialized materials on aquaculture instructions.	3.52	0.51	Aware
7	Interactive Virtual laboratories for practical demonstrations of aquaculture concepts	3.48	0.67	Aware
8	Internet of Things (IOT) devices like remote sensors and drones (UAVs) for aquaculture instructions	3.42	0.61	Aware
9	Institutional Repositories and Academic journals as sources of instructional materials on aquaculture	3.56	0.50	Aware
10	Biotechnology techniques like sex reversal and genetic engineering in the teaching of aquaculture	3.38	0.63	Aware
11	Big data analytics for instruction in aquaculture	3.54	0.61	Aware
12	Artificial Intelligence (AI) based systems, like smart sensors for aquaculture instruction	3.58	0.50	Aware
	Grand Mean	3.51		Aware

Table 2: presents the mean scores and standard deviations for various modern technologies used in aquaculture instruction, as perceived by lecturers. The mean scores, which range from 3.38 to 3.58, suggest a generally favourable awareness of these technologies, indicating that educators acknowledge their usefulness in enhancing teaching and learning experiences in aquaculture. Specifically, E-learning platforms, simulation softwares and AI-based systems all share the highest mean score of 3.58, reflecting strong agreement on their importance. The standard deviations are relatively low, ranging from 0.50 to 0.70, indicating consistent responses among participants. The grand mean of 3.51 further reinforces the positive attitude towards integrating these advanced technologies in aquaculture education.

Research Question Two: What is the level of utilisation of modern technologies for aquaculture instruction amongst lecturers and instructors?

Table 3: Mean and Standard deviation of the level of utilisation of modern technologies for aquaculture instruction amongst lecturers

S/N	Items	Mean	S. D	Remark
1	Modern technologies such as Virtual Reality (VR). The use of simulated, immersive and interactive environment used for aquaculture instruction.	2.50	0.85	Often Utilised
2	Simulation Software like fish farming Applications for example, Aquaculture Hub and Fish Culture used in aquaculture education.	2.69	0.92	Often Utilised
3	Gamification like Aquaponics puzzle in aquaculture instruction	2.94	1.02	Fully Utilised
4	The use of Augmented Reality (AR) to simulate aquaculture environments for teaching and learning purposes.	2.15	0.87	Not Utilised

5	E-learning platforms, like Moodle, Learning Management Systems (LMS) and Google Classroom to manage my aquaculture courses.	2.71	0.92	Often utilized
6	Online courseware like Coursera, EdX, and Udemy for specialized materials on aquaculture instructions.	2.63	0.93	Often utilized
7	Interactive Virtual laboratories for practical demonstrations of aquaculture concepts	2.52	0.83	Often utilized
8	Internet of Things (IOT) devices like remote sensors and drones (UAVs) for aquaculture instructions	2.21	0.87	Rarely utilized
9	Institutional Repositories and Academic journals as sources of instructional materials on aquaculture	2.85	1.02	Fully utilized
10	Biotechnology techniques like sex reversal and genetic engineering in the teaching of aquaculture	2.29	0.85	Rarely utilized
11	Big data analytics for instruction in aquaculture	2.44	0.78	Rarely utilised
12	Artificial Intelligence (AI) based systems, like smart sensors for aquaculture instruction	2.77	0.94	Often utilized
	Grand Mean	2.55		

The level of utilisation of modern technologies for aquaculture instruction among lecturers and instructors appears to be moderate, as indicated by the grand mean score of 2.55 on a scale where 3.0 would suggest frequent use. Among the various technologies, gamification tools like Aquaponics puzzles (mean = 2.94) and institutional Repositories and academic journals (mean = 2.85) are utilised more frequently than others, while Augmented Reality and IOT devices have lower usage levels, with mean scores of 2.15 and 2.21, respectively.

Research Question Three: Is gender a factor in the utilisation of modern technologies for aquaculture instruction amongst lecturers?

Table 4: Mean and Standard deviation of gender as a factor in the utilisation of modern technologies for aquaculture instruction amongst lecturers

	Gender	No.	S. D	Mean	Mean Difference
Utilisation	Female	35	0.50	2.57	0.25
	Male	17	0.64	2.82	

Table 4: represents the mean utilization score for male lecturers (2.82) is higher compared to their female counterparts (2.57), with a mean difference of 0.25. This suggests that male lecturers, on an average, engage more with modern technologies in their teaching practices than female lecturers. The standard deviations (0.50 for females and 0.64 for males) reflect variability in the utilization scores, with males showing slightly more variability. The difference in mean scores highlights a potential gender-based disparity in the adoption of technology for aquaculture education.

Hypotheses

H01: There are no significant gender differences in the utilization of modern technologies for aquaculture instruction amongst lecturers. To test this formulated hypothesis, Mann-Whitney U test was and the results is presented in table 5.

Table 5: Mann-Whitney U test comparison of gender differences in the utilisation of modern technologies for aquaculture instruction amongst lecturers.

	Gender	N	Mean Rank	Sum of Ranks
Utilization	1	35	30.03	510.50
	2	17	24.79	867.50
	Total	52		

Table 5 presents the results of a Mann-Whitney U test comparing gender differences in the utilisation of modern technologies for aquaculture instruction among lecturers. The sample consists of 52 lecturers, with 35 males (mean rank = 30.03, sum of ranks = 510.50) and 17 females (mean rank = 24.79, sum of ranks = 867.50). The difference in mean ranks suggests that male lecturers, on average, may have a higher level of utilisation of modern technologies considered in the, compared to their female counterparts. However, further analysis of the Mann-Whitney U statistic and the p-value is needed to determine whether this difference is statistically significant.

Table 6: Mann-Whitney U test comparison of gender differences in the utilisation of modern technologies for aquaculture instruction amongst lecturers

Test Statistics[a]	
	Utilization
Mann-Whitney U	237.500
Wilcoxon W	867.500
Z	-1.350
Asymp. Sig. (2-tailed)	0.177

a. Grouping Variable: Gender

Table 6 presents the results of a Mann-Whitney U test comparing gender differences in the utilisation of modern technologies for aquaculture instruction among lecturers. The Mann-Whitney U statistic is 237.500, with a corresponding Wilcoxon W value of 867.500. The Z-score of -1.350 suggests a non-significant difference between male and female lecturers. The p-value (Asymp. Sig. 2-tailed) of 0.177 is greater than the 0.05 significance level, indicating that there is no statistically significant difference in the utilisation of modern technologies based on gender.

Discussion of Findings

The findings from the study on lecturers' awareness and utilization of modern technologies in aquaculture instruction reveal a generally positive attitude towards tools like E-learning platforms, gamification, and AI-based systems. This positive perception aligns with prior research, such as Diguiriunn-Aweto and Oladele (2017), which highlighted the importance of effective communication and support services in adopting new practices. Similarly, the awareness and utilisation of these technologies in tertiary institutions are crucial, as targeted dissemination and support systems can enhance their adoption and utilisation in educational practices. However, the moderate overall utilisation of modern technologies, with varied adoption rates depending on the complexity and infrastructure needs, suggests that while some technologies like gamification and institutional repositories are more frequently used, others, such as Augmented Reality and IoT devices, are rarely used. This mirrors findings from studies like Muddassir et al. (2019) and Alabi et al. (2020), where awareness and utilisation of modern technologies were often hindered by barriers such as inadequate access and high costs of

acquisition of the technology. In the context of aquaculture instruction in Niger State Nigeria, addressing these challenges could significantly improve educational outcomes and the practical application of modern technologies in aquaculture education.

Moreover, gender-based disparities in the utilization of modern technologies, as suggested by Omeje et al. (2021), emphasize the need for more targeted interventions to bridge the gap in technology utilisation. While the current study found no significant gender differences in the use of these technologies, previous research indicated that women may face more barriers to accessing and utilising modern tools due to socioeconomic factors. Studies like Mbah and Njoku (2021) highlight the importance of equitable access and support for female educators to enhance their utilisation of modern technologies. Therefore, addressing gender-specific challenges in technology integration is essential for ensuring that all lecturers can fully benefit from the advancements in aquaculture instruction. Furthermore, the broader implications of these findings suggest that, similar to the conclusions of Omotesho et al. (2019) and Leilani and Restuwati (2020), improving the accessibility and affordability of modern technologies, alongside providing continuous training and support, is critical. These actions could enhance the capacity of educators of aquaculture in tertiary institutions in Niger State, to effectively integrate advanced technologies into their teaching practices. Policy makers and educators can develop more effective strategies to promote the use of modern technologies in aquaculture instruction, ultimately leading to improved educational outcomes and greater innovations in the field of aquaculture.

Conclusion

In conclusion, the study reveals that lecturers in Niger State's tertiary institutions have a generally positive awareness of modern technologies for aquaculture instruction, particularly appreciating tools like Virtual Reality, e-learning platforms, and gamification. However, the overall utilisation of these technologies varies, with higher utilisation rates for gamification and e- learning platforms compared to less commonly used tools like Augmented reality and IoT devices. While the data suggests no significant gender differences in the use of these technologies, a modest disparity was noted in some instances, with male lecturers slightly more inclined to utilising certain modern tools. These findings highlight the need for targeted interventions to enhance the accessibility, training, and support for the utilisation of advanced technologies in aquaculture education, ensuring that all lecturers, regardless of gender, can fully integrate these innovations into their teaching practices.

Recommendation

Based on the findings, the researchers recommend that:

1. Targeted training and support should be provided for lecturers on using advanced technologies like Augmented Reality and IoT devices to improve their adoption in aquaculture instruction.

2. Gender-inclusive strategies, such as tailored workshops and mentorship programs, should be implemented to ensure equal access and utilisation of modern technologies among male and female lecturers.

3. Technological infrastructure should be improved on by allocating more resources to make modern tools / devices readily available and easy to use for all teachers of aquaculture.

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ENHANCING LIBRARY AND INFORMATION SCIENCE CURRICULUM IN NIGERIA: INTEGRATING INTERDISCIPLINARY SKILLLS AND EMERGING TECHOLOGIES FOR ECONOMIC DEVELOPMENT

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Abstract
The rapidly changing world demands educational adaptability, especially from library and information science (LIS) students. The use of traditional physical textbooks, sitting in library chairs, and researching with physical books is becoming obsolete, much like historical artifacts for tourism. Emerging technologies offer innovative avenues for LIS students to solve problems in todays technologically modified world.
This research paper explores existing literatures on the relationship of library and information science and emerging technologies. It delves into empowering LIS students with skills required to thrive in a competitive, advanced world for economic development.
The researcher conducted a survey to learn how LIS students view the curriculum's content and value. From the data collected, the majority of undergraduate students were unsatisfied with the curriculum content but perceived the curriculum prepared them for the job market. The majority found the courses relevant to their career goals, with the curriculum content needing more balance between theory and practical application. Most of the students wanted more computer science courses included in their curriculum. Recommendations are made on how the economy can be developed, reducing unemployment by integrating emerging technology courses into the LIS curriculum to enhance problem-solving skills and employment prospects.

Key Words: Library and Information Science (LIS), Curriculum, Interdisciplinary, Emerging Technologies, Economic Development.

Introduction
In today's dynamic and rapidly changing world, should library and information science educators maintain the old curriculum? The answer is no. Should LIS undergraduate students maintain the traditional curriculum in today's advanced world? Our rapidly growing, data-driven culture is motivating curriculum change in nearly every discipline, not the least of which is information science (Ortiz-Repiso et al., 2018). With the high rise in unemployment and artificial intelligence taking over most tasks, there is a need for LIS instructors to think outside the box and come up with innovative curriculum to boost students' skills and solve real problems in interdisciplinary skills. Melissa et al., (2024) speculated that investing in education, particularly at higher levels, can contribute to long-term economic growth, with emphasis on the ability of education to shape human resources. Increased investment in education can create a stronger pool of skilled workers.

The development of entrepreneurship education is directed at achieving economic growth that is supported by harmony between the availability of skilled manpower with the ability to create jobs or entrepreneurship, responding to the challenges of the labor requirements, and restructuring the school curriculum (Dharmawati et al., 2020). Institutions of higher learning should adopt strategies that can help to develop the entrepreneurial potential of students. This can be achieved by enhancing students' creativity and innovativeness and creating a mindset and attitude of self-employment and business ventures. The integration of emerging

technologies in education plays a crucial role in economic development and global competitiveness (Ghosh & Ravichandran 2024).

Library and Information Science (LIS) education has been traditionally concerned with all aspects of data, information, and document management, ranging from creation, collection, organization, and storage to retrieval, dissemination, and preservation (Morrilo et al., 2020). It is imperative to introduce emerging technology skills by revising the curriculum to enhance students' interdisciplinary skills and empower them to tackle real-world challenges effectively. LIS education must continually evolve to meet the changing needs of its patrons. Technologies have been part of human society from as far back as archaeology can take us into the past (Nye, 2019). Technology is a complex concept that has evolved over time and is still rapidly evolving, with artificial intelligence (AI) at the forefront of innovation.

Concepts of Technology

The concept of technology in various fields has evolved over time, encompassing multiple dimensions. Khang et al., (2024) identified technologies as next-generation powerful data-drive solutions; Internet of Things, artificial intelligence-aided techniques, data analytics, and visualization tools. Libraries are increasingly adopting artificial intelligence applications to enhance efficiency, user experiences, and information management as technologies evolve. Library science and information technology are two closely related and often intersecting disciplines that deal primarily with the organization and retrieval of information. Library science is an interdisciplinary social science incorporating the humanities, law, and applied science and studying topics related to libraries; the collection, organization, and dissemination of information resources; and the political economy of information.

Concept of Library and Information Science Curriculum

According to Bakare and Bakare (2024), the core tool for measuring the sustainability of library and information science is the curriculum. The majority of students opined the redesigned curriculum will promote sustainable transformation, have a positive impact on the economy and by adopting the redefined LIS curriculum in Nigeria, it will strategically meet the information needs of the present clientele. Way back in 1995, Saracevic, described information science as an interdisciplinary field with connections to librarianship, computer science, cognitive science, and communication. Petras (2023) described information science as a process of manifesting information to facilitate and support the representation, access, documentation, and preservation of ideas, activities, or practices and to enable different types of interactions.

Curriculum

According to Osaat & Emujakporue (2024), education has a significant role it plays in the development of a nation. This is so because it is a hierarchy that must be followed to get to the top of sustainable development. It was made clear in the National Policy on Education in 2014 that education is an instrument per excellence for achieving national development. Statistics show that curriculum must be relevant to the reality of life by involving the application of the man-power requirement approach, the provision of adequate funding to meet the teaching and learning needs of the students, and promoting access to technologies that will meet the practical learning of students. When all these are done, to a high extent, education will positively lead to a reduction of graduates' unemployment in Nigeria, and this will lead to both economic and national development. Mwanzu & Wendo (2021) recommended for entrepreneurship education to be aligned with library practices, be offered throughout the study years of a student, and be taught beyond the basics while incorporating practical lessons. In addition, it should also be

handled by a professional with both entrepreneurship and LIS background and supported with information resources that are relevant. Salubi (2017) argued that the new curriculum should reflect contemporary innovations in the field of library and information science to enable graduates to be globally competitive.

Interdisciplinary Approaches in Library and Information Science Curriculum

Library and information science (LIS) is highly interdisciplinary by nature and is affected by the incessant evolution of technologies (Prebor 2010). Library and Information Science (LIS) education is evolving to meet the challenges of the digital age, emphasizing interdisciplinary, technology integration, and problem-solving skills. The emergence of new interdisciplinary fields of investigation, such as data science, e-health, and digital humanities, share common concerns with LIS, including the management, preservation, analysis, and retrieval of digital objects. Computer science and engineering have also studied the techniques for proper treatment of digital products. As digital information pervades our daily lives, increased attention to both the technical aspects and social aspects of digital objects becomes increasingly important to all disciplines (Murillo et al., 2020). A community of institutions known as information schools (iSchools) aim to lead education and research in information science. Core processes of information science (collecting, organising, managing, accessing, and supporting the use and manipulation of information) are acutely relevant to data-driven disciplinary areas such as data science. In terms of curriculum development, these core processes place information science and the iSchool community able to develop and advance distinct expertise meeting data-driven needs. Dilhani (2021), proposed the importance of including the role of clinical medical librarian in LIS curriculum development. Hussain and Ansari (2019) emphasised the need for integrating practical courses with theoretical knowledge to prepare LIS graduates for professional challenges.

Research Problem

High ranking universities have information schools which gives the students the liberty to select research areas to specialize in. The Information School (iSchool) community, like many other interdisciplinary communities, has been pursuing curriculum change to address data-driven workforce needs. Although this trend is apparent, reporting on the extent of curriculum change is limited (Ortiz-Repiso et al., 2018).

Research Questions

This research is guided by three (3) research questions.

1. How relevant do LIS undergraduate students find the content of the Library and Information Science curriculum?
2. What is the value perception of LIS undergraduate students on the Library and Information Science curriculum?
3. What courses do LIS undergraduate students perceive to be integrated into the Library and Information Science curriculum?

Methodology

The Department of Library and Information Science, Federal University of Technology Minna, presently has 78 undergraduate LIS students (47 students in the 100 level and 31 students in the 200 Level). A questionnaire was sent to 47 LIS students of 100 levels and only 29 responses were returned.

The researcher formulated 7 survey questions to address the research questions and collected data from all 100-level students to ascertain their level of general satisfaction with the LIS

curriculum. How relevant they find the content of the LIS curriculum. The researcher also questioned the students' perception of the value of their degree, and included an open-ended question asking which courses they believe would enhance their program. Although the study is limited because out of 47 responses expected, only 29 responses returned.

With only 29 responses, the sample may not be representative of a larger population, thereby limiting the generality of the findings to demographics. 100-level students have not gotten to the peak of the LIS curriculum; their judgment might be limited.

Data Analysis

Research Question 1: How relevant do LIS undergraduate students find the content of LIS curriculum?

Table 1: How satisfied are you with the current curriculum of Library and Information Science

Curriculum content	Frequency	Percentage
Very Satisfied	0	0%
Satisfied	1	3%
Neutral	4	14%
Unsatisfied	22	76%
Very unsatisfied	2	7%

Table one shows a significant level of dissatisfaction with the current curriculum of library and information science, with 83% of respondents expressing negative feelings towards the library and information science curriculum. 76 percent of the respondents were unsatisfied with the curriculum, while 7 percent were very unsatisfied. On the other hand, 14% of the respondents remained neutral, suggesting they neither feel negative nor positive about the curriculum. Only 3 percent of the respondents expressed satisfaction with the curriculum, with no respondent being very satisfied.

Table 2: Do you feel that the curriculum prepares you well for the job market or further studies in library and information science?

Curriculum content	Frequency	Percentage
Yes	18	69%
No	7	27%
Not sure	1	3%

Table 2 analysis shows that 69 percent of the students, which is the majority, feel that the curriculum prepares them well for the job market and further studies in library and information science, whereas 27% of the respondents feel that the curriculum has not prepared them for the job market nor further studies. A small group of respondents, accounting for just 3 percent, are uncertain as to whether or not the curriculum prepares them for the future. Although majority of the respondents were positive in their responses improvements should be made to address the concerns of about one-third of the respondents.

Question 3:

Table 3: How relevant do you find the courses in the curriculum to your career goals in the field of library and information science

Curriculum content	Frequency	Percentage
Highly relevant	15	57%
Somewhat relevant	10	39%
Neutral	1	3%
Somewhat Irrelevant	0	0%
Not relevant	0	0%

Table 3 analysis reveals that the majority of respondents find LIS curriculum to be relevant to their career goals. 57 percent consider the curriculum to be highly relevant; 39 percent responded that the curriculum is somewhat relevant to their career goals, while a meagre 3 percent neither agrees nor disagrees with the LIS curriculum being relevant to their career goals. 0 percent of respondents didn't find the curriculum irrelevant, which indicates some value in the curriculum. Notwithstanding, the analysis suggests a need for further improvement on the curriculum.

Question 4:

Table 4: Do the courses in the curriculum provide a good balance between theory and practical application

Curriculum content	**Frequency**	**Percentage**
Yes	1	4%
No	0	0%
Needs more balance	25	96%

Table 4 shows general agreement among the respondents, with 96% of the respondents suggesting that the curriculum needs a good balance between theory and practical application. Only 4 percent of the respondents believed the curriculum provides a good balance between theory and practice. 0 percent of respondents selected no, indicating students do not perceive the curriculum as entirely lacking balance. The data suggests there is a need to integrate practical applications alongside theories to better the educational needs of the students.

Question 5: How flexible is the curriculum in allowing you to choose courses that align with your specific interests?

Table 5: How flexible is the curriculum in allowing you to choose courses that align with your specific interests

Flexibility	**Frequency**	**Percentage**
Very flexible	17	68%%
Somewhat flexible	8	32%
Not flexible	0	0%

Table 5 data reveals that none of the students considered the curriculum to be flexible. 32 percent of respondents found the curriculum somewhat flexible, while the majority, 68 percent, found the curriculum to be flexible. This indicates the respondents feel they have a wide range of choices to cater for their career needs, indicating some limitations.

Research Question 2: What is the value perception of LIS undergraduate students on LIS curriculum?

Question 6: How do you perceive the value of a university degree in achieving your future goals?

Table 6: How do you perceive the value of a university degree in achieving your future goals

Perception	Frequency	Percentage
To secure a job in my field	1	4%
To gain skills that will enable me to earn money	13	52%
Just to have a degree as a qualification	11	44%
Others	0	0%

Table 6 shows the perception respondents have on the value of a university degree in achieving future goals. 4 percent of the respondents see it as a medium of securing a job in their field. 44 percent perceive the value of a university degree mainly to just have a degree as a qualification, while the majority, 52 percent perceive a degree's value should help them gain skills to enable them to earn money.

Research Question 3: What courses do LIS undergraduate students perceive to be integrated into LIS curriculum?

Question 7: Are there any subjects or skills you feel are missing from the curriculum? If so what are they?

This was an open ended-question, with majority of students expressing a need to have computer science related subjects added to the curriculum.

Recommendations

To achieve a smooth integration of emerging technologies into the library and information science curriculum, there is a need for the government and universities to train library and information science instructors to keep up with emerging trends before incorporating them into the curriculum.

Governments and universities should enhance the capacity of library and information science (LIS) programs through training and courses to meet the demands of the emerging information science field. Integrating the LIS curriculum with cutting-edge innovations such as virtual reality (VR), augmented reality (AR), artificial intelligence (AI), machine learning (ML), the internet of things (IoTs), robotics, automation, big data, analytics, block chain, 3D printing, social media analytics, content creation, and Gamification is essential. If LIS professionals can apply these skills in their field, they will be equipped to solve problems in any area using the same skill set. LIS students can provide valuable information to their clients through content creation, and virtual reality offers an innovative way of learning. Data science and analytics can support library and information science graduates in enhancing research productivity. Emerging technologies offer various ways to provide and manage information.

Practical application of the curriculum should be emphasized by equipping labs and assigning students to work on real-life problems and solutions. The LIS curriculum can also be made more flexible by including electives that allow students to specialize in specific skills of their interest.

Conclusion

The study shows significant dissatisfaction among library and information science students with the content of the curriculum; on the contrary the students believe the curriculum prepares

them for the job market and future studies. The majority of students suggested a theory and practical application in the LIS curriculum. In conclusion, with the high level of unemployment in our society today, it is paramount to improve the skills of undergraduate students for thorough innovative education, thereby boosting the entrepreneurship skills of undergraduate students of library and information science departments. It is essential to emulate the emerging diversity of curricula in the information school community to prepare students applications of information technology for social and economic development.

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DIGITAL TRANSFORMATION AND INTERNET CRIME.

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Abstract
The global embrace of digital technologies has brought unprecedented benefits, including enhanced efficiency, connectivity, and innovation. Yet, this digital revolution has also introduced significant risks, particularly in the form of cybercrime. Cybercriminals have increasingly leveraged emerging technologies such as artificial intelligence (AI), the Internet of Things (IoT), and cloud computing to conduct sophisticated and often devastating attacks. This paper explores how digital transformation, while offering numerous advantages, also creates opportunities for cybercriminals, necessitating a closer examination of the cybersecurity challenges and implications for various stakeholders. This research adopts a mixed-method approach, combining qualitative and quantitative methods to provide a comprehensive analysis of the impact of digital transformation on internet crime. Primary data was collected through surveys and interviews with cybersecurity experts, while secondary data was obtained from existing research, cybersecurity reports, and crime statistics. Analytical tools were employed to assess the relationship between digital transformation and the prevalence of internet crime, with case studies illustrating key findings. The research reveals that while digital transformation drives innovation, it also significantly increases vulnerabilities to cybercrime. Emerging technologies have not only enhanced the capabilities of legitimate businesses but have also been co-opted by cybercriminals, leading to more frequent and sophisticated attacks. The study highlights the need for robust cybersecurity strategies and the importance of updated policies and regulations to mitigate these risks. Businesses, governments, and the general public must work together to implement comprehensive cybersecurity measures and develop adaptive policies that address the evolving landscape of internet crime.

Keywords: Digital Transformation, Cybercrime, Internet Security, Emerging Technologies, Cybersecurity Policy

Introduction
Digital transformation refers to the integration of digital technologies into all areas of an organization, fundamentally changing how businesses operate and deliver value to customers. It encompasses the adoption of technologies such as cloud computing, artificial intelligence (AI), the Internet of Things (IoT), and data analytics to enhance business processes and services (Vial, 2019). This transformation is reshaping industries globally, from finance and healthcare to education and retail, by streamlining operations, improving customer experiences, and enabling data-driven decision-making (Verhoef et al., 2021). As industries continue to embrace digital technologies, the risk of internet crime, commonly referred to as cybercrime, has also increased. Cybercrime involves illegal activities conducted via the internet, including hacking, identity theft, ransomware attacks, and phishing scams. Initially, cybercrime was limited to basic hacking attempts, but with the rapid advancement of digital technologies, these attacks have grown more sophisticated. Modern cybercrime operations leverage AI and machine learning to exploit system vulnerabilities and target large-scale digital infrastructures (Broadhurst et al., 2021). This global shift towards digital transformation has created a new landscape for internet crime, where both individuals and organizations are vulnerable to

evolving threats. As more businesses and industries transition to digital platforms, the need for robust cybersecurity measures has become paramount to mitigate the risks associated with cybercrime.

Research Problem

Digital transformation is a dual-edged phenomenon. On one hand, it fosters innovation by revolutionizing business operations, enhancing efficiency, and driving economic growth. On the other hand, it introduces new vulnerabilities as systems become more interconnected and reliant on digital technologies. This heightened digital presence has led to an increase in the frequency and sophistication of internet crimes. Cybercriminals exploit emerging technologies such as AI, IoT, and big data, making it harder for traditional cybersecurity measures to keep pace. The challenge lies in balancing innovation with robust security to protect against evolving cyber threats.

Objectives of the Study

1. To explore the relationship between digital transformation and the rise in internet crime.
2. To identify key factors contributing to the vulnerability of digital systems.
3. To propose strategies for mitigating the risks associated with digital transformation.

Research Questions

1. How does digital transformation contribute to the rise in internet crime?
2. What are the primary vulnerabilities introduced by digital transformation?
3. What strategies can be employed to reduce the risk of internet crime?

Literature Review

Digital transformation refers to the use of digital technologies to fundamentally change business processes, customer experiences, and value propositions. Historically, digital transformation began with the introduction of computers and the internet, which revolutionized data management, communication, and commerce. Over the past few decades, the concept has evolved with the emergence of advanced technologies such as cloud computing, artificial intelligence (AI), and big data analytics, enabling businesses to shift towards more agile and customer-centric models (Vial, 2019). Several factors drive digital transformation across sectors. In the business world, consumer demand for faster, more personalized services has pushed companies to adopt digital tools to remain competitive. In healthcare, technologies like telemedicine and electronic health records (EHRs) have transformed patient care and management (Verhoef et al., 2021). In education, the rise of e-learning platforms and digital resources has reshaped how students engage with content.

The Role of Technology in Enabling Digital Transformation

Technology plays a pivotal role in enabling digital transformation. Cloud computing facilitates scalability, data storage, and remote access, while AI and IoT enable automation and real-time data analytics. These technologies create opportunities for innovation but also introduce challenges such as security vulnerabilities (Sebastian et al., 2017).

Internet Crime

Internet crimes, commonly referred to as cybercrimes, are illegal activities carried out using the internet and digital technologies. These crimes encompass a wide range of offenses, including hacking, identity theft, phishing, online fraud, ransomware, and cyberterrorism. Cybercrimes are often classified based on their target, such as crimes against individuals (e.g.,

identity theft), businesses (e.g., corporate espionage), or governments (e.g., cyberterrorism) (Holt & Bossler, 2016).

Evolution and Trends in Internet Crime

Internet crime has evolved dramatically since the inception of the internet. In the early days, cybercrime was largely limited to small-scale hacking and defacement of websites. However, with the rise of digital transformation and advanced technologies, cybercriminals have become more organized and sophisticated. Today's trends include the use of AI and machine learning to conduct large-scale phishing attacks, ransomware-as-a-service (RaaS), and attacks on critical infrastructure using IoT vulnerabilities (Broadhurst et al., 2021).

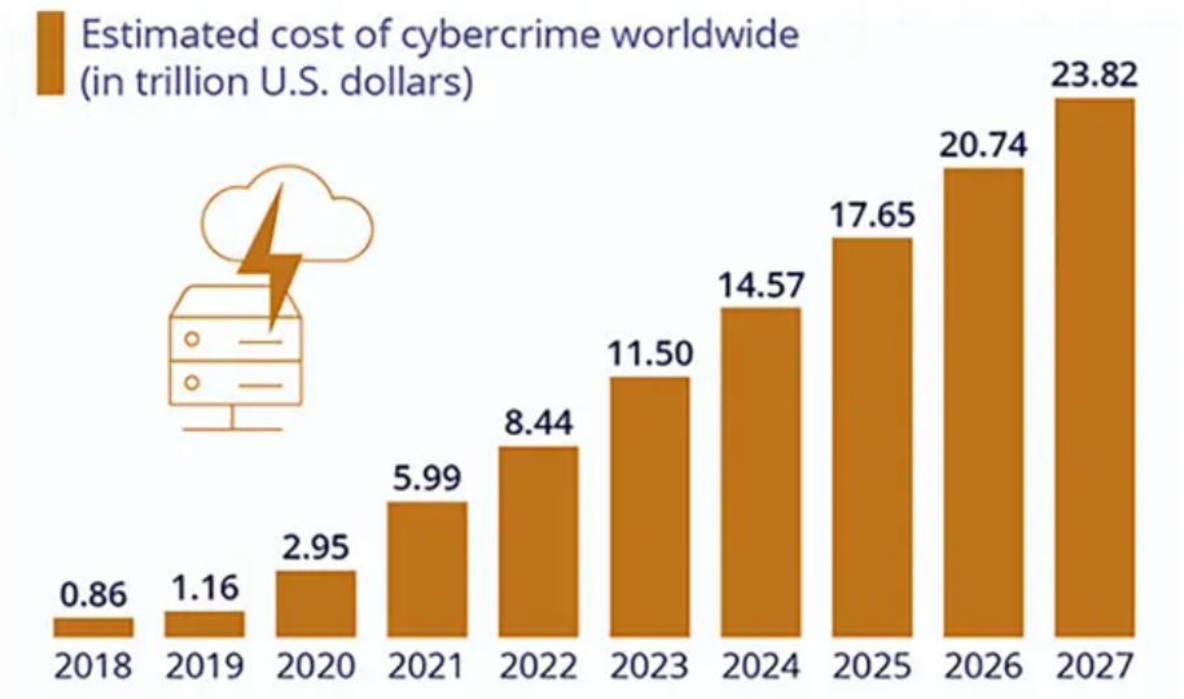

Figure 1 Evolution of Cybercrime worldwide (Source: Sprintzeal.com)

The Impact of Internet Crime

The impact of internet crime is far-reaching. For individuals, it can result in financial loss and emotional distress. Businesses face reputational damage, financial losses, and legal repercussions, while governments struggle with national security threats and economic disruption due to cyberattacks on critical infrastructure (Wall, 2017).

Internet Crime

Internet crimes, also known as cybercrimes, refer to illegal activities that are facilitated or conducted through the internet. These crimes can be classified into several categories, including hacking, identity theft, phishing, ransomware attacks, and cyberterrorism. Cybercrimes are typically categorized based on the target of the attack, such as individuals (e.g., identity theft), organizations (e.g., corporate espionage), or governments (e.g., cyberwarfare and terrorism) (Holt & Bossler, 2016).

Evolution and Trends in Internet Crime

Cybercrime has evolved significantly with the advancement of digital technology. Initially, cybercriminals focused on smaller, opportunistic attacks like basic hacking. However, as

digital transformation has expanded, cybercrime has become more organized and sophisticated. Modern trends in cybercrime include the use of ransomware-as-a-service (RaaS), AI-driven phishing schemes, and attacks targeting critical infrastructure using IoT devices (Broadhurst et al., 2021). The anonymity provided by the dark web has further fueled the growth of cybercrime, enabling the sale of illicit goods and services.

Impact of Internet Crime

Internet crime impacts individuals, businesses, and governments alike. Individuals may suffer financial losses, privacy violations, and emotional distress. Businesses face significant financial losses, reputational damage, and legal consequences, while governments grapple with national security threats and economic instability due to cyberattacks on public services and critical infrastructure (Wall, 2017).

Table 1 The impact of cybercrime on the Nigerian economy and banking

Year	Cybercrime losses (ATM & INTERNET) (₦ billion)	Growth rate of cybercrime losses (%) year-on-year	Total Fraud Loss (₦ billion)	Contribution of Cyber Crimes to Total Fraud (%)
2011	0.115	-	4.071	2.82
2012	0.794	590.4	4.516	17.58
2013	2.268	185.6	5.757	39.40
2014	4.438	95.6	6.193	71.66
2015	1.361	-69.3	3.173	42.89
2016	1.058	-22.2	2.4459	43.26

The table 1 summarizes data from the NDIC Annual Report (2011-2016) on cybercrime losses related to ATMs and the internet in Nigeria. It shows a significant increase in cybercrime losses from □0.115 billion in 2011 to a peak of □4.438 billion in 2014, followed by a decline in subsequent years. The growth rate of cybercrime losses peaked at 590.4% in 2012 before dropping to -22.2% in 2016. Cybercrime's contribution to total fraud losses also grew dramatically, from 2.82% in 2011 to 71.66% in 2014, before stabilizing around 43% by 2016.

The Nexus Between Digital Transformation and Internet Crime

Digital transformation, while revolutionizing industries, has also created new opportunities for cybercriminals. The increased adoption of digital platforms, cloud services, and interconnected devices has expanded the attack surface for cyber threats. Cybercriminals exploit vulnerabilities in digital systems, using sophisticated techniques to breach networks, steal data, and disrupt services (Vial, 2019). For instance, the Target data breach in 2013, resulting from compromised third-party vendor credentials, highlighted how digital transformation can expose businesses to cyber risks (Verhoef et al., 2021). Emerging technologies like AI, IoT,

and cloud computing are particularly instrumental in facilitating internet crime. AI-powered phishing attacks and IoT device vulnerabilities allow hackers to scale attacks more efficiently, while cloud computing's centralization of data makes it a high-value target for cyberattacks (Broadhurst et al., 2021).

Methodology

This study employs a mixed-method approach, integrating both qualitative and quantitative methods to explore the nexus between digital transformation and internet crime. The qualitative aspect will provide in-depth insights, while quantitative data will offer measurable trends.

Data Collection

Primary data will be gathered through surveys and interviews with cybersecurity experts, IT professionals, and law enforcement agencies, as well as case studies of organizations impacted by cybercrime. Secondary data will involve analyzing existing research, cybersecurity reports, and crime statistics from reliable sources like government agencies and industry reports to contextualize findings and trends.

Data Analysis

Analytical tools such as statistical tools such as Python was used for quantitative data analysis, including descriptive statistics and correlation analysis to assess the relationship between digital transformation and internet crime. Qualitative data from interviews and case studies will be analyzed through thematic analysis to identify recurring patterns. The mixed-method approach allows for a comprehensive assessment of how digital transformation influences the prevalence and nature of cybercrime.

Analysis and Discussion

Digital transformation has significantly impacted the prevalence of internet crime. As organizations and industries adopt new digital technologies, they inadvertently increase their exposure to cyber threats. The rapid transition to cloud computing, AI, IoT, and mobile platforms creates vast digital infrastructures, which, while offering efficiencies, are prime targets for cybercriminals. The proliferation of connected devices has expanded the attack surface, providing more opportunities for hackers to exploit system vulnerabilities (Broadhurst et al., 2021). For example, the rise in ransomware attacks demonstrates how cybercriminals use sophisticated techniques, such as AI-powered malware, to disrupt business operations and extort large sums.

Identification of Key Vulnerabilities in Digital Systems

Several key vulnerabilities in digital systems have been identified as contributing to the rise in internet crime. Poorly implemented security measures, such as weak passwords, unpatched software, and unprotected networks, leave organizations susceptible to breaches. Additionally, the rapid integration of IoT devices without adequate security protocols makes networks more prone to attacks (Verhoef et al., 2021). Cloud computing, while enabling flexible and scalable operations, centralizes data storage, making it a lucrative target for cybercriminals. Ultimately, the continuous evolution of technology outpaces the ability of many businesses to secure their systems effectively, thereby fostering a rise in internet crime.

Case Studies

One notable case where digital transformation led to increased internet crime is the 2013 Target data breach. Target's adoption of digital payment systems and centralized data storage made it

a prime target for hackers. Attackers gained access to the company's systems through compromised vendor credentials, leading to the theft of 40 million credit and debit card records. This breach highlights the vulnerabilities introduced by digital ecosystems and the importance of secure vendor management (Verhoef et al., 2021). Another case is the 2017 WannaCry ransomware attack, which exploited weaknesses in unpatched Windows systems globally, demonstrating how poor cybersecurity hygiene in digital transformation can lead to widespread damage (Broadhurst et al., 2021).

Lessons Learned

These cases emphasize the need for comprehensive cybersecurity practices during digital transformation. Organizations must prioritize cybersecurity by implementing robust security protocols, timely patching, and vendor risk management. The lessons learned from these cases stress the importance of anticipating cyber threats during technological advancement.

The Role of Policy and Regulation

Current legal frameworks, such as the General Data Protection Regulation (GDPR) and the U.S. Cybersecurity Information Sharing Act, govern aspects of digital transformation and cybersecurity. However, gaps remain, particularly in areas like IoT security and AI-powered cyberattacks. Existing policies often fail to address the complexities of emerging technologies, creating regulatory blind spots. There is a pressing need for updated, comprehensive legislation that incorporates the nuances of modern cybersecurity challenges to better protect businesses and individuals in the digital age (Holt & Bossler, 2016).

Mitigation Strategies

Technological Solutions

Advances in cybersecurity technology play a crucial role in mitigating the risks posed by internet crime. Encryption techniques, such as end-to-end encryption and homomorphic encryption, provide robust security for sensitive data by making it difficult for attackers to access information even if they breach the system (Hassan et al., 2020). AI-driven threat detection systems are increasingly used to identify and respond to cyber threats in real-time. These systems analyze large amounts of data to detect anomalies and potential threats, enabling faster responses to cyberattacks. Continuous monitoring of systems and proactive risk assessments are also essential for identifying vulnerabilities and preventing breaches before they occur (Verhoef et al., 2021).

Organizational Strategies

Businesses must adopt comprehensive strategies to protect against internet crime. Best practices include implementing strong access controls, regular software updates, and multi-factor authentication to reduce the risk of unauthorized access. Organizations should also establish incident response plans to ensure quick recovery from cyberattacks. Employee training and awareness programs are critical, as human error is a common factor in security breaches. By educating staff on phishing scams, secure password management, and safe internet usage, companies can reduce their vulnerability to cyberattacks. Creating a security-first culture and fostering collaboration between IT and other departments is key to maintaining a secure digital environment (Broadhurst et al., 2021).

Policy Recommendations

Governments and international bodies should strengthen cybersecurity policies by updating legal frameworks to address emerging technologies like AI and IoT, enforcing stricter regulations for data protection, and enhancing cross-border cooperation on cybercrime

investigations. Public-private partnerships play a vital role in combating internet crime by fostering collaboration between governments, private companies, and cybersecurity experts. These partnerships can promote information sharing, establish best practices, and jointly develop innovative solutions to address evolving cyber threats (Broadhurst et al., 2021; Holt & Bossler, 2016).

Conclusion

This research highlights the dual-edged nature of digital transformation, which, while driving innovation and growth, has simultaneously increased the prevalence of internet crime. Key vulnerabilities in digital systems—particularly those involving emerging technologies like AI, IoT, and cloud computing—have been exploited by cybercriminals. The analysis of case studies revealed the importance of robust cybersecurity practices and regulatory frameworks to mitigate these risks.

Implications for Stakeholders

The findings hold significant implications for businesses, policymakers, and the general public. Businesses must recognize the importance of implementing proactive cybersecurity measures, such as encryption, continuous monitoring, and employee training, to protect themselves from internet crime. Policymakers should update existing regulations and collaborate internationally to address the gaps in cybersecurity governance. The general public must remain vigilant about online safety, as individual actions can prevent the success of cyberattacks such as phishing and ransomware.

Future Research Directions

Future research should focus on the relationship between emerging digital technologies and internet crime. As AI and IoT devices become more integrated into daily life, new forms of cyber threats may emerge, requiring further investigation into advanced cybersecurity solutions.

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ACADEMIC COLLABORATION FOR EFFECTIVE CAREER PROGRESSION OF LIBRARY AND INFORMATION SCIENCE EDUCATORS IN UNIVERSITIES IN NORTH-CENTRAL, NIGERIA: ISSUES AND CHALLENGES

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Abstract
This paper examined issues and challenges surrounding the academic collaborative activities among LIS educators for effective career progression in universities in North-central, Nigeria. Collaborative learning activities has become an important tool for intellectual and professional development for all professions including LIS profession. Adopting different forms of academic collaborative activities especially in universities has become a key solution to solving complex and critical problems surrounding career progression. This paper therefore, examined glaring issues and challenges surrounding the career progression of LIS educators in universities in North-central, Nigeria. The paper further discussed activities involved in career progression; concept of academic collaboration; types of academic collaboration for effective career progression; advantages of academic collaboration; issues and challenges of academic collaboration, strategies for effective academic collaboration. The study concluded that when collaboration is being practised appropriately, it is likely to invigorate the faculty members in the pursuit of their career to a successful end because collaboration is a tool that can either make or mar the success of career progression among LIS educators if not adequately managed. The study, therefore, recommended among others that faculty members especially the newly employed staff should be mentored on the need for collaborative activities for effective career progression

Keywords: Academic Collaboration; Career Progression, Library Information Science Educators, Issues and Challenges, Universities In North-Central, Nigeria.

Introduction
The importance of career progression in a university system cannot be overemphasised because generally, employees in every institution particularly institutions of higher learning are expected to be productive and one of the physical indicators of this is seen in the career progression of faculty members including Library and Information Science (LIS) educators in universities in Nigeria. This simply means that every academic staff in a university be it either federal or state university is expected to be engaged in a progressive career activities. Career progression in a university system is simply the process of moving or elevating in the right direction from one position or rank to another during the working life of an employee.

Career progression is seen as a life time process in an academic setting. According to Omekwu (2021) career progression is synonymous to career development, career advancement, career movement, career upliftment or career mobility, therefore can be used interchangeably. According to Half (2021), career progression or development does not happen overnight rather it is a continuous process that an individual works on during his professional life, this means that any of the conventional signs of achievement, such as getting a promotion, earning a pay raise, or excelling at performance appraisal time, are all part of developing individuals' career.

According to Saka (2019) LIS educators are trained LIS professionals that are employed to teach LIS courses and supervise LIS researches in library schools whether at polytechnics, monotechnics, colleges of education and or universities In order for LIS educators to effectively achieve career development, collaboration should be put in place.

Activities involved in Career Progression

The importance of activities involved in career progression cannot be over emphasised. According to Abga and Bello (2023) career progression being an effective way to successfully grow and develop workers' professional life. It consists of the goals one intends to achieve, the position a person wishes to attain in his career life, the remunerations and emolument packages. For this reason, there are certain activities that come along with the journey of career progression as an employee moves from the rank of Graduate Assistant to the rank of a Professor. These activities can be achieved through collaborative efforts depending on the types of activity. These are:

1. **Professional Certification:** as part of the career progression, it is expected that lecturers particularly LIS educators are engaged in other professional certifications as this portrays an individual's expertise, skill, and most importantly knowledge in a specific area of study. This helps an individual's credibility and reputation.

2. **Leadership/Administrative Roles:** LIS educators are also expected to take up responsibilities that involve guiding, directing and managing activities to specifically achieve a goal. An individual can be mentored in terms of leadership and administrative roles as they move through the ladder of career progression.

3. **Publications:** these are intellectual printed works of people mostly in books, magazines, journals, conference papers, theses and dissertations, reports among others. This has become the most important part of promotion criteria which may either make or mar an individual's career progression. As contained in the promotion guidelines, a specific minimum number of publication is required depending on the rank an employee may be applying for.

4. **Awards/Recognition:** these are activities of career progression involving an individual's acknowledgement of his positive contributions to a particular field, profession, institutions, programme or even a society. This also can boost an individual's reputation an credibility

5. **Academic Qualifications:** As LIS educators continue to move in the right direction, they are expected to earn degrees or certificates before attaining certain ranks. For example, an employee may be required to possess a PhD in LIS before attaining the rank of a senior Lecturer in a University.

6. **Community Services (within and outside the university):** This is simply a voluntary service or work offered just to benefit a community or its members. This is considered as part of activities counted for promotion in the career progression journey.
7. **Students Supervision:** this involves coaching or supervision of both undergraduate and postgraduate students as the case may be.

8. **Promotions:** this usually is considered the most important part of the career progression processes as it brings together all other activities for one to be able to achieve his goal.

Concept of Academic Collaboration

Collaboration is a key term that has been emphasised in the literature of research and information science. Collaboration happens when a group of individuals join forces to share their knowledge and experiences in order to achieve a single goal, project, or objective**.** Academic collaboration could influence career progression because it is an academic relationship that involves a partnership between two or more individuals academically working together to purposely achieve a common goal. With regards to this study, it involves two or more LIS educators coming together to collaborate in terms of research, teaching, supervision, community services among other academic activities for the purpose of career advancement or progression.

Saka and Ibrahim (2023) stated that professional collaboration among academic staff especially at university level would help fulfil the objectives of establishing university and leading to effective, teaching, research and community service and consequently lead to National development. The authors therefore concluded that the spirit of collaboration among academics staff whether high or low would have a corresponding effect on national development. In a similar vein, Sprunger (2017) indicated that when experts in diverse fields collaborate especially through researches or any other academic activities, the intersection of divergent fields leads to innovative and original ideas, products, technologies and knowledge. Saka (2019) described collaboration in academics as a type of mentoring whereby two or more LIS educators particularly professor(mentor) and graduate assistant (mentee) coming together to make intellectual contributions in the form of teaching, research, publication, community service and staff exchange programmes with the library and information science schools.

Gurat and Sagun (2018) opined that collaborative learning technique improves the learners' problem-solving skills. This means that when individuals particularly the LIS educators are engaged in collaborative learning activities such as research or article writing, students' supervision, patent/creative work among other activities, they will become more productive as different ideas and knowledge are brought together to solve a specific problem for positive improvement. Collaborating academically with colleagues in terms of teaching, publications, researches, students' supervisions and other administrative activities is crucial to the overall success of career progression of LIS educators.

Types of Academic Collaboration

Various types of academic collaboration exist in a university. Saka *et al.* (2014) stated that as academic staff, they are expected to conduct research, teach, supervise students on SIWES and research projects, and embark on community services either individually or through collaboration, For instance:

2. **Collaboration in teaching within/outside the institution**: the importance of collaborative teaching cannot be over emphasised as it enhances the quality of what students are taught in class. This type of collaboration can takes place within and even outside the university to support teaching and learning activities. Saka and Ibrahim (2023) stated that collaborative teaching has to do with curriculum design, planning, implementation and evaluation.

3. **Collaboration in community services within/outside the institution:** faculty members particularly LIS educators can collaborate in terms of providing the immediate community with some of their pressing issues. Librarians and faculty members in the same university or from other universities can collaborate in community development by way of building blocks of classroom and libraries, donation of library materials and books to host community, primary schools as well as professional development (Saka, 2019).

4. **Collaboration in research within/outside the institution:** this type of collaboration involves two or more LIS educators having the same or related area of specialisation can come together to carry out a study to foster their level of career progresiion. Durante (2022) further mentioned that it is only when people come together with their best ideas, harness skills, talent and direct these towards a completion of a task, a project or overcoming a problem that has plagued institutions or societies at large, only then the best outcomes and products are produced. Furthermore, Durante (2022) stated that doing research or work independently is a demonstration of intellectual grit. However, participating in collaborative activity involves more intellectual virtues including curiosity, intellectual humility, attentiveness, intellectual carefulness, and open-mindedness which are characteristics necessary to advance in the 21st century research.

5. **Collaboration in publications within/outside the institution:** LIS educators can engage in collaborative publications to ensure progressive career activities. Aiyebelehin (2022) noted that most academics' research behaviour have been driven by the need to achieve the publishing standards imposed by various institutional authorities. This is because the degree of collaboration especially in publications are increasingly being used as a criterion for promotions in academic institutions, as due to this, researchers are now collaborating. Saka and Ibrahim (2023) supported this by stating that collaborative publication is a situation whereby academic librarians jointly publish an article with faculty members be it an LIS educators or faculty member or both. This could also bring about progressive career activities.

6. **Collaboration in students' supervision within the institution:** collaboration in supervision of students is of paramount importance, this could be in Student Industrial Work Experience Scheme (SIWES) training, thesis and or undergraduate project supervision. According to Saka and Ibrahim (2023). It is a common practice whereby academic staff within a faculty/school jointly supervise students on either SIWES training and in students' projects .

7. **Collaboration in administrative responsibilities:** universities cannot survive without administrative activities including departments. LIS educators can jointly collaborate in various administrative responsibilities assigned to them for the overall development of the department. For example during departmental accreditations, committees can be set up to jointly carry out activities for effective and smooth accreditation exercise.

Advantages of Academic Collaboration

Man is a social being and it is the interaction between members of a group that motivates them to effectively work together. There are numerous advantages of collaborating academically. According to Ekpoh and Edet (2017) certain reasons why people collaborate are as follows:

1. it enables access to skills and expertise
2. it enables access to equipment, resources or "stuff" that one does not have
3. it improves access to funds

4. it enables one to gain respect, admiration and recognition for professional advancement and efficiency (that is more hands and minds make it easier to learn the tacit of knowledge that goes with the techniques among others.

A single research perspective would not be able to stimulate innovation and knowledge advancement, but sharing perspectives and ideas may allow LIS educators to benefit from collaborative partnerships by having rare opportunities to work with colleagues they may not otherwise meet, boosting the likelihood of collaborative publications, research, supervisions among others which are very significant and advantageous to researchers' careers.

General Issues and Challenges of Academic Collaboration

With every advantages, there must be disadvantages or challenges affecting whatever situation. There are numerous challenges of collaborating with individuals generally be it academic or otherwise. According to Sachannand (2012) challenges faced by collaborators are: lack of fund, infrastructural limitations in ICT, issues in politics and culture, time consideration and inadequate collaborative climate. Part of the issues that may be surrounding collaboration is individuals' having issues with some of their personal qualities such as:

6. **Lack of self-confidence**: part of the issues surrounding collaboration among individuals is lacking the self-confidence to present oneself as approachable to colleages. To support this Kwibisa1 and Majzoub (2018) stated that common issues in collaborative activities include: lack of clear objectives and goals, lack of drive among collaborators, unclear division of responsibilities, lack of transparency, unclear shared benefit, absence of collective identity and conflict of interest.

7. **Not open minded:** when individuals are not open minded especially among collaborators, the relationship is bound to be affected as most individuals would love to keep matters to themselves.

8. **Unwillingness to freely share knowledge and skills:** The issue of not being open minded can bring about the employees unwillingness to share relevant knowledge and skills with others.

9. **Lack of commitment**. Lack of commitment especially when responsibilities are shared among collaborators can destroy the relationship among them. Successful collaboration team must have individuals who are dedicated, committed and are ready to do work for the purpose of career development.

10. **Funding:** one of the major issues in collaborative activities is who to fund the project at hand. When financial responsibility statements are spelt out clearly, it saves a lot of energy, time and of course money among collaborators.

These are some glaring issues surrounding effective collaboration thereby affecting career activities of faculty members including library and information science educators. In essence, collaborative activities in the academic environment bring together more academics particularly professors, other lecturers and students, into an active research writing, teaching, supervision, community service among other activities. It further allows a more experienced researcher to mentor and assist a less experienced one or an even more confident researcher to encourage and include a less confident one. Therefore, library and information science

education will receive a boost if collaborative activities among LIS educators is being practised and encouraged.

Strategies for effective Academic Collaboration

Despite all issues stated earlier, LIS educators can develop strategies in order to achieve a successful, peaceful and effective academic collaboration among colleagues for career progression through:

x. **Mentorship:** collaboration can be encouraged through formulation of mentor and mentee relationship especially within the department. In doing this, faculty members especially the newly employed staff should be mentored on the need for collaborative activities for effective career journey. This will foster cordial relationship among colleagues including senior colleagues.

xi. **Setting up a Committee:** when collaboration is effectively established through mentorship, the department can set of up committee(s) to oversee the affairs of collaborative activities among employees. Department of LIS can set up a committee on how to delegate and continuously monitor collaborative activities among employees. This will foster unity and understanding among colleagues within the same departments. This committee will nominate individuals to develop a research topics to individually accommodate other colleagues in their paper atleast once or twice in a year.

xii. **In house training/workshop on collaborative learning activities:** The department through a committee can organise regular training within the department on the need for a collaborative activity for the overall development of the department and university at large. Regular in house training/workshop can be organised by departments on the need for LIS educators to be engaged in collaborative learning activities within or outside the university.

Conclusion

The indispensability of collaboration cannot be over emphasised as it is an important tool for progressive career activities. When collaboration is being practised appropriately, it is likely to invigorate the faculty members in the pursuit of their career to a successful end because collaboration is a tool that can either make or mar the success of career progression among LIS educators if not adequately practised. Therefore, collaboration can have a positive impact on the career progression of LIS educators as it will help them develop skills and refine such skills to be successful in their career. Collaboration among individuals especially LIS educators is, therefore, crucial to the success and development of Library and Information Science Education in universities in North-central, and Nigeria at large.

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GENERATIVE ARTIFICIAL INTELLIGENCE TOOLS FOR RESEARCH ACTIVITIES OF POSTGRADUATE STUDENTS: THE REALITY OF ITS CONTINUITY

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Abstract
This paper focused on the use of generative artificial intelligence tools for research activities by postgraduate students. It highlighted the various aspect of research activities, the different types of generative Artificial Intelligence tools for research, positive and negative implications for research. The conclusion acknowledged the benefits and downside of using generation AI tools for research but called for attention to balancing these positive and negative implications.

Keywords: Artificial Intelligence; Generative Artificial Intelligence Tools; Research Activities; Postgraduate Students; Research Quality

Introduction
For postgraduate students, research projects are essential assignments that must be completed at the conclusion of their study. Writing papers, reviewing literature, gathering, reporting and analysing data, interpreting findings and giving seminars are all included. The ultimate aim of these activities is to increase knowledge and creativity in a certain field of study and their proper execution determines a postgraduate students' graduation or status in that subject. Therefore, there was pressure to find ways to speed up and ease the process of these research activities. Additionally, because current information is needed for research and there is an explosion of information, sorting, reading, and interpreting literature became more difficult, adding to the already laborious work involved in these activities (Roopa and Hunashyal 2020). Prior to now, conducting research required a lot of time and mental strain. Postgraduate students are typically heavily involved in reading publications, organising and categorising pertinent information, analysing and interpreting research data, and data interpretation. Even though the researchers completed all of these manually or with the help of a librarian or information analyst, it still took time and mental effort. Moreover, Laminoska and Augiene (2017) reported that postgraduate students view research projects as demanding and unpleasant endeavors that one would prefer to avoid but are typically undertaken out of necessity andompulsion. Their interest and desire to fully engage to the processes involved in research endeavors are thereby impacted.

Aspects of Research Activities
Research activities of postgraduate students are similar to any other researches, although they tend to dive deeper into the problem and it entails the following:

1. Paper writing and publication
2. Literature review
3. Attending seminar
4. Data collection
5. Data analysis
6. Result presentations
7. Identification and formulation of research question

Artificial Intelligence

The development of technology has made it easier to carry out research operations, and artificial intelligence is one such technology that has had a big impact on how these activities are conducted. Machine learning models that have been trained on a variety of tasks to generate predictions using data are what make up artificial intelligence (AI). A much simpler model called the Makov Chain, which was named after Andre Marco's statistical technique, serves as an early example of generative artificial intelligence. It was used to simulate the behaviour of random processes in email programmes for tasks like autocomplete functions and other next-word prediction tasks (Zewe, 2023).

Regarding applications that may help in the creation of images, texts, audios, movies, and 3D modelling, generative artificial intelligence stands out for its capacity to produce original and distinctive content that is akin to that of the human mind. Machine learning models trained to generate new data rather than forecast certain data sets are known as generative artificial intelligence models. These models are widely used; some examples include chatGPT, aithor.com, quillbot, paperbot, R discovery, and AI art generator

Types of Generative AI Research Tools and Their Functions

Kumar *et al*., (2020) identified some generative AI tools which are useful for carrying out research:

1. Grammarly is an AI tool which improves writing quality and clarity of PG research.
2. Tableau enables interactive and informative visualisation
3. Mendeley is a reference management tool for streamlining citations
4. Semantic scholar provides personalised paper recommendations
5. Claude is used for summarising documents
6. Research rabbit helps to organise research paper
7. ChatGPT is used for generating data based on user request
8. Quillbot is used for paraphrasing
9. Humata AI is used for summarising articles

Positive Implications of Generative AI Tools for Research Activities

Owing to the wide scope of postgraduate research, students are often looking for ways to expedite and streamline research procedures. Similarly, research may now be done much more quickly and easily thanks to generative artificial intelligence techniques. It facilitates easy reference, speedy write-ups, error detection in write-ups, and quick text or picture generation based on supplied information, all of which improve the research writing process.

Barros *et al*., (2023) averted that this cutting-edge technology known as generative artificial intelligence is making its way into several industries, including education. Researchers can use it to search the literature, make intelligent summaries, and edit research articles. The future of postgraduate students and the advancement of the country depend critically on our acceptance and integration of this technology into our teaching, learning, and research. By automating repetitive processes like literature reviews, data analysis, visualization, research collaboration, and management, generative artificial intelligence systems help postgraduate students' research activities be more productive, efficient, and of high quality. (Hernandez *et al.*, 2019).

Benefits of AI Tools for Research

Improve Efficiency- Generative AI tools can analyse data fast identifying patterns and generating insights that would have taken a longer time to achieve. This enhances efficiency

by maximising time allowing the PG students to focus on other task and reducing chances of error (Smith, 2022).

Streamlined literature review- These tools provide means for quick scanning of articles, extractions of vital information and relevant summaries which not only saves time of the PG student but also improves the quality of the research as these tools provide up-to-date information (Brown *et al*., 2023).

Negative Implications of Generative AI Tools for Research Activities

Generative AI tools have offered numerous benefits to education system especially in research activities but their impact has not been entirely positive, some negative effects have also occurred which if left unchecked can result in greater problem than the education system is prepared for. Generative AI tools can easily be misused or overused due to its undeniable advantages towards research, drawing more attention for ethical utilisation of these tools. Unethical use of these AI tools for research activities can undermine the quality, reliability and originality of the research.

Downside to Using Generative AI Tools for Research Activities

Some downsides in the use of generative AI for research are discussed below:

Overreliance- This is a situation where PG students go beyond merely consulting these tools to totally depending of their outputs or suggestions. According to Carr (2020) generative AI tools comes with an ease that can be quite addictive, luring PG students to solely rely on them and avoid the PG student's active involvement in the research processes.

Decreased critical thinking skills- This is a decline in the PG students' ability to construct strong arguments and make logical conclusions. AI tools are known for generating data based on request which leaves very little room for students to develop their problem-solving skills and critical thinking (Bennett and Maton, 2020).

Decreased originality and creativity- This is a situation where the research work constitutes more of the AI generations than that of the researcher. Susnjak (2022) opined that most of the content generated by generative AI tools are similar to existing published works which raises a question of credibility and originality of the research.

Deepfakes- These are image, audio or video generations that do not exist or alterations of the original. AI tools are trained on existing data and could generate false or outdated information which could be included in the research if proper verification and cross examination are not done leading to misinformation (Bender et al., 2021)

Superficial analysis- This occurs when analysis is not thorough but based on obvious observations. AI tools are unable to capture understated differences, complexities and context-dependent variations in data, resulting in generalised or inaccurate analysis. This is likely due to quality of the data the AI tool was trained on or binary classification systems which AI tools rely on that fail to account for the gray areas (Georgiou and Lycouris, 2022).

Conclusion

Generative AI tools have been able to improve the quality, productivity and efficiency of PG students' research activities, allowing them to focus on high-level thinking and strategy. Although, this has not been achieved without some negative impact on the PG students as well as their research outputs. The use of these tools have brought about conflicts in research

originality and critical thinking of the PG students. Hence, in spite of the benefits of using generative AI tools for research activities, it is crucial to acknowledge their limitations and promote a balance usage.

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EFFECT OF COMPUTER ASSISTED INSTRUCTIONAL TECHNIQUE ON JUNIOR SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN BASIC SCIENCE AND TECHNOLOGY FOR SUSTAINABLE NATIONAL DEVELOPMENT

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Abstract
This study was carried out to determine the effects of computer assisted instructional technique on junior secondary school Students' academic achievement in basic science and technology for sustainable national development. The study sample consisted of two classes of different secondary schools, one experimental with 88 students and the other one as control had 164 students. A random sampling technique using balloting method was used in selecting the two schools out of 31 public secondary schools in Minna metropolis, with a total population of 57,402 students in the metropolis. A pretest- posttest quasi-experimental research design was used. The instrument used was Basic Science and Technology; Achievement Test (BSTAT) which was validated and with reliability coefficient of r = 0.75. The hypotheses stated were tested using t-test statistics at P<0.05 level of significance. Major findings of the study revealed that there is significant difference in the academic achievement among secondary school students exposed to computer assisted instructional technique and those exposed to conventional teaching method in favour of experimental group. There is also significant difference in the academic achievement of male students exposed to computer assisted instructional technique and female students exposed to the same treatment in favour of the male students. In light of the findings from this study, recommendations were offered. Government concerned with the responsibilities of managing the affairs of secondary schools should design special training programmes for basic science and technology teachers so as to keep them abreast with the current development in methodology of teaching and new innovations that are being invented by educational researchers offered was among others.

Keywords: Computer assisted, Science, Students, Basic Science and Technology

Introduction
Science education has been recognized as vital because of the rapid pace of technological change and globalization of the economy which resulted in the need for individuals to have a broad scientific knowledge. On the other hand, the ever growing importance of scientific issues in daily lives demands a populace who have sufficient knowledge and understanding to follow science and scientific debates with interest, and to engage with the issues that science and technology poses, both for them individually, and for the society as a whole (Millar and Osborne, 2018).

Science education is an indispensable tool for national development because of the important position it occupies in the development and growth of all nation. Odunisi (2021) observed that the economic political strength of a nation is always assessed in terms of her achievement in

science and technology. This may be the reason why emphasis is placed on the provision of science education at all level of education in Nigeria.

The emphasis placed on science and technology along side with the important role it plays towards national development makes it pertinent and practically necessary for science to be taught in an organized and well structured pattern, involving activities for both teachers and students. This will undoubtedly make learning more interesting and meaningful. /

Science according to Ogunniyi (2020) is a field of study that is concerned with producing a scientifically literate society. It is an organized body of knowledge. It is a search for meaning or explanation of events in nature. Also Ogunniyi (2020) defined science in terms of methods or processes, that is, what scientists can do; or in term of its product, that is, knowledge in the form of facts, principles, concepts, attributes, laws and theories. Urevbu (2019) defined science as a body of knowledge which has been acquired through experimentation.

Science is a tool for achieving technological ends, solving human problems through tentative hypotheses. Science is research; it is an active pursuit of empirical knowledge based on scientific method. It is also an interconnected series of concepts and conceptual schemes that have developed and is developing as a result of experimentation and observations and are fruitful for further experimentation and observation (Conant, 2015 and Urevbu2019). Shaibu (2022) also saw science as a human complex activity that leads to production of a body of universal statements called laws, theories or hypotheses which serve to explain the observable behavior of the universe or some aspect of the universe. Science is a mode of thinking, a methodology, says (Frankfort-Nachmias and Nachmias, 2016). Science can also be seen as a process of investigation, which requires special skills called "computer assisted instructional techniques." This is needed in order to achieve the objectives of teaching science at the secondary school level as stipulated in the National Policy on Education (FME, 2014).

The computer-based Instruction makes teaching techniques far more effective than those of the traditional teaching methods as it is used for presenting information, testing and evaluation and providing feedback. It makes a contribution to the individualization of education. It motivates students and gets them to take an active part in the learning process. It helps to develop creativity and problem solving skills, identity and self-reliance in learners. CBI provides drawings, graphics, animation, music and plenty materials for the students to proceed at their own pace and in line with their individual differences. It serves to control lots of variables having an impact on learning, which cannot be controlled by means of traditional educational techniques (Kaşlı, 2020;
Chang, 2022).

Computer-Assisted-Instruction (CAI) is an innovative instructional method which encourages interaction between the computer and a learner. It is an electronic form of education which allows the learner in a friendly learning interaction with the computer to present and enjoy programmed learning activity. In using CAI, computer plays the teacher's role as it provides and imparts knowledge and skills to learners. Thus, the teacher instead of teaching the learners, only guides and assists them on how to ask questions and pose problems, formulate hypotheses, locate information and critically assess the information found in relation to the problems posed (Ater, 2016, Haddad & Jurich in Akinola, 2022).

Achievement is a result gained by effort. It is a great or heroic deed. Achievement is the act of accomplishing or finishing. According to Pandey (2018), academic achievement is the

performance of the students in the subjects they study in the school. It is directly related to students growth and development of knowledge in educational situation where teaching and learning take place. To Usman (2020), academic achievement is the measure of students' learning acquisition of certain skills at the end of teaching and learning activities. As observed by Devis and Mayuri (2023), academic achievement is excellence in all academic disciplines, in classes as well as in extracurricular activities. However, students' academic achievement can be affected by many variables such as teaching method, gender, and school location among other things.

Sustainable development, as defined by the World Development Report (1999) is development that meets the needs of current generation without compromising the ability of the future generations to meet their own needs. By this definition, then, sustainable development is development that takes the impact of the environment into account and tries to minimize environmental damages. According to Cyril, Akiaang, Ofem & Donal (2020), sustainable development is a multi-faceted development strategy that has a number of dimensions. Sustainable national development has also been defined by the Nigeria Study/Action Team (NEST, (1991) in Osuji (2014) as "an approach that combines the development needs and aspirations of the present without compromising the ability of the future while also maintaining ecological integrity". This implies according to Osuji a development process that is equitable and sensitive to ecological and environmental issues. It depends on the initiative, resourcefulness, and discipline of human beings who are the managers of developmental programmes. Education for sustainable development is lifelong process that leads to an informed and involved citizenry having the creative problem-solving skills, scientific and social literacy, and commitment to engage in responsible individual and co-operative actions. UK Panel for education for Sustainable Development (2018), stated that education for sustainable development enables people to develop the knowledge, values, and skills to participate in decisions about the ways things are viewed individually and collectively, locally and globally, that will improve the quality of life now without damaging the planet of the future. Education for sustainable development is a holistic approach for school management and the curriculum, not a separate subject. It therefore requires reflection on what to teach, and how to teach in order to clarify and extend the ability of students to think for themselves, encourage students to reflect and debate about issues to enable them to form their own opinions foster learning that emerges from discovery and is relevant to the learners' life experiences. Sustainable development as a construct is to meet the need of the present generation without compromising the needs of the future generation. It implies that while education meets the need of the present it does not compromise the ability of the future generations to meet own needs. Nevertheless, this ability to meet the needs is determined by human capital (through education, technology advance) and through physical capital (machine, tool etc). Kundan (2022) argued that continued sustainable development is only possible or assured when it is agreed and indeed concrete steps are taken to raise the level of literacy and numeracy in any society. Educational institutions and their programmes are therefore the tools with which to achieve development and its sustainability.

Statement of the Problem

There is a quest for scientific knowledge all over the world. This quest for knowledge as everyone's desiring to lead write, and make applications of acquired skills or knowledge, pose challenges in the teaching and learning of primary science. The challenges are nationwide, which include; inadequate competent, dedicated and qualified science teachers to teach science as required in the National Policy on Education and the primary science core curriculum. One of the goals of Primary Education clearly stated in the National Policy on Education (FME,

2023), is to lay a sound basis for scientific and reflective thinking in the students for sustainable development. The study on computer assisted instructional techniques is not new. Mari (2014) worked on the effect of computer assisted instructional techniques on formal reasoning ability among SSS students in Kaduna state and concluded that students perform better when taught using computer assisted instructional techniques. Therefore, this study sought to investigate the effect of computer assisted instructional technique on junior secondary school Students' achievement in basic science and technology in Niger State, Nigeria for Sustainable National Development.

Purpose of the Study

The purposes of the study are to;

i. Determine the effectiveness of computer assisted instructional technique on academic achievement in basic science and technology.
ii. Investigate whether computer assisted instructional technique can enhance academic achievement on male students for sustainable national development
iii. Determine the effect of computer assisted instructional technique on female students' academic achievement in basic science and technology for sustainable national development
iv. Investigate the effect of computer assisted instructional technique on male and female students' academic achievement in basic science and technology science when exposed to computer assisted instructional technique.

Research Questions

i. What is the effect of computer assisted instructional technique on the students' academic achievement?
ii. What is the difference in academic achievement of male primary pupils taught using computer assisted instructional technique and those taught using conventional teaching method in basic science and technology?
iii. What is the difference in female students' academic achievement in basic science and technology taught using computer assisted instructional technique and those taught using conventional teaching method?
iv. What is the effect of exposing male and female students to computer assisted in.tr technique on academic achievement in basic science and technology science.

Null Hypotheses . ,

Based on the research questions stated, the following hypotheses were formulated.

Ho_1. There is no significant difference in the academic achievement of secondary exposed to the computer assisted instructional technique and those exposed to conventional teaching method

Ho_2: There is no significant difference in the academic achievement of male students taught using computer assisted instructional technique and those taught with conventional teaching method in basic science and technology.

Ho_3: There is no significant difference in the academic achievement of female students taught using computer assisted instructional technique and those taught with conventional teaching method in basic science and technology.

Ho_4: There is no significant difference in the academic achievement between male and female students when exposed to computer assisted instructional technique in basic science and technology.

Methodology

In this study quasi-experimental-control group design involving pre and posttest was employed. The population of the study comprises all the primary six pupils which comprise thirty-one (31) public primary schools in Minna Metropolis. The schools are all coeducational. The study population is fifty-seven thousand four hundred and two (57,402) students. In selection of the four out of thirty one public secondary schools in Minna Metropolis, four schools were randomly sampled from thirty one Secondary School. For the purpose of this study, instrument i.e. Basic Science and Technology Achievement Test (BSTAT) was pilot tested using class six pupils of primary school, Bida. This study investigates the effects of computer assisted instructional technique on Junior Secondary School Students' academic achievement in basic science and technology. The instrument used for this study is Basic Science and Technology Achievement Test (BSTAT). The instrument was face validated by two experts. To determine the reliability of the instrument, a test-retest method was employed. The first and second test was given to the pupils of different school which are not part of this study. On the basis of the data obtained from pilot testing of the BSTAT, reliability of the instrument used for this study was found to have a reliability coefficient of r=0.75. This shows that the instrument is reliable and could be used for the study. The data collection procedures was carried out using treatment administration, the researcher did all the teachings of both the experimental and control groups. The teaching was done in six weeks that is eighteen (18) periods was used in teaching both the experimental and control groups using computer assisted instructional technique approach and lecture method respectively There are three periods allocated to primary science per week and each period is of thirty-five minutes because of the age level of the students which is average of eleven years. The statistical tool used in answering research questions so as to determine their performances was the mean scores and standard deviation. 1o lest hypotheses the significance differences in academic achievement of the students in the test was determine using t-test. The level of significance was $P< 0.05$ for retaining or rejecting the null hypotheses.

Results

Research Question 1: What is the effect of computer assisted instructional technique on the students' academic achievement?

Table 1. Students' Mean Scores in Basic Science and Technology Achievement Test (BSTAT) for Experimental and Control Group

Groups	N	Mean	St. Dev.
Experimental	88	11.17	1.44
Control	164	9.72	1.85

Table 1 result shows that the experimental group performed higher than the control group. This means that computer assisted instructional technique approach enhance students' academic achievement in basic science and technology. Therefore, that computer assisted instructional technique is more effective on pupils' academic achievement than conventional teaching method.

Research Question 2: What is the difference in academic achievement of those exposed to male primary pupils taught using computer assisted instructional technique and conventional teaching method in basic science and technology for sustainable development?

Table 2. Males' Mean scores Difference in Basic Science and Technology Achievement Test (BSTA T) for Experimental and Control Group

Groups	N	Mean	St. Dev.
Experimental	51	11.45	1.33
Control	99	9.83	1.81

From table 2 results show that the experimental group performed higher than the control group. This means that computer assisted instructional technique approach enhance male academic achievement in basic science and technology. Therefore, the research question two above have been answered that computer assisted instructional technique is more effective on males' academic achievement than conventional teaching method.

Research Question 3: What is the difference in female students' academic achievement in basic science and technology taught using computer assisted instructional technique and those taught using conventional teaching method?

Table 3. Females in Basic Science and Technology Achievement Test (BSTAT) for Experimental and Control Group

Groups	N	Mean	St. Dev.
Experimental	37	10.92	1.50
Control	65	9.58	1.90

From table 3 results show that the experimental group performed higher than the control group. This means that computer assisted instructional technique enhance females' academic achievement in basic science and technology. Therefore, computer assisted instructional technique is more effective on females' academic achievement exposed than conventional teaching method.

Research Question 4: What is the effect of exposing male and female students to computer assisted instructional technique academic achievement in basic science and technology for sustainable development?

Table 4. Males and Females in Basic Science and Technology Achievement Test (BSTAT) for Experimental Group

Groups	N	Mean	St. Dev.
Males	51	11.45	1.50
Females	37	10.92	1.50

From table 4, results show that the experimental group performed higher than the control group. This means that computer assisted instructional technique enhance males' academic achievement in basic science and technology. Therefore, the research question four above have been answered, that computer assisted instructional technique is more effective on males' academic achievement than conventional teaching method.

Hypothesis

Ho_1. There is no significant difference in academic achievement among secondary school students exposed to computer assisted instructional technique and those exposed to conventional teaching method of instruction.

Table 5.t-test Analysis of Students9 Mean Scores in Basic Science and Technology Achievement Test (BSTAT) for Experimental and Control Group

Groups	N	$\overline{X}$	Sd	Df	t-value Cal.	P	Remark
Experimental	88	11.17	1.44	250	6.89	0.00	Significant
Control	164	9.72	1.85				

* Significant at $P \leq 0.05$

Since the P-value of 0.00 obtained as shown in Table 5 is less than 0.05 it means that there is significant difference. The null hypothesis is rejected. This means that there is statistically significant difference in the academic achievement among secondary school students exposed to computer assisted instructional technique and those exposed to conventional teaching method. The significant difference was in favour of the experimental group.

HO_2. There is no significant difference in performance and creativity attainment of male students taught using computer assisted instructional technique and those taught with conventional teaching method in primary science.

This null hypothesis was used to compare the male mean scores in BSTAT for experimental and control group. The academic achievement of the male students was singled out and compared.

Table 6. t-test Analysis of Males9 Mean Scores of Basic Science and Technology Achievement Test (BSTAT) for Experimental and Control Group

Groups	N	$\overline{X}$	Sd	Df	t-value Cal.	P	Remark
Experimental	51	11.45	1.33	148	6.22	0.00	Significant
Control	99	9.83	1.81				

* Significant at $P \leq 0.05$

The result from table 6 revealed that there is significant difference in the academic achievement in basic science and technology between males that were taught using computer assisted instructional technique and those taught using conventional teaching method. The P-value was found to be 0.00 at $P \leq 0.05$. The null hypothesis is therefore rejected. This shows significant difference in the performance of males exposed to computer assisted instructional technique approach as compared to those exposed to conventional teaching method.

Ho_3. There is no significant difference in academic achievement of female students taught using computer assisted instructional technique and those taught with conventional teaching method in basic science and technology.

This null hypothesis was used to compare the mean scores of academic achievement of females in Basic Science and Technology Achievement Test (BSTAT) for the experimental and control group. Computer assisted instructional technique approach and conventional teaching method was used respectively.

Table 7: t-test Analysis of Females9 Mean Scores of Basic Science and Technology Achievement Test (BSTAT) for Experimental and Control Group

Groups	N	$\overline{X}$	Sd	Df	t-value Cal.	P	Remark
Experimental	37	10.92	1.50	100	3.91	0.00	Significant
Control	65	9.58	1.90				

* Significant at $P \leq 0.05$

The result from the table 7 revealed that there is significant difference in the academic achievement of females taught using computer assisted instructional technique approach and those taught using conventional teaching method. The P-value was found to be 0.00 at $P \leq 0.05$ level of significance. The null hypothesis is therefore rejected.

Ho_4. There is no significant difference between male and female students on academic achievement when exposed to computer assisted instructional technique in basic science and technology.

The null hypothesis was used to determine the academic achievement in Basic Science and Technology Achievement Test (BSTAT) using computer assisted instructional technique approach. Scores of the males and females subjects in the experimental group was analysed using t-test statistics.

Table 8: t-test Analysis of Males' and Females' Mean Scores of Basic Science and Technology Achievement Test (BSTAT) for Experimental Group

Groups	N	$\overline{X}$	Sd	Df	t-value Cal.	P	Remark
Males	51	11.45	1.33	86	1.72	0.00	Significant
Control	37	10.92	1.50				

*Significant at $P \leq 0.05$

The result from table 8 indicated that there was a significant difference between academic achievement of males and females when they are exposed to science teaching process approach.

This is because the P-value of 0.04 hypothesis is rejected. This result obtained at $P \leq 0.05$ level of significance. Therefore, the null contradicts the earlier findings of Mari (2001) who revealed superiority in performance of females over their male counterpart.

Discussion of the Results

This research work was aimed at determining the effects of computer assisted instructional technique on academic achievement among Junior Secondary Students in basic science and technology as compared with conventional method of instruction. Hypotheses were stated and tested based on the scores of the subjects obtained from B ST AT. Analyses of the data obtained were presented in the tables 1 to 4 and 5 in accordance with the stated hypotheses. The findings from the analysis are discussed. Hypothesis 1 states that there is no significant difference in performance among secondary school students exposed to computer assisted instructional technique and those exposed to conventional teaching method of instruction. The result presented in table 1 revealed there is significant difference in the academic achievement among secondary school students taught using computer assisted instructional technique approach and

those taught using conventional teaching method. The experimental group performed better than control group, the mean scores of the groups is 11.17 and 9.72 respectively. This result is in conformity with the findings of Mari (2014), Aktamis and Ergin (2018). The result also disagrees with the result findings of Sani (2017) who discovered a significant difference in the performance of control group taught using conventional teaching method over the experimental group taught using computer assisted instructional technique approach. The result of this study therefore indicated that computer assisted instructional technique approach is better than conventional teaching method in improving students' performance in primary science.

Hypothesis 2 states that there is no significant difference in academic achievement of male students taught using computer assisted instructional technique and those taught with conventional teaching method in basic science and technology. From the result in table 3, it was discovered in the t-test results of the posttest that there was a significant difference in the performance of male experimental group in the BSTAT taught using computer assisted instructional technique and the male control group taught using conventional method of instruction. The result agrees with the findings of Aktamis and Ergin (2018), where they discovered a significant difference in the performance of males treated with computer assisted instructional technique approach as compared with their males counterpart treated with conventional teaching method.

Hypothesis 3 states that there is no significant difference in academic achievement of female students taught using computer assisted instructional technique and those taught with conventional teaching method in basic science and technology. From the result in table 4, it was discovered that there was a significant difference in the performance of female experimental group in the BSTAT taught using computer assisted instructional technique and the female control group taught using conventional teaching method of instruction. The result agrees with the findings and Lyons (2020) where they discovered a significant difference in the performance of females treated with computer assisted instructional technique approach as compared with their females counterpart treated with conventional teaching method.

Hypothesis 4 states that there is no significant difference between male and female stu ents on academic achievement exposed to computer assisted instructional technique in basic science and technology. Table 5 shows a comparison of male and female mean scores exposed to BSTAT within the experimental group. The result indicated a significant difference in favour of male. This result is in conformity with the findings of Gumel (2017), and disagrees with the findings of Mari (2014) who revealed superiority in the performance of females over males.

Conclusions

From these revelations, the following conclusions are drawn: When students are exposed to computer assisted instructional technique approach they achieved better academically than those exposed to conventional method of teaching in basic science and technology. Males exposed to computer assisted instructional technique performed better than females exposed to the same treatment. Computer assisted instructional technique approach of teaching is not gender friendly in academic achievement.

Recommendations

Based on the findings of this study, the following recommendations were made:

i. That effort should be made by all stakeholders to discourage gender stereotyping. In view of this therefore, the home, the school and the society at large should encourage females to participate fully in skill-based activities within and outside school.

ii. Also enabling environment should be provided based on culture and believe of the society. No matter how effective certain method of teaching is, it may not yield the required result if the teachers are not properly and adequately equipped with the technical-know-how regarding the use of the method.

iii. Government concerned with the responsibilities of managing the affairs of secondary schools should design special training programs for basic science and technology teachers so as to keep them abreast with the current development in methodology of teaching and new innovation such as SAPA that are being invented by educational researchers.

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RECORD ORGANISATION FOR EFFECTIVE HEALTHCARE SERVICES OF PATIENTS WITH DISEASES IN PRIMARY HEALTH-CARE CENTRES IN KADUNA STATE.

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Abstract
Proper record organisation is essential for providing high-quality healthcare services to patients with illnesses in primary healthcare centres. Poorly organised records can lead to medical errors, delays in diagnosis and diminished care for patient. This paper examined the significance of record organisation, its advantages, and suggestions for implementation. Key elements included standardised protocols; health records; staff training; data quality and patients' involvement. An efficient record system and enhance patient care, minimise errors and boost operational effectiveness. This study offered a framework for primary healthcare centres to establish and implement effective record organisation methods that will ultimately lead to better health services for patients with illnesses.

Keywords: Record organisation, Healthcare services, Patients with diseases, Primary Healthcare centres. Kaduna State

Introduction
Adequate healthcare is necessary for patients especially for those with infectious and non-infectious diseases. Infectious diseases are disorders that are caused by organisms, usually microscopic in size such as bacteria, viruses, fungi or parasites that are passed, directly or indirectly from one person to another. Effective record organisation is essential for delivering quality healthcare, especially in primary healthcare centres where patients with various conditions receive their initial treatment. Well-structured medical records would allow healthcare providers to quickly access accurate and comprehensive patient information, which supports informed decision-making and high-quality care.

In contrast, poorly organised records can result in medical errors, delayed diagnose, and negative patient outcomes. Humans can be infected following exposure to an infected animal that harbors a pathogenic organism that is capable of infecting humans. WHO (2019) came up with a discovery of two infectious diseases which include: lower respiratory infections and

diarrheal diseases caused by a variety of infectious agents. However, non-infectious diseases are diseases that are not transmitted (spread) directly from one person to another and are also known as lifestyle diseases or chronic diseases. Majority of these diseases are caused by the way people live and are preventable. About 69% of all deaths are caused by cardiovascular disease, respiratory diseases and diabetes. There is a need therefore, to ensure that patients with infectious and non-infectious diseases records are well kept, organised and managedfor enhanced and sustainable healthcare.

According to Malake and Phiri (2020), organisations create, retain and preserve records so that they can be used. Record organisation be it personal or official, are very important in the life of an organisation. The success of any organisation depends on effective record organisation practice that ensures the right records are available at the right time for effective operations. The need for proper record keeping is indisputable; it is an ordinary and necessary component of virtually all business operations.

Concept of Healthcare Services

Healthcare service refers to the range of medical, diagnostic, therapeutic and supportive services provided by healthcare professionals and institutes to maintain, restore, or enhance health and well-being. This encompasses everything from preventive care and routine check-ups to emergency treatment and long-term care. Healthcare service encompasses a broad range of activities aimed at promoting, maintaining and restoring health. It includes preventive measures, diagnosis, treatment, rehabilitation and palliative care. Healthcare services can be delivered through various channels, including hospitals, clinics, community health centres and digital platforms.

The provision of healthcare involves interdisciplinary collaboration among medical professionals, allied health professionals, administrators and support staff. Ajala *et al*. (2018) stated that to be useful, the healthcare service must make it easy for patients with infectious and non-infectious diseases to have free access to use the healthcare service. Healthcare services have the responsibility to ensure that medical records are generated, organised and used in a way that users will be able to have easy access to their records at a time of need. This is because there is a changing role in information delivery that affects even the medical sector, effectiveness in the healthcare services given to individuals and communities will increase the probability of desirable healthcare outcomes. Services rendered in healthcare centres should be all inclusive and encompassing physical and mental healthcare, maternal care, medical and surgical services to the citizens, and the need to continuously improve those services for sustainable development in the health services.

Record Or**ganisation**

Record organisation is a fundamental aspect of healthcare services, as it enables healthcare professionals to access and manage patients' information efficiently. Effective record organisation is critical for providing high-quality patient safety and enhancing healthcare outcomes. Record organisation, serves as an important source of information in order to enhance sustainability and continuity of organisations. Records organisation is therefore considered as integral component of healthcare institutions used to facilitate the achievement of their routine activities. The purpose of records organisation includes the provision of relevant information to the end users. Relatedly, Hufman (2019) opined that health records are the lifeblood and essential tools in running the day – to – day services in health care centres
Record are organised according to activities of the transactions that led to its creation and files are opened for different categories of records. Eventually, files are separated according to

records relationship. Horsman, (2019) stated that, records are systematically categoriesd in a consistent manner to facilitate efficient organisation, retrieval, maintenance and disposal by grouping them based on their relationship or similarity. Records organisation enables the records system to give default security level, location and sentencing to each of the records.

According to Dikopoulou, Mihiotis and Dikopoulou (2021) health institutions organise and keep records of their patients especially those with infectious and non-infectious diseases to enhance accountability and proper planning of organisation of records assists in establishing a link between different records, naming records consistently and facilitating retrieval of records of patients with infectious and non-infectious diseases. It also renders security protection to records, as its different users are allocated different authorities for access and action on a particular type of record in healthcare services. Responsibilities for management of specific types of records are also distributed through classification and it is used to determine records.

Record organisation operation may also need the support of vocabulary control to explain and define specific terms used by the organisation. The organisation may option for either manual or electronic index. The coding and numbering of records are also important for the system to identify the location of the records for retrieval purpose, records are organised within the system according to the organisational filing plans or structuring and methods.

Diseases and Categories of Diseases

Diseases are abnormal conditions that disrupt the normal functions of living organisms, leading to harm or discomfort (WHO, 2020). They can be divided into several categories: infectious, non-infectious, genetic, and environmental influences or lifestyle choice diseases. Infectious diseases may impact physical, mental or social well-being and can range from mild to severe. Infectious diseases, which arise from pathogens like: bacteria, viruses, fungi, and parasites, result in millions of deaths globally each year. Notable examples include: Corona Virus Disease of 2019 (COVID-19), tuberculosis, malaria, and. Non-infectious diseases, including cancer, diabetes, cardiovascular disease, and account for 71% of all global deaths. Disease usually comes with symtoms, while Thompson *et al*. (2021) asserted that most infectious disease patients have an incubation period of time and symptoms are noted in part of the patients with infectious diseases

Infectious diseases are mostly contacted through physical contact with an infected person. Arias and Pirofski (2024) stated that, infectious diseases emerged as a specialty in the mid-20th century during a period of great progress in antimicrobial drug discovery and vaccine development that advanced patient healthcare services and stimulated healthcare and basic research. The rise of antimicrobial. Resistance, climate change and global connectivity have further complicated the landscape of infectious diseases. Examples of infectious diseases include:

i. bacterial infections: tuberculosis (TB), pneumonia, meningitis, septicemia (blood poisoning), urinary tract infections (UTIs) and food poisoning (examples, salmonella, E. coli).
ii. viral infections: Common cold, influenza (Flu), HIV/AIDS, herpes simplex (cold sores, genital herpes), hepatitis (A, B, C, D, E), measles, mumps and rubella (German measles).

iii. Fungal infections: Candidiasis (thrush, yeast infections), Aspergillosis, histoplasmosis, cryptococcosis and ringworm (athlete's foot, jock itch)

iv. parasitic lnfections: malaria, toxoplasmosis, giardiasis (intestinal parasite), amoebiasis (intestinal parasite), hookworm, roundworm and tapeworm.

v. prion diseases: Creutzfeldt-jakob disease and bovine spongiform encephalopathy (Mad Cow disease).

vi. zoonotic diseases (transmitted from animals to humans): rabies, lyme diseases, leptospirosis, brucellosis and Q fever

vii. vector-borne diseases (transmitted through insects or ticks): mosquito-borne diseases: dengue fever, chikungunya, zika virus, yellow fever and tick-borne diseases: Rocky mountain spotted fever, Anaplasmosis, Babesiosis.

viii waterborne diseases: Cholera, typhoid fever, dysentery and gastroenteritis (stomach flu).

ix. airborne diseases: Influenza (Flu), measles, mumps, rubella and varicella (chickenpox)

x. sexually transmitted infections (STIs): Chlamydia, gonorrhea, syphilis, herpes Simplex (genital herpes) and human Papillomavirus (HPV).

According to Chirouz (2022) different definitions of infectious diseases for different purposes can be found. In clinical practice, a temperature greater than 38.0 ºC is considered infectious disease, and infectious diseases is typically defined as a pyrogen-mediated rise in body temperature. Physiologically, it has been defined as "a state of elevated core temperature, which is often, but not necessarily, part of the defensive responses of multicellular organisms (host) to the invasion of live (micro-organisms) or inanimate matter recognised as pathogenic or alien by the host". The elevated body temperature during infectious diseases should be distinguished from that occurring in hyperthermia, when affected with infectious disease, the rise in temperature is a result of well-controlled hypothalamic thermoregulation, whereas in hyperthermia the rise in body temperature is unregulated and pyrogenic cytokines are not directly involved, representing a failure of homeostasis.

While according to World Health Organisation (WHO) (2020) non-infectious diseases are also known as chronic diseases and they lead to cause of death and disability worldwide. These diseases are not caused by a combination of genetic, environmental and lifestyle factors. Examples of non-infectious diseases include: heart diseases, stroke, cancer, diabetes, alzheimer disease.

Non-infectious diseases disproportionately affect people in LMICs, where more than three quarters of global non-infectious diseases deaths occur. non-infectious diseases are public health issues it is not yet clear how to best manage. Non-infectious diseases, also known as non-communicable diseases (NCDs) are medical conditions that are not caused by infectious agents such as: bacterial, viruses, fungi or parasites. Instead, they usually result from a combination of genetic, environmental and lifestyle factors. Examples of non-infectious diseases are: heart disease, diabetes, cancer, hypertension, asthma, stroke, obesity and many more. Non-infectious diseases are responsible for 60% of early death and disability globally, and their growing burden in low- income and middle income countries. Examples of non-infectious diseases include:

chronic diseases: Examples include heart disease, stroke,cancer (various types), diabetes, chronic obstructive pulmonary disease (COPD) and arthritis (osteoarthritis, rheumatoid arthritis).

genetic disorders: Examples include sickle cell disease, cystic fibrosis, down syndrome, muscular dystrophy, huntington's disease and tay-Sachs disease.

neurological disorders: They include alzheimer's disease, parkinson's disease, multiple sclerosis, epilepsy, cerebral palsy and stroke.

mental health disorders: Examples include depression, anxiety disorders (anxiety, panic disorder, OCD), bipolar disorder, schizophrenia, post-traumatic stress disorder (PTSD) and eating disorders (anorexia, bulimia).

metabolic disorders: Examples include obesity, hypothyroidism, hyperthyroidism, adrenal insufficiency and polycystic ovary syndrome (PCOS).

autoimmune disorders: Examples include rheumatoid arthritis, lupus-hashimoto's thyroiditis, type 1 diabetes, multiple sclerosis and psoriasis.

musculoskeletal disorders: They include osteoporosis, osteoarthritis, rheumatoid arthritis, fibromyalgia, tendinitis and bursitis.

gastrointestinal disorders: Examples include irritable bowel syndrome (IBS), inflammatory bowel disease (Crohn's disease, ulcerative colitis), gastroesophageal reflux disease (GERD)- peptic ulcers and celiac disease.

renal diseases: They include chronic kidney disease, acute kidney injury, nephrotic syndrome, glomerulonephritis and polycystic kidney disease.

endocrine disorders: examples include hypopituitarism, hyperpituitarism, adrenal insufficiency, cushing's syndrome and hyperaldosteronism.

Methods of Records Organisation in Healthcare Services

Effective records organisation is essential in healthcare services, where accurate and timely access to patient information is crucial for delivering high-quality care. Healthcare provider rely on well-organised records to make informed decision, coordinate care and ensure patient safety. Methods of record organisation in healthcare services have evolved significantly, particularly with the advent of electronic health records (EHRs). McGonigle and Mastrian (2020) provide a thorough overview of health record organisation, detailing both manual and electronic record-keeping systems and their implications for healthcare practice. Implementing EHR systems, offering insights into best practices for organising digital records effectively.

Various record organisation methods exist to suit different purposes in different extablishment. These include alphabetical ordering for easy reference, numerical sequencing for streamlined tracking and chronological sorting for historical context. Categorical grouping facilitates research, while geographical organisation is ideal for location-based records. Hierarchical structuring is useful for visualising relationships and digital tagging and metadata enable efficient sorting in digital systems. Additionally, Kavanagh and Phelps (2021) discussed the principles of record organisation in health information systems, highlighting strategies for

organising records to improve efficiency and accessibility which will cover a broad range of healthcare management practices, including record organisation and provide context for the integration of these practices within healthcare management frameworks. Records organisation systems offer advanced features for specialised sorting and indexing. The choice of method depends on the specific needs and goals of the record-keeping system, ensuring optimal organisation and accessibility. However, Collier (2020) highlighted various methods or approaches to managing patient records effectively and for easy retrieval of their records which include: Alphabetical organisation, numerical organisation, chronological organisation, categorical organisation, color-coding and digital storage.

Alphabetical organisation arranges records by patient name or surname, while numerical organisation uses patient ID or medical record numbers. Chronological organisation organises records by date of service or admission and categorical organisation groups records by category (infectious and non-infectious diseases), such as diagnoses or procedures. Color-coding uses visual label or tabs to categorise and organise records and digital storage uses electronic system, like electronic healthcare records (EHRS), to securely store and mange records. Those methods help healthcare providers efficiently manage patients' records, streamline clinical workflows and enhance overall healthcare services to patients with infectious and non-infectious diseases. By implementing these methods, healthcare centres can ensure that patient records are accurate up-to-date and easily accessible, supporting informed decision-making and high-quality patient healthcare services especially patients with infectious and non-infectious diseases. ISO (2021) stated that reliable records organisation methods must satisfy the following requirements: Routinely capture all records within the patients with infectious and non-infectious diseases in the healthcare centre, organise the records in a way that reflects all the necessary information about patients with infectious and non-infectious diseases, Protect the records from unauthorised alteration or disposal, routinely function as the primary source of information about actions that are documented in the records and provide ready access to the records and related metadata of the patients.

Advantages of Records Organisation

Effective record organisation provides significant benefits for healthcare services, especially for patients with illnesses. It enhances patient care by ensuring accurate and timely access to medical histories, test results, and treatment plans. With comprehensive and up-to-date records, continuity of care improves, allowing for seamless transitions between healthcare providers. Additionally, standardised documentation reduces errors and minimises test duplication, leading to greater efficiency. Better disease management is achieved through tracking vital signs, medications, and lab results. Patients are more engaged and empowered due to secure access to their personal health records.

Similarly, Comeford (2018) alluded that, the purpose of records organisation is to provide evidence of the quality of patient care. Other important information accessible from health records provided they are properly managed include patients' history, medical prescription, medical processes adopted, decisions made, actions agreed and sometimes where there is disagreement, who is taking decisions and who is agreeing to the decisions, among others. When these are done, they provide a platform for continuity of care among several health practitioners to measure and determine the patients' past and current health conditions.

Furthermore, data-driven decision-making and evidence-based practices contribute to improved health outcomes. Communication among healthcare teams becomes more streasmlined, reducing misunderstandings and delays. Clear documentation also helps to

decrease medical errors and adverse events. Compliance with regulatory and accreditation standards is maintained, and reliable, organized data supports research and quality improvement initiatives.

Disadvantages of Improper Health Record Organising

The organisation of patient records in healthcare centres has several notable disadvantages that hinder effective service delivery. High costs associated with the implementation and maintenance of these systems pose a significant barrier. Additionally, healthcare professionals often resist changes in the workflow and documentation processes, which can further limit the system's effectiveness (Healthcare Information and Management Systems Society, 2020). There are also significant cybersecurity risks that can compromise patient confidentiality. Information overload can make it challenging to locate relevant data, ultimately decreasing productivity.

Technical problems, such as system downtime or software issues, can obstruct access to essential patient records. The limited interoperability between different electronic health record (EHR) systems impedes seamless data sharing. Moreover, these record systems can increase the administrative workload on healthcare professionals, taking time away from direct patient care. There is also a persistent risk of data entry errors, which may lead to medical mistakes.

Effective Methods of Health Record Organisation

Effective record organisation in primary healthcare centres is crucial for delivering high-quality patient care. Successful methods include: manual systems such as alphabetical filing, numerical filing and color-coding. Electronic Health Records (EHRs) offer integrated systems (Healthcare Information and Management Systems Society, 2020), cloud-based storage and mobile access. Hybrid systems combining manual and electronic methods, such as scanning and imaging and barcode scanning, also enhance organisation. Problem-oriented medical records (POMR) and source-oriented records provide additional structure. Best practices include standardizing processes, ensuring data quality, providing ongoing staff training, and conducting regular audits. By implementing these methods, primary healthcare centers can improve patient care, reduce errors, and enhance operational efficiency**.**

Conclusion

Efficient record organisation is vital for providing high-quality healthcare services in primary care settings. Implementing standardised record-keeping protocols, utilising electronic health record (EHR) systems, and ensuring continuous staff training are key to enhancing patient care, minimising medical errors, and boosting operational efficiency. Successful execution involves collaboration among healthcare stakeholders, investment in necessary infrastructure and technology, and fostering a culture of data-driven decision-making. By focusing on record organisation, primary healthcare centres can improve health outcomes, increase patient satisfaction and lower healthcare costs. Ultimately, well-organised records allow healthcare professionals to concentrate on delivering compassionate, patient-centered care.

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APPRAISAL OF NIGERIA'S BENUE-SOUTH INDIGENOUS COMMUNICATION MODES, SYSTEMS AND APPLICATIONS FOR SUSTAINABLE DEVELOPMENT

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Abstract
This paper investigated how indigenous communication has been used to provide rural development activities on having access to information, knowledge needed to improve lives, respond to opportunities and challenges of; social, economic, cultural, political and technological changes in Benue-South of North-Central Nigeria. The study surveyed how indigenous communication modes and systems can be used to bring development to rural dwellers and the challenges involved. Diffusion of Innovation, Trado-Modern Communication Model and Strategic Entrepreneurship Model were used as theoretical frameworks. The paper adopted a qualitative research method making use of extensive literature review of articles, journals, periodicals on indigenous communication as well as Participant Observation with research assistants to collect data of questionnaire items of four research questions from 627 purposively sampled respondents. The findings revealed that usage of the communication needs to be more empowered through active use in the speech communities to ensure development in areas of access to information on healthcare, agriculture, economy technology and politics. Governments and Non -Governmental Organizations have to use indigenous communication to guide the people on development programmes. The study recommends an all-consuming approach to channel development programmes in the rural areas through; artificial intelligence in the broadcast and print media in interface with folk media as well as online journalism using indigenous language of the speech communities for physical and non-physical developments of the communities.

Keywords: Indigenous, Communication, Entrepreneurship, Development

Introduction
Language use in communication facilitates engagements within and between groups of people in speech communities. It allows for exchange of ideas and information for developments which are important repositories of different cultural values, knowledge and skills. Loss of language use in communication can threaten communication identity but its effective use can bring about peace and development because the world today is controlled by ever -improving information and technology revolutions (Nwocha;2004).

Furthermore, indigenous communication is an aspect of communication that uses the native language that is indigenous to the local people in their speech communities. It is used in rural communities for communication because it ensures communication fidelity in the speech communities. It is also called folk media, traditional modes of communication or oramedia (Wison;2000). Folk media were used in many rural societies before the introduction of

urbanized mass media for communication. There are still in used today in the indigenous communities of the Benue South of North-Central Nigeria. They are used for effective communication to maintain stable systems of information dissemination as well as positive mobilization for communal development. Amadi (2000), explains that their messages often have adequate explanatory ways on specific news and information. He added that the explicitness of the messages enables the audience to have enough details about each event and to clear possible areas of conflicts.

As good as these folk media are, one of the questions that comes to mind is on how they can be used to bring development to the rural populace in the 21st century Nigeria.

Rural development which encompasses noticeable changes in improving the quality of life and economic well-being of the people is seriously needed in this part of the North-Nigeria.

This is because participant observations revealed; the poor states of infrastructure in the rural areas. It has halt sumptuous of social-economic activities which has forced a lot of capable and potential skilled youths and individuals to out-migrate to areas where their potentials could best be exploited(Moses,2014).

This scene also has adverse effects on the idle youths who have resolved to stay in the rural communities irrespective of poor healthcare, un- healthy water, unstable power supply and poor formal education as well as all other indices of emerging and modernizing economies. The youths resort to drunkenness (brukkutu, dry gin), drug abuse and other social vices because even their modern communication tools of radio, television, newspapers, internet, phones and the social media which should be reinforcement of their communication

Identity as well as channel of mobilization for development are largely inadequate. They largely rely on their indigenous modes of communication which solely is not able to encourage them to acquire the development they need.

The Benue-South rural regions of Benue State are typically backward in terms development and in fractural progression.

These rural areas of the state and the units of this study are only known as agricultural societies. This is because agriculture is cherished and practiced in large quantities using human physical strength.

However, the land is infertile and without the use of chemical fertilizer to retain soil fertility. Beside, this difficulty,there is increasing cases of the incidence of farmers and herders confrontations, land fragmentations and land disputes due to too much preference that are attached to local settlements of the dwellers .in addition, roads linking the farms, are character eristically poor and mostly not motorable. The rural farmers equally do not have modern farm storage facilities like silos and thus they sell their produce at the instance of harvests (Biko,2003).

Furthermore, the visible healthcare and primary health care are very few. Some villages do not even have them and they only rely on small patent stores which are mostly owned by business owners and quack medical practitioners.in the term of education, few unkempt primary schools are seen. The schools are characterized by few personnel's, subtended structures, scanty classrooms, poor working environments in terms of small-spaced offices,

on-existence of laboratory for science experimentation, libraries and sporting facilities unlike the once in the urban areas (Andvig). This necessitates entrepreneurship and its skills-a process in which individuals pursue opportunities, fulfilling needs and wants through innovations, together with the attendant risks. Thus, entrepreneurship is a careful process of determining and analyzing unmet needs and creatively satisfying those needs.

Thus the premise upon which this study is motivated and appraised are; communication of the folk media in indigenous Benue- South indigenous communities to keep it alive in the speech communities, preserve the Idoma language and culture as well as use it for development in order to make life better for the rural people.

Brief History of Benue-South People of North-Central Nigeria.

Aig-imoukhuede (1981) in Ejembi (2006) states that geographically the progenitors of many of the ethnic groups that inhabits Benue State today were associated with the rise and fall of the Kwararafa Kingdom. He explained that Kwararafa under the Jukun leadership was a confederation of many ethnic groups which in a number of ways, layed the foundation of present-day Benue State and the neighboring states like; Plateau, Taraba, Kogi, Nassarawa and Cross River States. The modes and traditional communication systems of these areas of the Benue -South appraised were; Ado, Adoka, Oturkpo, Ohimini, Otukpa, Outounku and Ogbadigbo.

Theoretical Framework

This paper used a triangulation of theories in appraising the subject matter of the study. This study is firstly anchored on the Diffusion of Innovation Theory by Everett Rogers in 1962.The theory states and explains how, why and at what rate new ideas, technologies or innovations diffuse or spread (Rogers,1962). Base on this theory, with groups of people successfully adopting to the new idea or technology its spread eventually reaches the remotest level. The aim of diffusion is that people as a social system, adopt a new ideas, behaviors or product. Even though the adoption happens in process of; innovators, early adopters, early majority, late majority and laggards, this theory is relevant to this study because Strategic Entrepreneurship model and new media technology has become indispensable in channeling development to rural communities using indigenous communication.

Secondly, the study is underpinned by Trado-Modern Communication Model by Des Wilson (2000). Wilson, (2000) states that the Trado-Modern Communication Model is a combination of traditional communication technology with modern media hardware in a manner that both complement each other. Wilson (2000) model is a four stage processes. This according to him comes from a clear recognition of the fact that both folk media and modern communication media system operating separately in a social cultural environment has failed the objectives which has been set for it. This Model is useful in diffusing new entrepreneurship ideas through, oramedia for development in the rural environments.

Lastly, The Strategic Entrepreneurial Model is adopted for this study. The mode was developed by HIitt and his group in (2003). Joice (2004) explains that the model ensures; strategic mindset, entrepreneurial culture, managing resources strategically, applying creativity& developing innovations, competitive advantages and finally creating wealth. This model is useful to this study because the people have to be guided through their indigenous communication with the contents of the strategic entrepreneurship model.

Purpose of The Study

THE ultimate purpose of this study is to appraised the indigenous modes and systems of the Benue-South rural people of North- Central Nigeria and find out how they can used to express the communicative identity of the people and be used to bring development to the people. Specifically, this study will;

I. Ascertain how the oral media can be used to express the communication identity in the Benue -South speech communities.
Ii. assess how indigenous communication can be used to bring development to the rural communities.
Iii. find out ways by which folk media can be used to encourage economic growth in the communities.
iv. find out factors mitigating use of indigenous communication for developments in the area

Research Questions

I. How can the people improve on the usage, preservation and expression of their folk media as a communication identity?
ii. What are the various ways of developing rural dwellers and their environments using the folk media?
iii. What are the various factors constraining the effective use of the folk media for rural development?
iv. In what way can the rural dwellers mitigate challenges of poor economy using modes of their indigenous communication?

Review of Related Literature

The most distinguishing features of human languages is their capacity for productivity and creativity as demonstrated by unlimited ability to communicate myriad experiences, express new ideas and embrace with discoveries (Hockett,2020). This is in consonance with communication which is a necessary tool in any given society. This is because communication motivate and create a conducive and an enabling environment where people would want to organize themselves for peace and development in their communities. It is essential in every aspect of life because it brings about easy and effective development.

Added to this is the fact that communication is as old as man. Communication activities in the rural areas enable easy transmission of information between individuals as well as their communities. Wilson (2000) puts indigenous communication in these words;

'It is the product of the inter play between a traditional community's custom. and conflicts, harmony and strive, cultural convergences and divergences, culture specific, tangibles, interpersonal relations, symbols and codes and moral tradition which include mythology, oral literature, (poetry, story-telling, proverbs) masqurades, witches, rituals, rites, music, dance, drama, cust umes and similar abstractions and artifacts which encompasses a people factual symbolic and cosmological existence from birth to death.

Selected Verbal Aspects Benue-South Indegious Communication

When we glimpse ourselves from the perspective of getting along with others, effective is not just incidental to being humans, it is at the very core of our lives in both rural and urban societies. This is because "Whatever agreement or assent that is arrived at in human affairs… is reached by linguistic process—Benjamin Lee Whart.

Spoken words of language of the Benue -South people of North -Central Nigeria is the Idoma Language. The Idoma Languge is in the Niger -Congo phylum. The native speakers are found in; Africa, Central Africa, West Africa and below the Sahara. The phylum is further divided into groups including; West Atlantic, Mande groups of West African languages, Benue-Congo group of languages and Adamawa -Eastern branch of languages (Ejembi,2021).

One of the verbal aspects of the Benue -South indigenous communication is in the names given to people and places, Names given to people and places means more than an identification marks. Observations, revealed that the Idomas distinguished between one name and another according to the source and circumstances of the naming. Ajayi (2004) observes that African names are pregnant with deep meanings and that they have social significance. This is because the names communicate the aspirations and values of the people for development.

Names given to this part of the Benue South rural communities using their indigenous communication are classified into three major areas. The areas are;

1. God, for example Owoicho -literally means the name for God
2. Ground, for example; Ajene
3. Lineage, example, Igbaha.

Sofuola (1972) in Ejembi (2010) makes a similar classification of Yoruba names. Eg Oluwa Fumilayo -God has given me joy. Omolaye –Offspring is life and Owotomo -money is not as valuable as children.

Greetings is another source of indigenous oramedia. Greetings were observed to be a daily celebration of one's presence. The Benue-South rural people take greetings very seriously. Participant observations revealed that when people meet, they celeb rate their encounters through greetings. Greetings are made to suit all kinds of occasions. The salutation of the Benue -South rural people as indeed many African people may be too long, too loud, and too elaborate in the eyes of the westerner. When friends or relations meet, their greetings involve enquiries about each other's health, family and states of their economic activities.

Visits are very critical aspects of the indigenous communication. Visits go a long way in fostering relationships bet ween friends and relatives. Within the Benue-South rural dwellers the understanding of brotherhood that exist the people is communicated through different types of visits. During such visits conversations take place over local drinks "kunnu", kolanuts or a calabash of local palm wine. Multiple kinds of information are exchange for the development of the individuals and the community.

Proverbs used in such conversations are often loaded with metaphors and allegories which are easy to memorize. The proverbs used as the store house of communicating wisdom for developments. Good communicators who can skillfully use proverbs are usually welcome to social gathering of the rural people and are invited to speak for peace and progress of the community.

In social gatherings singers and musicians are often invited to entertain and inspire the people. But the songs communicate instructions and challenge the audience to the physical and psychological development of te community. It was observed that the songs are largely philosophical and there spur the audience to dancing, singing and other activities of developments within the communities. The songs urge the community to live in peace as well as uphold the dignity of the human person.

A close examination of the Idoma folk tales revealed that they are humanistic. They are made up tales and riddles and they present the world in a realistic manner. They communicate the presence of evil and good and they eventually point to the triumph of good over evil for human progress. Folktales activities in the Benue-South rural region are usually done in the night before bedtime.

Religious centers are also sources of indigenous folk media. The religious centers like the churches and the mosques are places of gossips and fashion centers. They are also places of worship where group norms or attitudes are either changed or reinforced. In the religious centres the officiating minister uses the oramedia of the rural communities to give important announcements as well as carry out worship activities in the religious centers for the development of the rural communities.

Ugboajah (1977) in Ejembi (2010) describes the importance of the market in the lives of the African people. He explained that the market place can offer the place and time utility for integrative communication and perform the function of a confluence of the functions of multiple communication streams. Wherever people meet to buy and sell, to converse and salute, to haggle and bargain products and services becomes the market

Equally, important is the role of the town crier in traditional modes of communication village town crier typifies the model communicator who possesses both empathy and cultural undertaking of his audience. The town crier in traditional communication stops at strategic points in rural communities to give out information in the indigenous language of the community.
The non-verbal aspects of the indigenous modes and systems of the Benue-South rural people includes; stones, plates, masquerades, dance, extra-mundane communication, rites, rituals, customs, and witchcrafts among others.

Be that as they are, the traditional modes of communication have so many limitations that they can hardly ensure developments in the rural areas of the Benue-South people. Some of these limitations include the following;

1. Lack of a standard technical vocabulary in the description, analysis and conceptualization of the media models as well as the process of the traditional communication.
2. Absence of appropriate language s which can be universally applied to all similar or identical concepts.

3. The diversity in the traditional political system in Africa societies and the conflicts between them and the adopted system usually requires the use of western media structures, policies and facilities.

4. Hardware of the media can easily be replicated but they cannot be preserved—a scientific and technological problem.

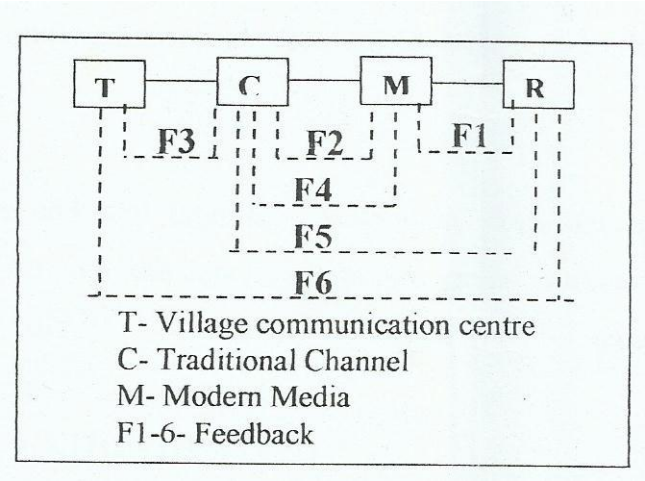
5. Ineptitude of traditional society's technology to transcend space and other barriers in the manner as communication satellite, creates the apparent difference in time value of information between western and traditional communication system

6. The traditional system is complex and needs to be understood for it to be integrated into modern media system and artificial intelligence.

7. The technology of indigenous communication' s arts, principles and practices are problematic because the languages and dialects are not standardized. The idea of creating a universal awareness seems impossible.

8. Urbanization and noise are a problem to the traditional media. Some facilities like high sounding music equipment and cacophonic of blare of vehicles restrict access to traditional media messages

To find solution to these challenges Wilson (2000) suggests an interface through his model of Trado-modern communication model. The trado-modern model of communication is a combination of traditional communication technology with modern hardware in a manner that both compliments each other.



Thus, to ensure developments in the rural areas, modern mass media as well as the artificial intelligence need to work in harmony with the indigenous modes and systems of communication in the rural areas of the Benue-South. But how?
Diffusion of Entrepreneurial Skills through Benue-South Folkmedia; A Sine Qua Non of Effective Rural Development

Twenty- first(21st) Century globalization has increased competitions and lack of relevant skills have led to slower economic growth for developing countries (Paru,2016). This position is even made more pathetic in rural communities of developing countries and by the concentration of national economic developers on educational certificates of job seekers. This, had its beginning in the colonial era, where the Nigerian state was 'pigeon-holed" into white collar mentality-driving the mad rush for educational qualification as the only bench mark for gainful employment in a productive venture or government establishment (Nwammeza;2021). This inappropriate background created room for white collar job psychosis thereby killing the interest and zeal for psycho-motive development of dwellers in the rural communities.

A panacea to this under-development can begin to introduction of entrepreneurial skills in the rural areas using the indigenous communication folk media. The researcher points out that if the 4th "E" of the word "Entrepreneurship" and only the only "E" in the word oral-media is to be effective for development then usage of the skills is the most appropriate solution. This, necessitates clamor fo paradigm shift into psycho-manipulative development of rural ties'

experiences for gainful and self-sustainable engagement through the oral media in Strategic Entrepreneurship model in the following ways;

1. Entrepreneurship mindset

Rural dwellers in the Benue-South need to develop entrepreneurial mindset to meet their needs as well as the needs of the communities. Such mindsets can be conscious efforts of entrepreneurial leaders of the communities. When the mindsets are planned taking into cognizance the needs of the community as well as what the community has in abundance, it has to be communicated to the people using the folkmedia. Such entrepreneurial mind set was developed by Nigerian business industrialist Aliko Dangote who was once a rural dweller (Nwanmeze,2021).He started his business in commodities and building materials in 1977 before moving to Lagos to continue his business to grow to an industrialist.

2. Entrepreneurial culture

A culture of entrepreneurship has to be developed in the rural communities. Stakeholders of the communities have to introduce the culture through the folkmedia in modern media technologies like the radio and the television. A good example of a political entrepreneurial stakeholder who transformed the common people of South Africa from common people into extraordinary people was Nelson Mandiba Mandela(South Africa's first black p resident,1994-1999).The stakeholders in the rural communities as well as those from the the community that live outside the community can use the various traditional modes of communication like speeches in the language,proverbs and provision of material objects to inspire the rural people to development and greatness.

3. Managing resources strategically

Proverbs and folk tales of oramedia in modern media technology can be used to guide rural people on how to manage their resources meaningfully. This can be down by laying emphasis on the need for survival and to change with the world for survival. Development in this area can also be achieved by welcoming ideas from in and outside the communities as well as being pragatic about the ideas in managing the resources strategically for development

4. Creative Leadership.

Creative leadership is needed in the Benue -South rural communities for development. Such leader should have high level of vision and cognitive power. They will help the leader to manage the community appropriately by using the folkmedia that can be used to bring faster development to the community. Leadership that can put economic development as top priority and embrace free trade and security for the people by ensuring that experts on various professions are put in their appropriate places to pragmatically carry out development using the most appropriate modes of communication

5. Applying Radical Economic Transformation

Socio-economic changes in the Benue-South rural area have to do with management to curb rampant corruption, ethnic conflicts within the communities, waste and mismanagement of harvested crops and economic trees. This can be carried out by demonstrating the prudency and punishing offenders to scare off potential offenders as as as educating the populace using the media

6. Need of Strategically thinking

Strong strategic thinking is required to bring development to the rural people. The strategic thinking can be based on labor-intensive import substitution, to labor-intensive export-oriented, manufacturing, to shift the rural economy to high end products, focusing extensively

on health agriculture, human capital and rural technology. This equally applies to the ability of knowing the appropriate media to use in inspiring the people.

7. Instilling Communitarian feeling for Development.

Rural communities can be developed by using trado-modern communication and ideals of communitarianism. This is contained in Confucian ethics which emphasized the community/society/nation, over the individual with respect for meritocracy and achievement. Communitarian feeling has to do with been patriotic about the survival and sustainability of the community.

8. Leading by example

Entrepreneurship skills is the corner stone of development in the rural areas but such development can be motivated and inspired by leadership by example. Rural communitarian leaders ought to demonstrate development of their communities by setting examples of highest degree of hard work, efficiency, honesty, inspiration and involve in the development of their communities from the beginning to the end.

Methodology

The study was empirical using descriptive study design. According to Nworgu (2015) the design allows the collection and analysis of data from only a few people or items considered to be representation of the entire group. This study was carried out in the Benue-South of Benue State of North-Central Nigeria. The region consists of seven local government areas and they are of the same ethnic group called' The Idoma Nation' of The universe of the population is the entire people but the sample of the study is made up of two hundred and seventy stakeholders. They were made up of politicians, village heads teachers and business men and women within the communities. Thirty-eight respondents were purposely selected from each of the seven local government areas and four communication scholar and four experts on entrepreneurship in the urban areas of the Benue -South were equally selected for the study. The questionnaire was constructed on Liket scale of (strongly agree, agree, and strongly disagree). The questionnaire has two sections. Section A sought to elicist information on the respondents' personal data of age, gender, knowledge and use of folk media, modern media as well as usable entrepreneurial skills for rural development. Section 'B' was made up of four clusters with items from the four research questions. The questionnaire was titled 'Developing Rural Areas, Using Indigenous Communication Interface with Modern Media in Entrepreneurial Skills Acquisition The instrument was validated by experts in the Faculty of Communication studies University of Portharcourt and tested for reliability using Cronch alpha with index of 0.81,0.86,0.72,and 0.83 individually for each of the four clusters with overall coefficient index of 0.834.This shows that the instrument was reliable and good to be used for the study. The researcher distributed two hundred and eighty (280) questionnaire items with the help of trained research assistants. Two hundred and seven one were retrieved but only two hundred and fifty(89.3%) were usable for computation. The data were analyzed descriptively with frequency count, percentage, mean, standard deviation and the hypothesis were tested using t-test of 0.05 level of significance.

Results

Research Question 1; How can the rural dwellers improve on usage and preservation of their folk media.?

Table 1; Respondents'mean ratings on how to use and preserve the media.

S/N	item	X	SD
1.	usage of the media actively.	3.08	1.67
2.	standardization of the language.	2.86	0.73
3.	use oramedia in modern broadcast media.,.	2.75	0.54
4.	stakeholders work to preserve language	2.77	0.63
5.	loyalty to the folkmedia,	2.61	0.70
6.	populization	3.24	1.46
7.	positive attitude of media staff	2.83	0.88
8.	inter-face of oramedia and modern media.	2.85	0.79
9.	folkmedia education.	2.66	0.72
10.	reducing spoken words to writing,	2.81	0.74
Grand mean		2.85	0.88

Source: Appraisal of folkmedia for rural development, 2024

The responses presented on the table revealed that all the respondents agreed on how to use and preserve the folk media. The items ranged from 2.61 to 3.24 with a grand mean of 2.85 and standard deviation of 0.88 with the aggregate mean score of 2.85 above the mean of 2.50. This means that all the respondents agreed the items above are always s by which the folk media can be used and preserved as a communication identity of the indigenous people

Research question Two

Table two; various ways of development using folkmedia.

S/N	ITEMS	X	SD
1.	Inspire the rural populace on development.,	2.69	0.61
2.	emphasize creativity and innovations of development by using proverbs.,	2.74	0.88
3.	give development news using folkmedia.	2.81	0.74
4.	advertise goods and services through folkmedia.,	2.60	0.72.
5.	carry out public relation by interpersonal talks.,	2.70	0.69
6.	give traditional sports and entertainment.,	2.83	0.88
7.	mobilize people at grassroot for developments,	2.85	0.79
8.	educate people through cultural groups,	2.86	0.73
9.	create health and security consciousness.	2.75	0.54

10	encourage mores and positive attitude.	2.77	0.63
	Encourage agricultural produce and good storage	2.61	0.34
	Grand mean	2.75	0.68

Source: Appraisal of folkmedia for rural development, 2024

The result on table two shows the various ways in which the folk media can be used to carry out development in the rural areas. The respondents all agreed that development can be carried out through the various above with education of the people having the highest mean of 2.86 and advertisement of goods and services having the lowest mean of 2.60

Research Question Three; What are the factors constraining effective use of oramedia for development?

Table three; Factors constraining effective use of oral media for development.

S/N	ITEMS	X	SD
1.	inapproprate use of diversity of political system	2.19	0.61
2.	non-standization of oramedia for development	2.74	0.88
3.	unskill use of oramedia to encourage creativity and innovation for entrepreneurial skills	2.81	0.74
4.	ineffective use of oramedia to instill entrepreneurial mindsets.	1.79	0.54.
5.	poor government efforts in development programmes.	2.71	0.69.
6.	ineptitude of oral media unlike modern western media.	2.87	0.88
7.	poverty of rural socio-economic environment.	2.56	0.79
8.	inability of rural communities to emulate other rural communities that are more develop.	3.00	0.54.
9.	lack of entrepreneurial sponsored activities.	2.98	0.83
10.	rural communities' poor system of recognizing successful people of the community and appealing for development.	2.60	0.72.
	Grand total	2.62	0.72

Source: Appraisal of folkmedia for rural development, 2024

Table three above mean responses on factors constraining use of folk media for development from items 1-10. The grand mean is 2.62 which indicates that these factors actually have enormous effects in determining how the oramedia can be use for effective development in the rural areas. The highest mean is on lack of entrepreneurial sponsored activities in the rural areas.

Discussion of Finding.

The respondents accepted the items as means by which they can use and preserve their folk media as their indigenous communication identity. The high mean scores are on 'Populization" and on active use of the folk media in the speech community. This findings is in agreement with Wilson (2000) that the oramedia can be preserve from extinction by active usage in both

interface of the western media hardware and traditional media as well as various speech communities.

The findings on ways of developing the rural communities revealed that there are several ways of developing the communities using the oral communities. The high mean scores are on using the folk media to spread news on various types of developments and using the oramedia on public relation activities in interpersonal communications. This finding agreed Bohan (2009) He highlighted that development of the human person in all societies comes from information on and how it is communicated to ensure its fidelity as well as its impacts. Usage of the media, ensures understanding and thus any development information that is effectively communicated with the appropriate resources, can be committedly carried out to ensure development.

On the factors constraining effective use of the media and entrepreneurship skills for developments the mean scores revealed ineffective use of the oral media to instill entrepreneurial skills. This is in consonance with Wadhwa (2010) that such skills can enable one to be self -employed so as to achieve greater personal freedom and ample time to carry out bigger development efforts in the community.

Conclusion.

Success in preserving our indigenous languages and their various modes of communication begins with active usage and making them known in the various channels of the print media as well as the broadcast media. The rural communities can equally be develop through efforts of the government and spirited individuals but above all by educating the people on entrepreneurial skills. Negative attitudes to accept and use this reality in rural environments have serious negative implications on developments.

Recommendations

In consideration of the findings, the following findings recommendations are made;

1. There should be true commitment and demonstration of true commitment by active use of the oramedia in the speech communities and its publications in both the print and broadcast media to preserve it from extinction in this era of globalization.

2. Entrepreneurial skills should be introduced using the folk media to the people and entrepreneurial mindsets should be instill in the rural populace to carry out developments in the communities.

3. They should emulate communities that have demonstrated more developments than them in the areas of health, roads agriculture, infrastructure and security. They should learn their methods and try to see how they can apply them to their own communities

4. Stakeholders in rural communities should attract developments from; Governments, Non-government Organizations, successful business industrialists during various festivals of traditional modes and systems of communication.

5. Modern mass media and online should interface with the folk media to encourage entrepreneurial mindsets on both urban dwellers and rural people to develop rural environments.

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ENTREPRENEURSHIP EDUCATION CURRICULUM CONTENT AND NEW VENTURE CREATION AMONG GRADUATES OF HIGHER EDUCATION INSTITUTIONS IN NIGERIA.

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Abstract
The positive *impact of a strong and vibrant entrepreneurship-driven private sector on the economic and social development of nations, has led to countries' development and implementation of policies, programmes, and strategies to encourage individuals and groups' participation in entrepreneurial activities. In Nigeria, one such policy is the compulsory introduction of Entrepreneurship Education (EE) in the curriculum of Higher Education Institutions (HEIs) by their regulatory bodies aimed at producing graduates who will be self-employed, reliant, and job creators. More than a decade since this policy was implemented, the rate of graduate unemployment in Nigeria has been experiencing exponential growth. It is against this background that this paper discussed the extent to which the entrepreneurship education curriculum content promotes new venture creation among graduates of Higher Education Institutions in Nigeria. The study observed that due to the multidisciplinary interest in the field of entrepreneurship which gave rise to multiplicity of objectives the development and design of EE curriculum content have been faced with some challenges. Also, students are not able to get the needed confidence, commitment and drive for the achievement of entrepreneurial goals and aspirations on graduation. Notwithstanding, effort should be made to make available a well-defined objective and an appropriate means of evaluating the success achieved through feedback from students which can be fed into the content development process and review.*

Keywords: Entrepreneurship Education (EE), entrepreneurship education curriculum, self-reliant, Higher Education Institutions (HEIs)

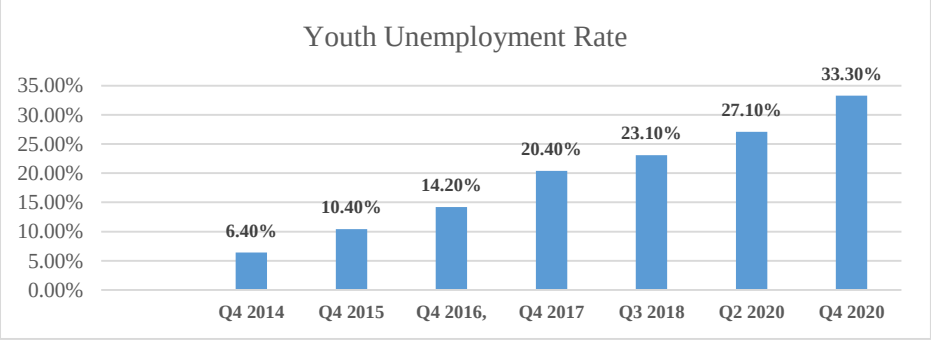
Introduction
The positive impact of a strong and vibrant entrepreneurship-driven private sector on the nation's economic and social development cannot be overemphasised. This has led various countries of the world to shift attention from over-dependence on paid employment towards promoting self-employment and the creation of new ventures (Adewumi, 2021), thereby, developing and implementing policies, programmes, and strategies to encourage individuals and groups' commitment to entrepreneurial activities in form of new venture creation (Ukachukwu and Naetor, 2020).

For instance, many developed countries like the Chinese government, had since 2002 launched policies that streamlined business registration and tax reduction for startups to encourage university graduate startups. They also implemented the integration of entrepreneurship education into Chinese University programmes, to promote the development of entrepreneurial skills that will enable University students to start businesses and create job opportunities for others, thus relieving the pressure for government jobs (Yuan *et al*, 2020). Similarly, Kenya launched "Kenya Vision 2030" to develop entrepreneurial skills among its citizenry (Wambua *et al.*, 2020).

In Nigeria, several policies and programmes have been launched by successive governments to encourage its citizens, mainly youths, to acquire entrepreneurial skills and knowledge that will enable them to engage in entrepreneurial activities that will promote self-employment and as well generate employment (Ukachukwu and Naetor, 2020).

One such policy launched is the mandate given by the Federal Government of Nigeria, through the Ministry of Education to the National Universities Commission (NUC) which is the agency that oversees the administration of Universities in Nigeria to enforce the compulsory introduction of entrepreneurship education in the curricula of all Nigerian Universities, which took effect from the 2007/2008 academic session (Sulaimon, 2020; Brimah, 2021). Similarly, the National Board for Technical Education (NBTE) which is the regulatory body that oversees the educational programme for Polytechnics in Nigeria also enforced the introduction of compulsory entrepreneurship education in their curriculum starting from the 2008/2009 academic session (Onyesom, 2017). This was made mandatory for all undergraduate programmes offered in Nigerian tertiary institutions and it is aimed at reducing graduates' unemployment by equipping students with entrepreneurial skills, knowledge, and competencies that will enable them to diversify businesses, create employment rather than be job seekers (Onyesom, 2017; Sulaimon, 2020; Brimah, 2021). EE is offered in all universities in Nigeria as General Studies courses (GST) - GST 223 - Introduction to Entrepreneurship and GST 311 – Entrepreneurship (National Universities Commission, 2018). While in Polytechnics as EED 126 - Introduction to Entrepreneurship; EED 216 - Practice of Entrepreneurship and EED 413 - Entrepreneurship Development.

It is more than a decade since the introduction of the compulsory EE into the curriculum of HEIs' in Nigeria, and it is expected that 16 years (2007-2023) and 15 years (2008-2023) of Universities and Polytechnics' implementation of these policies respectively, it would have entrepreneurially empowered the graduates to venture into businesses and create employment, thereby reducing the unemployment rate. However, data have shown that youth unemployment in Nigeria has been experiencing an exponential growth rate with a high turnout of Higher Institution graduates yearly. Fig 1 shows the youth unemployment rate from 6.4% in 2014 to 33.0% in 2020 (National Bureau of Statistics, 2021).



Source: NBS, 2021

Researchers have argued and queried the value entrepreneurship education provides on whether it actually leads to start-ups or only promotes positive entrepreneurial attitudes and intentions as there is a widely held belief that graduates starting businesses immediately after graduation is minimal (Kirkwood *et al.* 2014; Botha and Ras, 2016). According to Sulaimon (2020), the policy so far, is yet to record significant success. Peter *et al.,* (2021) opined that the high unemployment rate increase is due to most graduates lacking the basic entrepreneurial skills to venture into businesses. Fayolle (2013) however, identified that there is no consensus about the best content and approaches to be used in entrepreneurship education despite the growing number of tertiary institutions.

This study aims to discuss the impact of entrepreneurship education curriculum content in achieving the objective of new venture creation among graduates of tertiary institutions.

Review of Literature

Entrepreneurship education

Entrepreneurship education is a type of educational programme designed to inculcate the requisite skills and knowledge individuals need to understand the requirements of the market and customers and be able to recognize business opportunities (Fadzilah and Hussain, 2021). It is what activates the development and implementation of a business plan, networking skills, evaluation of internal and external business environments, and eventual creation of ideas (Fadzilah and Hussain, 2021). Entrepreneurship education is a tool that offers students the ability to think creatively, analyze business ideas objectively, solve problems effectively, and evaluate a given project optimally (Gyan *et al.*, 2015; Msughter and Ahon, 2020). EE aims to produce a behavioural change in the form of measurable outcomes such as graduate startups and self-employment through the development of student's knowledge, skills, and attitudes (Odigbo and Otalu, 2020). Hagebakken *et al.* (2021) believe that entrepreneurship education is a means to create economic activity. Entrepreneurship education, therefore, is to prepare graduates to be successful in their entrepreneurial careers when they set up new business ventures or small and medium enterprises (SMEs) (Nian *et al.*, 2014).

With the high demand for employment over the available job opportunities in most countries especially, developing countries like Nigeria, entrepreneurship education is to bridge the gap between the demand and supply of employment through the creation of new ventures which in turn enhances the national economy (Obong and Okoroma, 2021).

Entrepreneurship education in this study is conceptualized as the mandatory entrepreneurship courses offered by tertiary institutions aimed at inculcating the requisite entrepreneurial skills, knowledge, and competencies that would stimulate the students to be self-employed and be able to create new ventures upon graduation.

Impacts of entrepreneurship education

The criteria of what to measure as the actual outcome of entrepreneurship education have been subjected to a serious debate among scholars (Hahn *et al.*, 2019). Studies have shown that University-based entrepreneurship education has been increasingly recognized to support an array of potential entrepreneurial outcomes ranging from entrepreneurial skills, knowledge, attitude, graduate startups, new ventures, job creation, and finally, contributes to the development and growth of the economy (Nabi *et al.*, 2017). The impact assessment of entrepreneurship education at policy, institutional, and individual levels is necessary because, it would enable the policymakers, educational institutions, or individuals to determine the

extent of accomplishment of objectives and justify its inclusion in the curriculum of tertiary institutions as well as the resources committed to it (European Commission Report, 2012; Alinno, 2020). Prudent assessments of the impact of entrepreneurship education on the expected valuable outcomes from tertiary institutions' undergraduates and graduates have produced mixed and contradictory results that report both positive and negative effects (Hahn, 2019). These inconsistent findings of EE impact studies have been attributed partly or wholly to the inexactitudes in the statistical methods applied, the nature and context of pedagogical interventions, contextual factors (Nabi *et al.*, 2017), and environmental conditions (Walter and Block, 2016). However, a proper synergetic interaction among the different components of EE in designing the programme would effectively increase the desired entrepreneurial outcomes. Nabi *et al.* (2017) broadly segmented the five-level model impact indicators of entrepreneurship education by Jack and Anderson (1998) into two: 1) Lower-level impact indicators referred to as short-term or subjective indicators covered the levels 1 & 2 and 2) Higher-level impact or long term/objective indicators.

Short-term impact of EE:

The short-term impact measures the entrepreneurial interest, awareness, knowledge, skills, attitude, and intention of individuals during the entrepreneurship education programme or pre- and post-programme (Nabi *et al.*, 2017). The lack of these key entrepreneurial competencies (entrepreneurial skills, knowledge, and attitude) has led to the failure of many businesses (Nian *et al.*, 2014). Studies have been carried out to determine the impacts of entrepreneurship education on tertiary institution students and graduates, however, mostly on lower-level impact indicators like entrepreneurial intention (Boahemaah *et al.*, 2020; Peter *et al.*, 2021; Adıgüzel and Musluhittinoğlu, 2021), entrepreneurial knowledge and skill gained (Din *et al.*, 2016; Hahn *et al.*, 2019). Other areas were entrepreneurial perception/ insights (Nian *et al.*, 2014), entrepreneurial attitude (Stamboulis and Barlas, 2014; Murugesan and Jayavelu, 2015), entrepreneurial mindset (Cui *et al.*, 2019), entrepreneurial motivation (Farhangmehr *et al.*, 2016), entrepreneurial orientation (Marques *et al.*, 2018), and entrepreneurial self-efficacy (Shinnar *et al.*, 2014; Kassean *et al.*, 2015).

Medium and long-term impacts of EE:

The higher-level impact or long-term/objective indicators of EE which include numbers and types of new ventures created between 0- and 5-years post programme; the survival of the ventures 10 years post programme; then more than 10 years post programme, employment generated and contribution to the growth of the economy and society (Nabi *et al.*, 2017). This suggests a progression from short-term impact to actual entrepreneurship. However, sometimes it might not come to be, because of the likely time lag between the expressions of intention to start a new venture and the actual entrepreneurial activity (Alaref *et al*., 2019).

New venture creation

As a distinct phenomenon in entrepreneurship, new venture creation comprises the establishment of new businesses, mergers and acquisitions, and advancing the business, among others (Kariv, 2013). It is a function of entrepreneurship and entrepreneurial activities which is synonymous to new venture creation are driven by knowledge or awareness (Doran *et al.*, 2018; Emezi and Emele, 2021). Therefore, a new venture creation entails business ownership, formal and informal investments, nascent entrepreneurship, new business ownership, early-stage entrepreneurial activity, necessity-driven entrepreneurial activity, and new product early-stage entrepreneurial activity (Doran *et al.*, 2018).

NVC are also organizations based on knowledge, with rapid revenue growth brought about by the development of different innovations. It is an entrepreneurial process that connects series of actions and stages from the development of entrepreneurial intention to the realization of a new venture idea based on opportunities emanating from the environment, technology competencies, and other resources (Salamzadeh and Kirby, 2017; Mets *et al.*, 2019). This supports Schumpeter's concept that new venture creation depends on the individual's opportunity recognition process that leads to technological change (innovation and creative destruction) (Salamzadeh, 2015). During the entrepreneurial journey, there is a need to repeatedly assess and reassess the maturity of the venture idea and the process for entry into the market, as a new venture is created only by successfully reaching the market, otherwise, it is only perceived not yet real (Trabskaia and Mets, 2021). A new business venture makes entry into the market, creates value, and exits (Salamzadeh and Kirby, 2017). It is of great national importance due to its inclination to economic growth and development (Awolaja and Ajayi, 2020).

Relationship between entrepreneurship education and new venture creation.

In recognition the link between EE and NVC has led to the increasing interest on NVC in and out of academia due to its importance in the gainful engagement of tertiary institution graduates (Nian *et al*., 2014; Hien and Cho, 2018). According to Olorundare and Kayode (2014), entrepreneurship education promotes self-employment opportunities and under-dependency on white-collar jobs for graduates. That is, EE is a process that manifests itself in the creation of a new venture through entrepreneurial learning (Mets *et al*. 2019).

New venture creation has been acknowledged as one of the expected outcomes of entrepreneurship education (Otache, 2019), which starts with entrepreneurial skills and intentionality (Afriyie, 2016). Kazmi and Nadradi (2017), concord that entrepreneurship education influences students' attitudes and behaviour to form the intention of venturing into business. Though, the intention may be affected by the low level of entrepreneurial activities by graduates (Iwuoha, 2018), but acquiring the requisite entrepreneurial knowledge and skills through EE is paramount for the successful establishment of new ventures (Egerova *et al*., 2016). Entrepreneurship education builds the foundation for successful and stable venture creation (Alinno, 2020). It assists and provides graduates with the platform for the identification, exploitation, and transformation of opportunities into creation of new ventures (Minello *et al*., 2019; Alinno, 2020). Afriyie (2016) observed that adopting the right approach to teaching and learning entrepreneurship education increases individuals' self-efficacy to start and run new businesses. It promotes the creation and growth of small and medium enterprises using entrepreneurial graduates (Moses *et al.*, 2015). Profitable and sustainable business creation is possible only through entrepreneurship education which offers awareness, essential skills, and motivation to the students (Salihu, 2016). Moses *et al.* (2015) observed a well representation of graduate entrepreneurs in the major sectors of the economy. And most new ventures created by graduates are commonly applauded for their potential sustaining effect on industries (Galloway *et al*., 2015). On the contrary, Awolaja and Ajayi (2020) argued that entrepreneurship education has an insignificant positive effect on undergraduates venturing into business.

Entrepreneurship education curriculum content

A curriculum is a document that provides the objectives of the subject, the methods to be applied, the activities to be carried out, the resources required and the suitable assessment procedure (Oforma, 2019). It is the road map that guides the teacher's activities to bring about the desired positive behavioural change in the student (Umezulike and Anozie, 2022).

Curriculum contents contain the expected knowledge to be learned by the students and a guide to be followed in teaching (Andah *et al*., 2019). Achieving the objectives of the course is greatly determined by its curriculum content. The content of the EE curriculum should have the ability to stimulate and enable students to think critically and develop novel business ideas that would help them create new ventures (Olokundun *et al*., 2018; Peter *et al*., 2021). It should consist of the ability of the recipient to manage resources, be creative and innovative, recognize opportunities, create ideas, manage and grow business, take risks, and plan and market business (Daneshjoovash and Hosseini, 2019).

The curriculum content of EE must be contemporary and should involve both theory and practical in the various aspects of emotional, social, marketing, and finance that will take the student rightly through new venture creation and growth (Murray et al., 2018). It should be targeted at enabling students identify opportunities, evaluate business concepts, development of operational plans, source funds, and launch and grow business ventures (Wambua *et al.* 2020). It must be structured according to the student's learning environment and specific field of study (Oluwasanya, 2016). Therefore, the curriculum content of EE should provide a structured source of learning experiences proposed to achieve a positive learning outcome for tertiary institution graduates. The multiplicity nature of entrepreneurship requires that the curriculum content of entrepreneurship education should be structured to incorporate the necessary topics that will help to develop and produce the desired entrepreneurial outcome from the students (Moses and Mosunmola, 2014).

Accepting the fact that EE is aimed at developing entrepreneurial skills and a mindset for life, new venture creation remains the context (Neck and Corbett, 2018

The National Universities Commission (NUC), produces Benchmark Minimum Academic Standard (BEMAS) document for all programmes offered in Nigerian Universities. This document serves as a guide to all universities in designing their curricula in terms of minimum acceptable standards of input, process, and measurable benchmark of knowledge, skill, and competencies expected to be acquired by an average graduate of each of the academic programme (National Universities Commission, 2018). In line with this, the specific objectives of EE with respect to the two mandatory entrepreneurship courses for all undergraduate students in Nigerian universities (GST 223 - Introduction to Entrepreneurship and GST 311 – Entrepreneurship) as specified in the BEMAS are to enable the students:

- understand the relationship of enterprise, entrepreneur, business entrepreneurship, innovation and creativity,
- analyze the historical perspective of entrepreneurship in Nigeria, and relate it to the recent trend of unemployment, underemployment, job dissatisfaction, personal, national, and global economic recession
- identify the roles of entrepreneurial development agencies and regulatory bodies
- cultivate the spirit of entrepreneurship
- correct wrong attitudes and mind-sets and develop high entrepreneurial potential in students
- select possible business ideas
- build the capacity to develop a business plan to start a business (National Universities Commission, 2018).

In a similar manner, the National Board for Technical Education (NBTE) as the body that coordinates the activities of Polytechnics in Nigeria developed and produced the curriculum

used in teaching entrepreneurship education in Polytechnics. Thus the curriculum contents for all the levels are outlined as:

EED 126: Introduction to Entrepreneurship

- Understand the meaning and scope of enterprise and entrepreneurship.
- Understand the history of entrepreneurship in Nigeria.
- Understand the types, characteristics, and rationale of entrepreneurship.
- Understand the role of entrepreneurship in economic development.
- Understand entrepreneurial characteristics and attitudes.
- Understand the key competencies and determining factors for success in entrepreneurship.
- Know the motivational patterns of entrepreneurs.

EED 216: Practice of Entrepreneurship:

- Know techniques for generating business ideas as well as for identifying and assessing business opportunities.
- Know how to evaluate a business idea for developing an enterprise.
- Know methods of product/service selection.
- Understand the process and procedure for starting an enterprise.
- Know the operational techniques in managing an enterprise.
- Understand the various existing industries and support agencies in Nigeria.
- Appreciate the role of commercial and development banks in small and medium-scale industry development.
- Understand the role of personal savings and portfolio investment in National Economic Development.

EED 413: Entrepreneurship Development:

- Understand the history of entrepreneurship development in Nigeria.
- Understand the role of personal savings and portfolio investment in national economic development.
- Understand various life skills needed by an entrepreneur.
- Understand the various sources of information for entrepreneurship development.
- Appreciate the role of commercial and development banks in small-scale industrial development.
- Know the functions of various support agencies in small and medium-scale industrial development.
- Understand the activities of different industrial associations concerning entrepreneurship.
- Know the functional areas of business.
- Understand the need for business planning.
- Understands the strategies for consolidation and expansion of a business enterprise.
- Understand the need for both management and business succession plans.

Some researchers have contested the efficacy of EE curriculum contents in achieving the expected outcomes due to some inherent problems (Nian *et al*., 2014; Ereh *et al*., 2019; Wambua *et al.*, 2020). Adamu (2015), stated that the standard of Nigerian tertiary institutions' entrepreneurship education curriculum content is not different from what is obtainable in other countries of the world though, there may be environmental and cultural differences, the basics are the same. The curriculum involves the why, what, and how of instructions, therefore it

specifies the teacher's activities during learning that imparted the expected skills, knowledge, and attitudes to learners (Ereh *et al*., 2019).

Social Cognitive Learning Theory (SLT)

The Social Learning Theory was postulated by Albert Bandura in 1977. The theory is dependent on the interaction between people and the extent to which they successfully promote emotion and practical skills, shape self-perception and the perception by others (Mwange, 2018). It highlights the importance of observation, modelling, and imitation of behaviours, attitudes, and emotional reactions of others and how environmental factors interact with the cognitive factors to influence human learning and change in behaviour (McLeod, 2016). Bandura extended SLT by linking it with self-efficacy and reciprocal determinism in which self-efficacy is the belief that a person can successfully engage in a behaviour that is required to produce the desired outcome and reciprocal determinism is how the interaction of the individual and environment affect each other in a way that impacts behaviour (Mwange, 2018). Therefore, as it relates to the outcomes of entrepreneurship education, its curriculum content should be structured to ensure students and graduates are to establish symbolic representations of the internal and external processes like the use of business plans, business start-ups by students, behavioural simulations, field trips, video and movie-based learning and consultation with practising entrepreneurs in guiding their actions to achieve the intended behavioural outcomes of the programmes (Fernando and Nishantha, 2019). This implies that learning by getting involved in an entrepreneurship learning environment combined with mentoring processes between older and new instructors can expedite a decision-making process to consider engaging in entrepreneurship and should be considered in curriculum development (Mwange, 2018).

First, the social learning theory is one of the most influential theories of learning and development, with concepts rooted in many of the basic principles of traditional learning theory (Nabavi, 2012). It expresses that learning takes place as a result of a change in behaviour which is due to an individual's interaction with people and the environment to meet change and achieve its objectives (Harinie *et al.,* 2017). Second, the social learning theory made a definitive prediction on the impact of entrepreneurship education as the theory identified that learning leads to insightful and foresighted behaviours as it allows the individual to establish symbolic representations to external influences which can be later used in guiding their actions during a direct experience (Fernando and Nishantha, 2019). It also states that individuals learn from each other as they interact through a mixture of internal and external processes in which they observe, practice and experience the consequences of the behaviour, which can be success or failure (Mwange, 2018). The theorist claims that imitation involves the actual reproduction of observed motor activities. (Fernando and Nishantha, 2019). Third, learning is believed to be an internal process, however, the outcome of learning may or may not result in a change of behaviour and the outcome of learning behaviour could be manifested in everyday behaviour visually and verbally (Nabavi, 2012). Fourth, the predictive power of the SLT has been proven to be supportive of experimental studies (Brauer and Tittle, 2012), and very strong in empirical research (Kruis *et al*., 2019).

Based on the SLT, it is expected that EE which uses entrepreneurial role models, mentoring processes between older and new instructors, business plans, business start-ups by students, behavioural simulations, field trips, video and movie-based learning and consultation with practising entrepreneurs in guiding their actions, is effective in developing entrepreneurial behaviours that are crucial for the achievement of the intended behavioural outcomes of the programme which is a new venture creation and employment generation. However, as

identified in the real world of learning, the outcome of the learning may or may not lead to change in behaviour.

Empirical Review

Uzoegwu and Egbe (2014) examined the challenges and prospects of compulsory entrepreneurship education in the curriculum of Nigerian universities for self-reliance by analyzing the responses of 450 final-year students of the University of Nigeria, Nsukka collected using a questionnaire. The findings from the analysis carried out showed that there are some attitudinal and methodological challenges encountered by the inclusion of EE in the curriculum such as students having the impression that everybody cannot be an entrepreneur and the use of lecture method in teaching the course.

Olokundun, *et al*. (2018) examined the impact of entrepreneurship curriculum content on the entrepreneurial development of university students in Nigeria using data sourced from 50 entrepreneurship educators through structured questionnaire and semi structured interview. Results of the analysis showed that though the curriculum content of entrepreneurship in Nigeria university is able to develop students' critical thinking abilities and business idea generation competencies, it is not able develop the needed confidence, commitment and drive for the achievement of entrepreneurial goals and aspirations of students at graduation. The study recommended the inclusion of real-life scenarios in practical activities in the entrepreneurship curriculum to motivate the development of the drive and commitment required for students to engage in entrepreneurship at graduation.

Summary and conclusion

Globally, entrepreneurship education has been acknowledged as the mechanism to empower youths to fight unemployment and provide lasting cures for extreme hunger and poverty caused by unemployment (Oluwaseun and Gbenga, 2020; Fadzilah and Hussain, 2021). So, it has become inevitably necessary to equip students with entrepreneurial skills and Knowledge so that they will be proficient in their chosen careers and contribute effectively to the economic growth of the nation which is being driven by the private sector (Usoro and Otu, 2020). However, the development and design of EE curriculum content have been faced with a lot of challenges as a result of the extensive coverage of entrepreneurship courses, given the multiplicity of objectives concerning what students should learn and the multidisciplinary interest in the field (Neck and Corbett, 2018; Hagg and Gabrielsson, 2020).

Fayolle (2013) acknowledged the fact that there is still no consensus about the best content and approaches to be used in entrepreneurship education despite the growing number of tertiary institutions. Notwithstanding, an effort should be made to make available a well-defined objective and an appropriate means of evaluating the success achieved through feedback from students which can be fed into the content development process (Oluwasanya, 2016).

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EFFECTS OF WEB-BASED INFOGRAPHICS AND WEB-QUEST INTEGRATED INSTRUCTION ON ACADEMIC ACHIEVEMENT AND INTEREST OF PRE-SERVICE PHYSICS TEACHERS AMONG COLLEGES OF EDUCATION SOUTH-EAST, NIGERIA

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Abstract
This study investigates the effects of Web-based infographics and Web-quest integrated instruction on the learning outcomes of pre-service physics teachers in colleges of education across South-East Nigeria. A quasi-experimental design with a pre-test, post-test, and retention test was employed, involving a total population of 1,014 pre-service science teachers in colleges of education across South-East Nigeria. Participants were distributed into two experimental groups: Group E1 utilized infographics, while Group E2 engaged with the Web-quest instructional platform. The research included a sample size of 338 pre-service science teachers, distributed into two experimental groups: Group E1 utilized infographics, while Group E2 engaged with the Web-quest instructional platform. Data collection involved three validated instruments: the Physics Achievement Test (PAT), Infographics and Web-Quest Instruction platforms, and Web-based Infographics and Web-Quest Integrated instruction Interest Questionnaire (WIIIQ) and (WQIIQ). Reliability coefficients were determined, with the PAT showing a reliability index of 0.76, while the Web-quest and Infographics instruments had coefficients of 0.86 and 0.87, respectively. Data analysis employed descriptive statistics, t-tests, ANOVA, Mann-Whitney U tests, and Kruskal-Wallis tests at a significance level of $p < 0.05$. There was a significant difference in the academic achievement scores of pre-service physics teachers taught using Web-based infographics compared to those taught using the Web-quest integrated instructional platform. A significant difference was found in the interest levels of pre-service physics teachers based on the instructional platform used. Interestingly, the group taught with Web-based infographics showed higher levels of interest compared to the Web-quest group. The study concludes that integrating innovative teaching strategies significantly enhances learning outcomes and recommends further research to explore additional instructional methods and their impacts on diverse student populations.

Keywords: Web-based Infographics, Web-quest, Academic Achievement, Interest Levels, Pre-service Physics Teachers, Colleges of Education, and South-East Nigeria

Introduction
Technology has become a transformative force in education, redesigning ways students engage with and understand scientific concepts. The integration of current technologies in science education provides educators and learners with innovative tools to explore, experiment, and comprehend the intricacies of the natural world (Doyan, et. al., 2021). The dynamic combination of science and technology not only closes traditional accessibility gaps but also introduces a range of engaging experiences that cater to various learning styles. As we delve into the discovery of the current technologies in science education, we embark on a journey to uncover the digital, interactive, and virtual aspects shaping the future of how we teach and learn about sciences (Salihu and Abubakar, 2020).

From augmented reality to online simulations, these technologies can transform science education by promoting curiosity, critical thinking, and a deeper understanding of the scientific principles that form the basis of understanding the world (Mishra, 2018). Technology in science education has come a long way and continues to evolve, providing new opportunities for teachers and students alike, the integration of technology in science education is crucial to prepare students for the demands of the modern world (Pakhomova, et al., 2023). Technology continues to evolve and has become increasingly relevant in the field of science education offering a range of tools for the teaching and learning process. Here are some commonly utilized technologies in science education as Interactive Whiteboards, Smartboards, Online Simulations, Virtual Labs, Augmented Reality (AR) and Virtual Reality (VR), Educational Apps and Games in Science Education,3D Printing, Robotics and Artificial Intelligence (AI), Infographics and Web-Quest (Doyan et. al., 2021). The matter of information organization has emerged as a significant concern in the contemporary day due to the disorder caused by extensive amounts of unprocessed data However, With the emergence of various technological novation and tools as stated above many teachers have adopted the idea of using Web-based infographics and Web-quests to effectively use the Internet in the classroom but no literature has shown the impact of the combination of the two innovative approaches to effective teaching and learning of physics among preservice physics teachers in Southeast Nigeria.

An infographic is more than a collection of visuals and data; it is a medium for creating links. Infographics provide an excellent way to interpret facts and knowledge and to help students develop their analytical thinking skills. The ultimate aim of an infographic is to integrate facts, details, and visual elements to maximize communication effectiveness. Infographics as an instructional strategy is a visual graphic display that indicates the relationship between facts, concepts, or ideas within a learning activity. The visual representation of infographics provides learners with a systematic framework of insight to be learned (Elaldi and Çifçi, 2021; Chatzikyrkou, et. al., 2020). This helps to direct the learners' attention to key concepts and hypothetical relationships. The use of such infographics, thus, promotes understanding and enhances organization and long-term retention of data. It stresses meaningful learning which serves to facilitate learning and minimize boredom on the part of the learners (Alzoubi, et. al., 2023). Finally, an infographic can show a student's ability to sort information, shape relationships, recognize trends, and present the data as more concrete knowledge.

Learning outcomes are statements describing the knowledge, ideas, concepts, interests, skills, and attitudes that students are expected to demonstrate upon completion of a learning experience. Learning outcomes are the specific knowledge, skills, and abilities that students are expected to possess and acquire upon completion of a course content or materials, program, or degree (Zhu, et. al., 2021). Learning outcomes are the measurable, noticeable observable outcomes that students achieve or attain as a result of their learning experiences" (Rennie and Morrison, 2022). However, there is a significant gap in the literature regarding the effectiveness of integrating web-based infographics and web-quests integrated instruction into physics instruction. While some studies have investigated the use of Web-based infographics or Web-quests in education, research is needed to explore the impact of combining these two innovative approaches on learning outcomes in physics education. Therefore, this study aims to investigate the effects of web-based infographics and web-quest integrated instruction on learning outcomes of pre-service physics teachers in Colleges of Education in Southeast, Nigeria, including student achievement, retention, and interest.

Aim and Objectives of the Study

This study aims to investigate the effects of Web-based infographics and Web-quest integrated instruction on learning outcomes of pre-service physics teachers among colleges of education in South-East, Nigeria. Specifically, the study intends to determine the comparative effect of;

1. Web-based Infographics and Web-quest integrated instructional platform on the academic achievement of pre-service Physics teachers.
2. Web-based infographics and Web-Quest integrated instructional platform on pre-service Physics teacher's interest.

Research Questions

Based on the above objectives, the study raised the following research questions:

1. What is the effect of Web-based Infographics and Web-quest integrated instructional platforms on the mean academic scores of Pre-service physics teachers?
2. To what extent does the effect of Web-based Infographics and Web-quest integrated instructional platforms on Pre-service physics teachers mean interest in physics?

Hypotheses

The following null hypotheses will be formulated and tested at 0.05 alpha level of significance in the study:

HO_1: There is no significant difference in the mean academic achievement scores of pre-service physics teachers taught with Web-based Infographics and Web-quest integrated instructional platforms.

HO_2: There is no significant difference in the mean interest scores of pre-service physics teachers taught with Web-based Infographics and Web-quest integrated instructional platforms.

Research Methodology

Research Design

A quasi-experimental research design and descriptive survey design was used, Pre-test, post-test non-equivalent non-randomized design was used. The design was adopted because it allows the use of intact class. The pre-test was administered before the treatment, while the post-test was administered after the treatment to determine the achievement of physics students. The design sketch is shown in Table 1.

Table 1 Research Design

Group	Pretest	Treatment	Posttest
E 1	O_1	X_1	O_2
E 2	O_1	X_2	O_2

Key: The interpretations of the layout are as follows

E 1 => (Infographics)

E 1 => (Web-Quest)

O_1 => Pretest, O_2 => Posttest,

O_1 O_1 Pretest Observation of Exp I & II

O_1 O_2 Posttest Observation of Exp I & II

X_1 => Treatment for E1 (Experimental group1 Infographics)

X_2 => Treatment for E 2 (Experimental group2 Web-Quest Instruction)

The population for this study consists of 1, 014 pre-service science teachers Colleges of Education for the 2023/2024 academic session in Southeast Nigeria, the geopolitical zones comprise five states, namely Abia, Anambra, Ebonyi, Enugu, and Imo. The sample for the study consists of NCE II intact class of pre-service physics teachers. A simple random sampling technique was adopted to select six (6) Colleges of Education offering Physics Education from five (5) South-East States of Nigeria. Afterward, the six (6) selected Colleges of Education was purposively assigned to Experimental Group I and Experimental Group II respectively. These Colleges was purposively assigned based on equivalence (facilities and manpower), school type (government institutions), gender composition (mixed schools), ICT facilities and students' exposure to the Internet. three (3) of the Colleges of Education was assigned to a web-based infographics instructional platform as experimental group I, and the other three Colleges of Education was assigned to Web-Quest integrated instructional platform as experimental group II. An intact class (a complete class without single selection), was used for each of the sampled schools for the study, Group E1 (Infographics-164) comprise of Male-67 and Female- 97 and Group E2 (Web-Quest-174) comprising of Male-69 and Female-105.

Three research instruments were employed by the researcher and use to gather data for the study. They include:

1. Test instrument
   a. Achievement test: Physics Achievement Test (PAT).
2. Treatment instruments
   4. Web-based infographics Learning Platform (WBIP)
   5. WebQuest Integrate Instruction Platform (WQIIP).
3. Physics Interest Inventory Scale Questionnaire (PIISQ)

The instruments developed for this study was validated by experts in Educational Technology, Psychologist, Measurement and Evaluation experts. The experts was given the aim and objectives of the study alongside the instruments and was asked to validate the items by making their inputs inform of correction, and suggestions with regard to structure of items, and objectivity of questions so that the items was suitable for data collection. Their suggestions, corrections and recommendations was incorporated to produce the final copy of the instruments. Pearson Product Moment Correlation Co-efficient formula was used in calculating the PAT reliability coefficient index of 0.76 while Cronbach Alpha was used in obtaining the reliability co-efficient of the interest questionnaire with the following reliability co-efficient Web-Quest 0.86 and Info graphic 0.87 which shows that the instruments were reliable. The data collected from the administration of research instruments was analysed using descriptive and inferential statistics. Mean and Standard Deviation was used to answer the stated research questions. T-test and Mann U Whitney test was used to analyze the achievement and interest scores respectively at 0.05 level significance. The data was analyzed using statistical package for social sciences (SPSS) 23.00 version.

Result

Analysis of research questions

Research Question One

What is the effect of Web-based Infographics and Web-quest integrated instructional platforms on the mean academic scores of Pre-service physics teachers?

Mean and standard deviations were used to answer this research question and the analysis is presented in Table 2.

Table 2: Mean and Standard Deviation of Achievement Scores of Students Taught using Web-based Infographics and Web-quest integrated instructional Platforms

Group	Strategy	N	Pretest		Posttest		Mean Gain
			$\bar{x}$	SD	$\bar{x}$	SD	
Experimental I	Web-based Infographics	164	24.14	5.85	45.55	8.19	21.41
Experimental II	Web-quest integrated	174	24.40	5.80	53.00	13.53	28.60

Table 2 shows the result of descriptive statistics on achievement scores of preservice physics teachers exposed to Web-based Infographics and Web-quest integrated instructional Platforms at Pretest and Posttest, respectively. The result indicates that the mean and standard deviation scores at Pretest and Posttest for experimental group I (Web-based Infographics) is $\bar{x}$ = 24.14, SD = 5.85 and $\bar{x}$ = 45.55, SD = 8.19, respectively. This gives a mean gain of 21.41 in favour of Posttest. Similarly, the mean and standard deviation scores at Pretest and Posttest for experimental group II (Web-quest integrated) is $\bar{x}$ = 24.40, SD = 5.80 and $\bar{x}$ = 53.00, SD = 13.53, respectively. This gives a mean gain of 28.60 in favour of Posttest. From the results, it could be deduced that Web-quest integrated instructional method improves academic achievement of preservice physics teachers compared to Web-based Infographics.

Research Question Two

To what extent does the effect of Web-based Infographics and Web-quest integrated instructional platforms on Pre-service physics teachers mean interest in physics?

Table 4: Mean and Standard Deviation of Interest Rating of Students Taught using Web-based Infographics and Web-quest integrated instructional Platforms

Group	Strategy	N	Pretest		Posttest		Mean Gain
			$\bar{x}$	SD	$\bar{x}$	SD	
Experimental I	Web-based Infographics	164	45.31	10.25	77.32	10.16	32.01
Experimental II	Web-quest integrated	174	44.07	5.80	67.98	12.22	23.91

Table 4 shows the result of descriptive statistics on interest rating scores of preservice physics teachers exposed to Web-based Infographics and Web-quest integrated instructional Platforms at pretest and Posttest, respectively. The result indicates that the mean and standard deviation scores at pretest and posttest for experimental group I (Web-based Infographics) is $\bar{x}$ = 45.31, SD = 10.25 and $\bar{x}$ = 44.07, SD = 12.22, respectively. This gives a mean gain of 32.01 in favour of posttest. Similarly, the mean and standard deviation scores at posttest and posttest for experimental group II (Web-quest integrated) is $\bar{x}$ = 44.07, SD = 5.80 and $\bar{x}$ = 67.98, SD = 12.22, respectively. This gives a mean gain of 23.91 in favour of posttest. From the results, it could be deduced that both Web-quest integrated instructional and Web-based Infographics method improves academic achievement of preservice physics teachers compared to Web-based Infographics.

Analysis of research hypotheses

Research Hypothesis One

H_{O1}: There is no significant difference in the mean academic achievement scores of pre-service physics teachers taught with Web-based Infographics and Web-quest integrated

instructional platforms. The results for testing null hypothesis one using independent sample t-test at a 0.05 significance level are presented in Table 5.

Table 5: Summary of Analysis of Independent Samples t-test on Achievement Scores of Experimental Groups at Protest

Group	N	Mean	SD	Df	t-value	P-value
Experimental I - Web-based infographics	164	45.55	8.19	366	6.163	0.000*
Experimental II- Web-Quest-Integrated	174	53.00	13.53			

* Significant at 0.05 level

Table 5 shows a sample t test of Posttest mean achievement scores of preservice physics teachers taught using Web-based Infographics and Web-quest integrated instructional platforms. The results indicate that of the t- test analysis of Posttest mean achievement scores of preservice physics teachers exposed to taught using Web-based Infographics and Web-quest integrated instructional platforms. revealed a t-value of 6.163with *p* value of 0.00, when computed at 0.05 level of significance ($t_{(366)} = 6.163$, $P < 0.05$). Therefore, since the *p*-value of 0.00 is less than 0.05 level of significance, Hence, p value is significant. On the basis of this, null hypothesis one is thereby rejected. Thus, there is significant difference between Posttest mean achievement scores of preservice physics teachers taught -based Infographics and Web-quest integrated instructional platforms.

Research Hypothesis Two

HO_3: There is no significant difference in the mean achievement scores of Male and Female pre-service physics teachers taught with the Infographics and Web-quest integrated instructional platforms. The results for testing null hypothesis two using Mann-Whitney U test at a 0.05 significance level are presented in Table 6.

Table 7: Summary of Analysis of Mann-Whitney U on Mean Interest Rating of Experimental Groups at Posttest.

Group	N	Mean Rank	Sum of Rank	Mann-Whitney U	P-value
Experimental I - Web-based infographics	164	205.42	35742.50	8018.50	0.000*
Experimental II- Web-Quest-Integrated	174	131.39	21548.50		

*Significant at 0.05 level

Table 7 presents the pretest mean interest ratings, showing that the mean ranks were 205.42 for the Web-based Infographics group and 131.39 for the Web-quest integrated group. The Mann-Whitney U test yielded a U statistic of 8018.50with a p-value of 0.000, which is significant at the 0.05 level. Consequently, the null hypothesis three, which posits no significant difference in the posttest mean interest ratings between preservice physics teachers taught using Web based Infographics and Web-quest integrated instructional platforms is rejected. Hence, there is difference in the mean interest scores of preservice physics teachers taught Web-based Infographics and Web-quest integrated instructional platforms.

Summary of Findings

Based on the results of data analysis presented, findings revealed that;

1. There is significant difference in the mean academic achievement scores of pre-service physics teachers taught with Web-based Infographics and Web-quest integrated instructional platforms, in favour of Web-quest integrated instructional platform

2. There is significant difference in significant difference in the interest rating of pre-service physics teachers taught with Web-based Infographics and Web-quest integrated instructional platforms, in favour of Web-based Infographics instructional platform.

Discussion of Results

The findings from the study underscore the effectiveness of both web-based integrated infographics and web-Quest integrated instructional platforms on learning outcomes of pre-service physics teachers among colleges of education in South-East, Nigeria.. The detailed discussion of each finding is as follows:

The study revealed a significant difference in the mean academic achievement scores between pre-service physics teachers taught with Web-based Infographics and those taught with Web-quest integrated instructional platforms. The Web-quest platform proved to be more effective in enhancing the academic performance of the students. This result aligns with previous studies, such as that by Alebous (2021), who found that Web-quest strategies enhanced students' acquisition of biological concepts. Similarly, Saheed et al. (2019) observed that Web-quests significantly improved secondary school biology students' understanding of cell division, a notoriously difficult topic. The study found no gender-based differences in performance, but it did note that low-scoring students particularly benefited from the Web-quest approach. a structured, inquiry-based approach where students follow guided steps to explore a topic.

However, while Web-quest platforms were superior in terms of academic achievement, the findings revealed that Web-based Infographics were more effective in increasing the interest of pre-service physics teachers. This is supported by Pakhomova *et al.* (2023), who found that visual and engaging content like infographics can stimulate students' interest in grammar lessons. Infographics are known for their visually appealing format, making complex content easier to understand and more engaging.

Conclusion and Recommendations

This study evaluates the effectiveness of two instructional platforms—Web-based Infographics and Web-quest integrated platforms—on the learning outcomes of pre-service physics teachers in South-East Nigeria. Through a comprehensive analysis of academic achievement, retention, and interest levels among students, the study sought to determine which method provided a more enriching educational experience. The findings indicate that both instructional strategies have their unique strengths, yet significant differences emerged in various aspects of student performance.

The finding revealed a significant difference in the mean academic achievement scores between the two instructional methods, favoring the Web-quest integrated platform. This suggests that the exploratory nature of Web-quests may provide a more effective environment for learning physics concepts. The finding also highlighted that retention scores also favored the Web-quest platform, emphasizing its potential to enhance long-term memory of the material taught. Interestingly, the third finding showed that Web-based Infographics were more effective in boosting the interest ratings of pre-service physics teachers, underscoring the

appeal of visually engaging content. Lastly, the interest scores reflected notable gender-specific preferences, with differences highlighted between the two groups based on the instructional method employed. Overall, these findings contribute valuable insights into the pedagogical approaches used in teaching physics, suggesting that both Web-based Infographics and Web-quest integrated platforms offer distinct benefits that can be leveraged to enhance educational outcomes for pre-service teachers.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. Given the significant improvement in academic achievement and retention scores associated with Web-quest integrated instructional platforms, educational institutions should prioritize the incorporation of these platforms into their physics curricula. Training programs for educators should focus on effective implementation strategies that foster exploration and inquiry-based learning.

2. Recognizing the differences in performance and interest levels between male and female students, educators should adopt gender-responsive instructional strategies. This may include offering a mix of exploratory and structured learning experiences that cater to diverse learning preferences, ensuring that all students are adequately supported.

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EMERGING TECHNOLOGIES IN STEM AND TVET FOR ECONOMIC DEVELOPMENT

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Abstract
This paper explores the integration of emerging technologies in Science, Technology, Engineering, and Mathematics (STEM) and Technical and Vocational Education and Training (TVET) education in Nigeria, focusing on the opportunities and challenges posed by these advancements. Technologies such as artificial intelligence (AI), virtual reality (VR), augmented reality (AR), and 3D printing are examined for their potential to revolutionize education and drive innovation. Despite the clear benefits, including personalized learning, improved engagement, and increased access to educational resources, several challenges hinder their widespread adoption. Key obstacles include inadequate infrastructure, particularly unreliable electricity and limited internet access, a shortage of trained educators skilled in using these technologies, and financial barriers that prevent schools from acquiring necessary tools. To overcome these hurdles, the paper advocates for investments in infrastructure, targeted teacher training programs, and financial support mechanisms such as public-private partnerships and international aid. Additionally, policy reforms are needed to create an enabling environment for technology adoption in education. By addressing these challenges, Nigeria can enhance the quality of its teaching, better prepare students for the modern workforce, and contribute to sustainable economic growth. This paper concludes by emphasizing the importance of a collaborative approach to integrating emerging technologies in education to ensure long-term benefits for the country's development.

Keywords: Emerging technologies, STEM education, TVET, AI, VR, AR, infrastructure, economic development

Introduction
The integration of Science, Technology, Engineering, and Mathematics (STEM) with Technical and Vocational Education and Training (TVET) presents a unique opportunity to transform economic development on a global scale. By aligning the theoretical rigor of STEM with the practical skills of TVET, this convergence can unlock innovative solutions to some of the most pressing societal challenges. Emerging technologies, such as artificial intelligence, robotics, and renewable energy, play a crucial role in driving this transformation, fostering sustainable growth and enhanced productivity across industries.

Artificial intelligence (AI) stands at the forefront of this revolution, with its capabilities in machine learning, automation, and decision-making improving efficiency in various sectors. Meanwhile, robotics and automation streamline manufacturing, reduce costs, and enhance product quality. The Internet of Things (IoT) further contributes by enabling the connection and automation of physical objects, leading to real-time data collection and analysis, and optimizing processes in fields ranging from agriculture to healthcare.

Additive manufacturing technologies like 3D printing are transforming product design and production, allowing for rapid prototyping and customization. Additionally, the shift towards renewable energy sources such as solar, wind, and hydropower is promoting sustainable energy solutions, reducing reliance on fossil fuels, and fostering energy independence. In the realm of biotechnology, advances are driving progress in agriculture, healthcare, and environmental protection, further contributing to economic growth. Together, these emerging technologies hold the potential to reshape industries, improve living standards, and create a more resilient and innovative global economy.

Application of Emerging Technologies in (TVET), and (STEM) for Economic Development.

Artificial Intelligence (AI) is profoundly transforming Nigeria's STEM and TVET sectors by enhancing educational outcomes and driving economic growth. In STEM education, AI-powered platforms and intelligent tutoring systems offer personalized learning experiences by analyzing student data to create tailored paths and provide real-time feedback, which improves engagement and mastery of complex subjects (Ogunleye & Olatunji, 2020). In TVET, AI automates skill assessments and job-matching processes, allowing for customized training programs and better alignment of graduates with employment opportunities (Akinyemi et al., 2021). Additionally, AI enhances manufacturing by optimizing processes, identifying inefficiencies, and increasing productivity, which is crucial for TVET-related sectors. Overall, AI drives economic growth by streamlining operations, reducing labor costs, and fostering innovation through data-driven insights and automation, thereby boosting productivity and efficiency across industries.

Robotics, automation, and the Internet of Things (IoT) are significantly advancing Nigeria's economic development across several sectors. In manufacturing, these technologies improve productivity by automating tasks such as assembly and packaging, reducing costs, and enhancing product quality (Adeyemi & Olatunji, 2020). In agriculture, IoT and robotics facilitate precision farming and crop monitoring, boosting efficiency and yields while lowering labor costs (Oladele et al., 2021). Education benefits from robotics through enhanced STEM and TVET programs, preparing a skilled workforce for the robotics industry. Healthcare advancements include IoT-enabled remote patient monitoring, which improves healthcare delivery (Okpala et al., 2020). Concurrently, 3D printing is revolutionizing manufacturing by enabling rapid prototyping and customization, thus fostering innovation and reducing costs (Adeyemi & Olatunji, 2020). In healthcare, it creates personalized medical devices and prosthetics, improving patient care (Okpala et al., 2020). Additionally, 3D printing in education supports creativity and problem-solving, and aids architects and designers with physical models for better visualization. These technologies collectively enhance industrial productivity, healthcare, and educational outcomes, driving socio-economic growth in Nigeria.

Renewable energy offers a sustainable solution to Nigeria’s energy challenges by providing cleaner alternatives to fossil fuels, such as solar, wind, and hydropower. Solar energy is particularly promising due to Nigeria's ample sunlight, with projects like the Kaduna Solar Power Plant demonstrating progress in supplying electricity to both urban and rural areas (Oladele et al., 2020). Wind energy, feasible in northern Nigeria due to favorable conditions, could support large-scale wind farms and diversify the national energy mix. Hydropower, utilizing Nigeria’s rivers and dams, plays a crucial role with existing facilities like the Kainji Dam and offers potential for further expansion. Beyond improving energy security and reducing foreign exchange spent on fossil fuels, renewable energy supports environmental sustainability by emitting fewer greenhouse gases Owebor *et al*, (2021) and drives economic

growth through job creation in various sectors. Additionally, solar home systems enhance the quality of life and economic activities in rural areas not connected to the grid.

Biotechnology is emerging as a key driver of innovation and economic growth in Nigeria, with applications across agriculture, healthcare, and environmental protection. In agriculture, it is used to develop genetically modified crops resistant to pests, diseases, and drought, enhancing productivity and food security (Tertsegha et al., 2021). Biotechnology also supports the creation of biofertilizers and biopesticides, offering eco-friendly alternatives to chemical products. Additionally, precision agriculture, using biotechnology-enabled tools like sensors and drones, optimizes resource use and improves crop yields. In healthcare, biotechnology accelerates drug discovery and diagnostics, enhances disease treatment, and aids in producing biopharmaceuticals such as vaccines. Environmental protection benefits from biotechnology through bioremediation for pollution cleanup, waste management, and the development of renewable energy sources like biofuels, supporting sustainability in Nigeria (Das et al 2023).

Emerging technologies are revolutionizing STEM and TVET education by enhancing engagement and accessibility. Tools like Virtual Reality (VR) and Augmented Reality (AR) create immersive learning environments for exploring complex concepts through interactive simulations (Rama & Venugopal, 2022). Gamification boosts student motivation by integrating game-like elements such as rewards and progress tracking into the learning process. Simulations and virtual labs provide hands-on experiences without physical resources, making experimentation safe and accessible to remote or disabled learners (Nwanguma, & Hope (2023)). Nwanguma continued that AI-powered adaptive systems personalize learning by tailoring content and assessments to individual needs, offering real-time feedback to optimize outcomes. Additionally, AI accelerates research and development by analyzing large datasets to identify patterns and predict outcomes, thus enhancing efficiency in fields such as biology and materials science, and automating repetitive tasks to allow researchers to focus on innovative work. These advancements collectively contribute to more effective, inclusive, and innovative educational and research environments.

Emerging technologies in STEM and TVET are revolutionizing Nigeria's manufacturing industry by boosting productivity, improving product quality, and enhancing safety. Automation and robotics streamline processes, reduce labor costs, and improve precision, leading to fewer defects and higher quality products (Ribeiro et al 2021). Automation also enhances workplace safety by taking over hazardous tasks and minimizing accident risks. AI contributes through predictive maintenance by analyzing data to forecast equipment issues, reducing downtime, and increasing reliability. AI-powered quality control systems further ensure consistent product standards by detecting defects in real-time. Additionally, technologies like 3D printing enable rapid prototyping and customization, reducing lead times and costs according to Oren (2024) while IoT devices provide real-time monitoring and data analysis to optimize manufacturing operations. Despite challenges such as high initial costs and the need for skilled labor, these technologies offer long-term benefits, including cost savings and increased global competitiveness for Nigeria’s manufacturing sector.

Emerging technologies in STEM and TVET are playing a crucial role in transforming agriculture and enhancing environmental sustainability in Nigeria by providing innovative solutions to challenges like food security and resource management. Precision agriculture, powered by IoT sensors, drones, and AI, allows farmers to optimize irrigation, fertilization, and pest control through real-time data analysis, improving crop yields and reducing waste (Trent, and Shyamal (2020) These technologies also support climate change mitigation by

reducing dependence on fossil fuels, as renewable energy sources such as solar and wind power are increasingly used in agricultural operations. Additionally, IoT and remote sensing technologies help monitor environmental conditions like air and water quality, track deforestation, and manage natural resources efficiently, while AI analyzes large datasets to predict environmental issues such as natural disasters. Despite challenges like limited access to technology, these advancements hold significant potential for sustainable development in Nigeria.

In environmental sustainability, technologies such as IoT sensors, remote sensing, and AI are critical for monitoring and managing environmental conditions. IoT sensors track air and water quality, while remote sensing provides insights into land use changes and deforestation. AI algorithms analyze data to predict and address environmental hazards, improving early warning systems for natural disasters and pollution events. Furthermore, biotechnology advances aid in pollution control through bioremediation and enhanced waste management practices, and renewable energy technologies support sustainable resource management by reducing fossil fuel dependence and promoting cleaner alternatives (Oladele et al., 2021). These technologies collectively address critical environmental challenges and support sustainable development gaol.

Emerging technologies are making substantial advancements in healthcare and medicine by improving diagnostic accuracy, patient monitoring, and treatment methods. Artificial Intelligence (AI) is pivotal in medical imaging, where it analyzes X-rays, CT scans, and MRIs to detect abnormalities and support precise diagnoses (**Chioma** (2022) IoT-enabled wearable devices also play a key role by continuously monitoring critical health parameters such as heart rate and glucose levels, which aids in disease management and early intervention. (**Chioma continued** These technologies enhance diagnostic capabilities and patient care by enabling remote monitoring and telemedicine, thus increasing healthcare access in underserved areas and alleviating the burden on healthcare facility. In drug discovery and surgical procedures, bioinformatics accelerates drug development by analyzing biological data, while 3D printing enables the creation of customized medical devices and prosthetics, and surgical robotics facilitates minimally invasive surgeries that reduce trauma and recovery times (Ashok M (2023). Together, these advancements lead to improved healthcare outcomes and more efficient medical practices.

Challenges of Emerging Technologies in STEM and TVET in Nigeria.

The adoption of emerging technologies in STEM and TVET education in Nigeria faces several significant challenges. One major issue is the lack of adequate infrastructure, such as reliable electricity and internet connectivity, particularly in rural areas. These are essential for the effective implementation of technologies like virtual labs, AI-powered tools, and other digital platforms. The World Bank reported that less than 60% of Nigerians have access to electricity, and broadband penetration remains limited, which hampers the widespread use of technology in education (World Bank, 2020). Without the necessary infrastructure, many students, particularly in remote areas, are unable to benefit from the potential of emerging technologies. Another critical challenge is the shortage of skilled educators and technical support personnel capable of effectively using and maintaining these technologies. Many teachers in Nigeria lack the necessary training to incorporate tools like virtual reality, AI, and adaptive learning systems into their classrooms. According to Barnes et al. (2019), the country's education system struggles with inadequate teacher training programs in technological applications, limiting the integration of these tools. This gap in teacher capacity means that even where the infrastructure exists, the full potential of these technologies is not being realized in classrooms.

Lastly, financial constraints pose a significant barrier to the adoption of emerging technologies in Nigeria's STEM and TVET sectors. The cost of acquiring and maintaining cutting-edge technologies, such as AI-powered systems, virtual labs, and advanced computing devices, is high. Given the limited funding available for education in Nigeria, Barnes continued that many schools and training centers cannot afford these investments. This financial strain also extends to students, many of whom do not have access to personal devices or internet connections at home, further limiting the impact of technology-enhanced education. These challenges underscore the need for substantial investments in infrastructure, teacher training, and financial support to fully realize the benefits of emerging technologies in Nigeria's education system

The way forward

To address the challenges of integrating emerging technologies into STEM and TVET education in Nigeria, several strategic actions are essential. First, there is a critical need for infrastructure development, particularly in improving electricity and internet connectivity, which are fundamental for technological adoption. The Nigerian government, in partnership with private sector stakeholders, should work to expand broadband access, particularly in rural areas where connectivity is limited. Additionally, leveraging renewable energy solutions such as solar power can mitigate electricity challenges in off-grid locations, ensuring that schools and training centers have the necessary resources to deploy and utilize advanced technologies effectively.

Strengthening teacher training and capacity building is equally vital. Joonhyeong (2023) in support of this says that educators require comprehensive training programs that focus on integrating digital tools, virtual labs, and AI-powered systems into the curriculum. Development initiatives should be designed to enhance technical skills and pedagogical approaches for using these emerging technologies. This can be facilitated through government-funded workshops, partnerships with international educational technology organizations, and the inclusion of technology-focused modules in teacher education programs. Harry *et al* (2009), are of the view that financial solutions are needed to support technology adoption, including public-private partnerships (PPPs) to finance technological tools and infrastructure, and grants or low-interest loans from international development agencies. The government should also provide subsidies and tax incentives for institutions investing in advanced technologies and ensure affordability for students through device-sharing programs and support for low-income families. Finally, an inclusive policy framework is crucial, Felicia and Bassey (2021) are also of the view that the Nigerian government must develop policies that prioritize technology use in education and create regulatory environments that encourage innovation and experimentation with emerging technologies. By addressing these areas, stakeholders can drive the effective integration of technology into education, making it more accessible, engaging, and effective.

Summary/conclusion

Integrating emerging technologies like virtual reality (VR), augmented reality (AR), artificial intelligence (AI), and 3D printing into Nigeria's STEM and TVET education systems presents significant opportunities to enhance learning and foster innovation. However, challenges such as inadequate infrastructure, including unreliable electricity and limited internet access, a shortage of skilled educators, and financial constraints, particularly affect rural areas and exacerbate educational disparities. To address these issues, Nigeria needs a comprehensive strategy that includes investing in infrastructure improvements, strengthening teacher training programs, implementing financial solutions like public-private partnerships and subsidies, and

developing an inclusive policy framework to support technology integration in education. By tackling these barriers, Nigeria can create an environment conducive to technology-driven education, ultimately improving educational outcomes and supporting sustainable economic growth.

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LEVERAGING AI AND MOTHER TONGUE IN BASIC EDUCATION: INNOVATIVE SCIENCE AND MATHEMATICS PEDAGOGY FOR ENTREPRENEURSHIP, ECONOMIC DEVELOPMENT, AND ENHANCED LEARNING

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Abstract
Integrating mother-tongue instruction and artificial intelligence (AI) in science and mathematics education offers a transformative opportunity for Nigeria, with profound implications for entrepreneurship, economic development, and innovation. This innovative approach combines the cognitive and cultural benefits of mother-tongue instruction with the technological advancements of AI to significantly enhance learning outcomes, foster academic performance, and cultivate entrepreneurial skills. The study recommends incorporating mother-tongue instruction to allow Nigerian students to have a better understanding and retention of scientific and mathematical concepts. Furthermore, it is recommended that science and mathematics educators develop mother tongue-based educational resources and undergo training in AI-enhanced, mother tongue-based instruction. Comprehensive training for other educational stakeholders on mother-tongue pedagogy and AI literacy is also recommended to effectively implement these strategies.

Keywords: Mother-Tongue Instruction, AI, Science and Mathematics, Innovative Pedagogy, Entrepreneurship, Economic Development and Innovation.

Introduction
In the contemporary educational landscape, integrating mother-tongue instruction and artificial intelligence (AI) in science and mathematics represents a transformative approach with profound implications for entrepreneurship and economic development, particularly in Nigeria. This innovative pedagogy leverages the cognitive and cultural benefits of mother-tongue instruction while harnessing the technological advancements of AI to enhance learning outcomes and foster entrepreneurial skills.

Mother-tongue instruction enhances student comprehension and retention, leading to improved academic performance and cognitive development (UNESCO, 2023). In Nigeria, with its diverse linguistic landscape, implementing mother-tongue instruction can bridge educational gaps and promote inclusivity, addressing disparities in educational attainment across regions (UNESCO, 2023). On the other hand, the integration of AI in education revolutionizes traditional teaching methods, personalizing learning experiences and facilitating the development of critical thinking and problem-solving skills (Almasri, 2024). Additionally, AI can simulate complex scientific and mathematical concepts, making them more accessible to students (Park et al., 2023).

The integration of mother-tongue instruction and artificial intelligence (AI) in teaching science and mathematics holds great potential for fostering entrepreneurship and economic development in Nigeria (Melchor et al., 2023). This innovative pedagogical approach enhances educational outcomes, fosters entrepreneurial skills, and contributes to economic development by leveraging linguistic diversity and technological advancements to create a more inclusive and effective learning environment.

Problem Statement

Disadvantaged communities, especially at Basic level of education, often face challenges in science and mathematics education due to language barriers, limiting their understanding and entrepreneurial potential. An innovative solution is using AI to enhance mathematics and entrepreneurship education in the mother tongue through tools like language translation, intelligent tutoring, simulations, and mentorship platforms. This approach seeks to improve academic performance, promote cultural relevance, develop entrepreneurship skills, and empower students to drive sustainable economic growth, breaking language barriers and fostering inclusive education for these communities.

Features of AI-Powered Mother-Tongue Educational Platform

The integration of an AI-powered educational platform for mother-tongue instruction in science and mathematics holds the potential to revolutionize learning in resource-constrained environments. This platform would offer multilingual AI tutoring, adaptive learning paths, voice recognition, multimodal learning materials, real-time feedback, and content localization, all tailored to the local context. By incorporating advanced features such as these, the platform can make learning more accessible, personalized, and effective for students. The potential for such a platform to address the specific needs of students in resource-constrained environments is evident, as highlighted by Oromena (2024), Mohamed et al. (2022), and Egara & Mosimege (2024). Additionally, the incorporation of local contexts into science and math problems as proposed by Usman, Wushishi, Gambari & Olayinka (2017) could significantly enhance students' understanding of the relevance of their learning to their immediate environment.

Benefits of Mother-Tongue Instruction in Science and Mathematics Education in Nigeria

Mother-tongue instruction in science and mathematics significantly enhances students' academic performance and cognitive development. When learners are taught in their native language, they can grasp complex mathematical concepts more readily, as they are not simultaneously grappling with language barriers. This dual focus on language and content can lead to deeper understanding and retention of mathematical principles. Recent studies have shown that students instructed in their mother tongue exhibit improved problem-solving skills and higher academic achievement in mathematics (Adebayo, 2023). Moreover, implementing mother-tongue instruction in mathematics helps bridge educational gaps and promotes inclusivity. In a linguistically diverse country like Nigeria, many students face challenges when taught in a second language. By using the mother tongue, educators can ensure that all students, regardless of their linguistic background, have equal access to quality education. This approach not only reduces dropout rates but also fosters a more inclusive learning environment where all students feel valued and understood (Ogunleye, 2022). Mother-tongue instruction significantly boosts students' engagement and motivation for learning. When students are taught in a language they are comfortable with, they are more likely to participate actively in class and show enthusiasm for the subject matter. This increased engagement can lead to better attendance, higher levels of participation, and a more positive attitude towards learning mathematics. Furthermore, it empowers students to express their ideas and questions more freely, thereby enhancing their overall learning experience (Eze, 2023).

Furthermore, Mother Tongue-based instruction increases accessibility and reduces language barriers, ensuring equal opportunities and enhanced cultural relevance by connecting learning to local contexts and experiences. It also fosters better retention, as students retain information longer when taught in their mother tongue. A study by Usman et al. (2017) demonstrated the effectiveness of a web-based instructional package in Hausa for teaching Geometry. Similarly, studies by Bature (2017), Danladi (2018), and Okebukola and Jegede (2020) found that

students taught in their mother tongue show better understanding and retention of mathematical and scientific concepts compared to those instructed in English.

AI-Powered Mother Tongue Platforms Potential for Developing Entrepreneurial Skills

AI-powered platforms in native languages facilitate the development of critical entrepreneurial skills such as critical thinking, problem-solving, creativity, and innovation (Smith, 2021). By tailoring content to challenge critical thinking and providing instant feedback on problem-solving approaches, AI-driven platforms contribute to skill enhancement (Jones, 2020). Additionally, these platforms present diverse entrepreneurial ideas and encourage innovation by contextualizing global best practices in the learner's mother tongue (Brown, 2019). Therefore, the use of AI in native language platforms significantly fosters key entrepreneurial skills essential for success in today's competitive business world. **Leveraging AI to Scale Mother-Tongue Instruction:**

In resource-constrained environments, AI offers transformative potential which includes:

1. AI-driven platforms like Duolingo and Mindspark can adapt content to students' proficiency levels in their mother tongue, offering personalized tutorials.

2. AI-powered can automate translation of learning materials into multiple local languages, thereby reducing reliance on costly human resources.

3. AI-powered Natural Language Processing (NLP) can be used to develop applications that teach literacy and numeracy in native languages. For example, programs using AI algorithms can create adaptive exercises based on students' language comprehension, gradually increasing complexity based on performance.

4. AI can be integrated into teacher training programs to help educators better teach in mother tongues, particularly in regions where resources are scarce. Virtual teaching assistants and AI-enhanced platforms can provide scalable training modules and guidance for teachers.

5. In rural and underserved areas, AI tutors could offer lessons in a student's native language, with speech recognition and conversational AI technologies enabling students to interact with the platform. This allows students to learn in their preferred language, democratizing access to quality education.

Strategies for Implementing the integrated AI and Mother Tongue in to Science and Mathematics Classroom

Integrating mother-tongue instruction and artificial intelligence (AI) in science and mathematics could be achieved through the following: Develop mother tongue-based educational resources (platform) and collaborate with local experts. Integrate AI-powered tools that leverage existing platforms or develop customized solutions. Train teachers through workshop and seminar on skills development in an AI-enhanced, mother tongue-based instruction andContinuously monitor and evaluate the effectiveness of the platform and adapt strategies.

Impact of Integrating Mother-Tongue Instruction and AI in Science and Mathematics

Integrating mother-tongue instruction with AI in science and mathematics education enhances entrepreneurial skills among students. This approach enables better understanding and application of concepts to real-world problems, fostering critical thinking and problem-solving

skills (Egara & Mosimege, 2024). This inclusive method can bridge educational and economic disparities in Nigeria, making high-quality education accessible to all students, regardless of their linguistic background or geographical location, thereby contributing to overall economic development (Oromena, 2024).

The integration of AI in science and mathematics education, coupled with mother-tongue instruction, can promote innovation and technological advancement. Students who are proficient in mathematics and comfortable with AI technologies are more likely to engage in innovative activities and technological entrepreneurship. This can lead to the creation of new technologies and businesses, driving economic growth and positioning Nigeria as a leader in technological innovation (Mohamed et al., 2022).

A strong foundation in mathematics, supported by mother-tongue instruction and AI, boosts workforce readiness. Proficiency in mathematics prepares students for STEM careers and AI tools provide hands-on experiences for the modern workforce (Gao, 2020). Efforts to address language barriers in education in Nigeria include initiatives by various organizations such as the Centre for Hausa Language and Culture at Bayero University Kano and Google's African Language Program, which includes Hausa (Gao, 2020).

Challenges and Concerns of Integrating Mother-Tongue Instruction and AI in Mathematics Education in Nigeria

The integration of mother-tongue instruction and AI in mathematics education faces challenges such as the scarcity of instructional materials in local languages, the need for comprehensive teacher training, and limited technological infrastructure. Critics express concerns about the logistical complexity and resource-intensiveness of implementing mother-tongue instruction in a multilingual society like Nigeria, as well as the potential exacerbation of existing inequalities in access to technology and digital literacy. Despite these challenges, the benefits of integrating mother-tongue instruction and AI in science and mathematics education outweigh the drawbacks, as it can democratize education, foster innovation, and drive economic growth. However, technical challenges remain, including data quality and quantity, dialectal variations in local languages, and limited digital content compared to global languages. (Alberto et al., 2016; Oromena, 2024; Mohamed et al., 2022; Almasri, 2024).

Conclusion

The following recommendations are made from the discussions on mother-tongue instruction and artificial intelligence (AI) in science and mathematics for learning enhancement and entrepreneurial development:

1. Incorporating mother-tongue instruction could allow Nigerian students to have better understanding and retain scientific and mathematical concepts, bridging the gap between their home languages and the language of instruction.

2. The approach is relevant to Nigeria, where linguistic diversity is vast, and many students face challenges learning in a second language. Additionally, embedding AI-powered educational tools can provide personalised learning experiences, adaptive assessments, and real-time feedback, addressing individual student needs and enhancing overall learning outcomes.

3. AI-powered tools can offer personalised learning experiences, adaptive assessments, and real-time feedback, addressing individual student needs and improving overall educational outcomes.

4. Embracing the integration of mother-tongue instruction and AI can help Nigeria cultivate a generation of learners who are not only academically proficient but also equipped with the entrepreneurial skills necessary for economic development in the 21st century. The potential to democratise education and empower students from diverse linguistic backgrounds highlights the importance of pursuing this forward-thinking strategy.

Recommendation

To integrate mother-tongue instruction and AI in Science and Mathematics pedagogy in Nigeria, the following recommendations are made:

1. Science and Mathematics educators, in collaboration with educational authorities, should develop mother tongue-based educational resources with an entrepreneurial focus.

2. Educational institutions and AI developers should collaborate to create culturally relevant educational materials using AI-powered tools.

3. Educational authorities and training institutions should train teachers and stakeholders on AI-enhanced, mother tongue-based instruction with entrepreneurial skills.

4. Educational policymakers and research institutions should advocate for supportive educational policies and continuous research to evaluate effectiveness.

5. The government should invest in technological infrastructure for reliable internet, digital devices, and AI software.

6. Educational policymakers and thought leaders should support a paradigm shift in educational policy and practice.

7. Educational institutions, government bodies, and industry experts should encourage collaboration between educators, entrepreneurs, and industry experts.

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IMPACT OF RESOURCE SHARING ON LIBRARY SERVICE EFFICIENCY IN UNIVERSITY LIBRARY

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Abstract
This paper explores the impact of resource sharing on the efficiency of library services in university libraries, highlighting its significance in addressing the increasing demands for academic resources. University libraries, serving as vital hubs for scholarly information, are facing challenges in maintaining comprehensive collections to meet the diverse needs of students, faculty, and researchers. Resource sharing, including interlibrary loans, document delivery, and shared cataloging, emerge as key strategies to enhance service efficiency. By collaborating with other libraries and utilizing digital technologies, university libraries can expand their access to materials, reduce redundancy, and optimize their budgetary resources. The study emphasizes that no single library can independently satisfy all user demands due to budget constraints and the rapid growth of information. Through resource sharing, libraries can improve accessibility, streamline operations and foster greater collaboration among institutions. The paper concludes by strengthening for collaborative networks, investing in advanced technologies, and standardizing metadata practices to further enhance the effectiveness of resource sharing in university libraries.

Keywords: Library Service Efficiency, Resource Sharing, University Library

Introduction
Libraries play essential roles in academic institutions, providing access to information that supports learning, teaching and research. University libraries in particular, serve as critical hubs for scholarly resources, offering students, faculty, and researchers access to a vast array of books, journals, databases, and other materials necessary for academic success. However, with the growing volume of academic content and the increasing demands placed on university libraries, the need for efficient library services has become more pressing than ever. Efficiency in library services is no longer just about having a comprehensive collection; it now encompasses how quickly, effectively, and economically libraries can meet the information needs of their users.

Academic libraries are libraries established in Polytechnics, Monotechnics, Colleges of Education and Universities, to take care of the information needs of students, lecturers, researchers and other community of scholars. University library services are rendered to support the teaching, learning and research activities of their parent institutions. The university library being an integral part of an academic institution is saddled with the responsibility of providing print and electronic information resources to support the vision and mission of the parent institution. Academic libraries are widely acknowledged as centers for the provision of information resources that empowers the educational institutions to produce highly resourceful people to impact positively on national development and academic excellence among nations, including Nigeria.

Libraries have shifted their attention to developing human capital as a key to addressing the information needs of their clients especially in this era of information overload and technological advancements by enhancing effective library services (Amoah and Akussah, 2023).

Resource sharing

One key strategy employed by university libraries to enhance their efficiency is resource sharing. Resource sharing refers to the practice of collaborating with other libraries to make their materials available to a broader audience. This can take the form of interlibrary loans, shared digital resources and cooperative cataloging, among other collaborative activities. Resource sharing has become a common practice among university libraries as it allows them to expand their collection without having to bear the full financial burden of acquiring and maintaining all resources independently.

According to Wiggins and Thomas (2019) "resource sharing in libraries refers to the practice of libraries collaborating to provide access to their collections and services to a wide audience. This collaboration can take various forms such as inter library loan (ILL), cooperative collection development, and participating in library consortia. The goal of resource is to enhance access to information for library users beyond what any single library could provide independently. It promotes efficiency by reducing duplication of resources and allows libraries to offer a broader range of materials and services to their patrons".

However, libraries are among the major beneficiaries of electronic information networks. They are taking advantage of modern ICTs to share information resources. They are establishing electronic information communication networks in which they pool their resources together for the benefit of their clients. For example, in South Africa among other countries, academic libraries have formed consortia in which they use electronic networks to share access to library systems, electronic document delivery and development of common online public access catalogues (OPACs) (Darch *et al*., 2019)

Inter-library Loan (ILL)

Inter-library loan is a collaborative system where libraries lend and borrow materials from one another to meet the informational needs of their users. Through ILL, users can access books, articles, and other resources not available in their home library, expanding their reach beyond local collections. This service supports academic research and learning by providing access to specialized materials that may not be affordable or accessible otherwise (Smith, 2018). Technology plays a crucial role in streamlining ILL, allowing users to request and track materials efficiently through online platforms (Johnson & Williams, 2020). Despite logistical challenges such as borrowing restrictions and delays in physical material delivery, ILL remains a vital resource-sharing strategy that enhances the availability of information across institutions (Brown, 2019).

Document Delivery Service (DDS)

Document Delivery Service (DDS) is a library service that provides users with access to copies of articles, book chapters, and other materials that are not available within their institutions. Unlike interlibrary loan, where physical materials are loaned between libraries, DDS focuses on delivering digital or physical copies of requested items directly to users. This service is essential for researchers who need timely access to specific documents for their work, especially in cases where travel to other libraries is not feasible (Wilson, 2017). DDS often involves partnerships with external libraries or commercial providers, allowing users to access

a broader range of resources (Anderson, 2019). With advancements in digital technologies, many documents can now be scanned and delivered electronically, reducing turnaround time and improving user satisfaction (Garcia & Lee, 2020).

Shared Cataloguing and Metadata

Shared Cataloguing and Metadata involve libraries collaborating to create and maintain standardized bibliographic records that can be used across multiple institutions. Shared cataloguing helps reduce duplication of effort by allowing libraries to pool resources and share catalog records for the same materials. This practice is crucial for ensuring consistent metadata standards, which improves the discoverability and accessibility of resources across library systems (Taylor, 2018). Metadata, which describes the content and structure of resources, plays a key role in this process by providing essential information about materials, such as titles, authors, subjects, and formats. Effective shared cataloguing ensures that metadata is consistent, enhancing the user experience and improving access to a wide range of resources (Miller & Johnson, 2019). Organizations like OCLC facilitates global shared cataloguing through services like WorldCat which allows libraries worldwide to contribute and use shared bibliographic records (Kumar, 2020).

Service has been defined differently by various authorities among which are marketing experts in library and information professionals who viewed services as resources, commodity or activity that can be transferred from an individual, cooperate body or an organization to another. Corroboratively, Lovelock and Wirtz (2019) acknowledged services as economic activities offered by one party to another. Similarly, Kotler and Armstrong (2020) defined service as an activity, benefit, offered for sale that is essentially intangible and does not result in the ownership of anything. From these definitions, service is an activity that is being offered by an individual, organization, corporate body to another by giving them the needed sources. So, service should be defined in their own term, not in relation to goods. Effective service as described by Udensi and Akor (2019) is “the standard in the library that can best be determined by looking at library resources capability and utilization, meaning that the effectiveness of the library services can only be judged by its collections, facilities and staff performance”. Library services are day to day activities offered by the university libraries to meet the information needs of the users‟ . This can be rendered in direct or indirect ways. Direct services are those offered to users through direct contact, while indirect services are the behind the scene activities rendered by the library staff. Example of library services are Inter library loan, consortia, gift and donations, Current Awareness Service (CAS), Selective Dissemination of Information (SDI), research support and bibliographic searching, acquisition, information organization, circulation service, reference service, information literacy instruction, digital library service, document delivery, computer and technology service, online service, library outreach, collection development, library assessment and evaluation and reprographic service. These services aim to support the informational, educational and recreational needs of library users and to promote lifelong learning, literacy and community engagement.

Gorman (2010) defined library services as "the provision of resources and assistance to meet the information needs of library users." His definition emphasizes both the availability of resources and the assistance provided to users in accessing and utilising those resources effectively. Ranganathan (1931), an Indian mathematician and librarian, proposed the five laws of Library Science, with the first law stating, "Books are for use." His view emphasized the user-centric nature of library services, focusing on making resources accessible and useful to patrons.

A known library axiomatic is that no library in the world no matter how highly placed is self-sufficient in information collection as to solely satisfy the information needs of her teeming users. This belief has led to the initiation of collaborations, inter-library cooperation and library networking in this era of globalization as a result of the emergence of Information and Communication Technology (ICT) and the associated astronomical growth in information which has given rise to information explosion thereby making it practically impossible for any library to have it all (Yacom, 2021).

The discourse is that no library today can boast of having it all to satisfy all the vital needs and demands of her clientele without recourse to some forms of collaborative assistance or the other. This is non-arguably factual considering the global economic crunch in that no library can say to have sufficient budget to off-set the cost of acquisition, bibliographic processing and storage techniques of information resources which have failed to keep pace with the astronomical growth rate of information and attendant demand placed on libraries to satisfy their users.

Conclusion

The study has revealed that resource sharing is a critical factor in enhancing the availability and accessibility of information across institutions. By leveraging systems such as interlibrary loans, shared cataloging and digital repositories, university libraries can provide broader access to resources, reduce duplication of efforts, and cut costs. Resource sharing fosters collaboration among libraries, allowing them to extend their collections and services beyond their physical boundaries. This leads to increased user satisfaction, more efficient use of library resources, and improved service delivery.

Recommendations

The recommendations are proposed to enhance the effectiveness of resource sharing and improve library service efficiency:

1. Strengthen Collaborative Networks: Universities should enhance partnerships by joining regional, national, and international consortia. This will expand access to diverse resources and enable efficient sharing across institutions.
2. Invest in Advanced Technology: Universities must invest in modern systems such as cloud-based integrated library systems (ILS), shared cataloging platforms, and robust interlibrary loan systems to streamline resource sharing and reduce manual tasks.
3. Standardize Metadata and Cataloging: Standardizing metadata and cataloging practices will ensure seamless resource discovery and accessibility across different library platforms, enhancing searchability and interoperability.
4. Enhance Staff Training: Continuous professional development in resource-sharing technologies and best practices is essential. Well-trained staff can effectively manage systems, improving overall library efficiency.
5. Expand Digital Resource Sharing: Prioritize digital resource initiatives such as shared repositories, e-books, and open-access journals. This reduces dependence on physical resources and improves remote access, especially for users in distant locations.
6. Implement Monitoring and Evaluation: Establish regular monitoring systems to evaluate resource-sharing activities, assess user satisfaction, and identify areas for improvement, ensuring services evolve with user needs.
7. Promote User Awareness: Actively promote resource-sharing services like interlibrary loans and digital repositories through orientation programs, guides, and online tools, ensuring that users fully understand the available services.

This concise and direct version maintains clarity while emphasizing the key actions needed to improve resource-sharing efficiency and library services.
By implementing these recommendations, university libraries can significantly improve the efficiency of their services, expand access to valuable resources, and better support academic research and learning.

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CONCEPTUAL FRAMEWORK ON THE INFLUENCE AND USE OF INSTITUTIONAL REPOSITORY AND CONTINUOUS PROFESSIONAL DEVELOPMENT ON ACADEMIC OUTPUT OF AGRICULTURAL LECTURERS

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Abstract

This paper aimed at designing a conceptual framework of the influence and use of institutional repository and continuous professional development on academic output of agricultural lecturers. Through a conceptual analysis and by synthesizing existing literatures, the paper provided an overview of the concept of academic output, institutional repository, continuous professional development and agricultural lecturers. The paper argued that conceptual model posits that the use of institutional repository directly influences the academic output and continuous professional development of agricultural lecturers in Universities. In the context of the academic institutions, academic output entails ensuring that the lecturers make proper use of the academic resources for their continuous professional development. It also identified that the use of institutional repository in the universities is an essential aspect of creating an effective and efficient method that foster the continuous professional development, academic output and success of all agricultural lecturers. The paper concluded by emphasizing there is no significant relationship between use of institutional repository, continuous professional development and academic output among agricultural lecturers in universities. The study recommended among others that the management of universities should establish clear guidelines on the use of institutional repository to ensuring responsible and proper academic output of agricultural lecturers.

Keywords: Academic output, Continuous professional development, institutional repository, Agricultural Lecturers

Introduction

The university system is organized into either faculties or schools with members as academic staff also known as lecturers. Each faculty is made up of related programmes organized into departments. One of the earliest faculties in Nigerian universities is the Faculty of Agriculture with various programmes which according to Smith et al. (2020) comprised crop production, animal production, soil science, crop science, nutrition, agricultural engineering, pharmacology and the environment. The lecturers in the faculties of agriculture, like their counterparts in other faculties, are involved in teaching, research and Continuous Professional Development (CPD) which are the cardinal functions of any university. Agricultural lecturers are also involved in contributing to the academic output of their universities. These may be through journal articles, books, conference papers as well as participating in CPD programmes and activities. These academic outputs are usually stored and disseminated through the institutional repository (IR).

The Concept of Academic Output

Academic output refers to the tangible results of academic work, including research publications, presentations, and other scholarly achievements (Kumar, 2021). It is a key

indicator of academic productivity and impact (Hicks, 2023). Kumar (2021) defined academic output as the measurable results of academic activities, including research publications, conference presentations, and other scholarly achievements. Hicks (2023) noted that academic output is a critical factor in evaluating academic performance and impact, as it reflects the tangible contributions of scholars to their field. Altbach (2024) stated that academic output is increasingly important in the global knowledge economy, as it drives innovation, collaboration, and societal impact. Oyediran (2022) highlighted the importance of academic output in promoting knowledge sharing and dissemination, stating that academic output is essential for advancing knowledge and understanding in various fields.

According to Simisaye (2019), academic output is critical in the appointment and promotion of lecturers as stated in the service schemes that govern their appointments and promotions. Aside from educational qualifications and relevant experience, they are expected to obtain appointments and promotions based on satisfactory academic output in renowned journals, conference proceedings, and seminar papers, research publications, teaching materials, research data, presentations, theses and dissertations, journal articles, book chapters, conference papers, technical papers to mention but a few as a condition of their job and positions. The number of academic outputs varies by academic rank at tertiary institutions, and a Ph.D. in a relevant field is required for lecturers, particularly university professors (Schimanski and Alperin, 2018).

The concept of institutional repositories

Institutional repositories (IR) are digital platforms designed to collect, preserve, and disseminate the scholarly outputs of academic institutions. They provide a crucial service by offering open access to research outputs such as these, dissertations, journal articles, and datasets. The availability and effectiveness of Institutional repositories in universities can significantly impact the accessibility and visibility of academic research, contributing to enhanced scholarly communication and institutional reputation.

The concept of institutional repositories emerged in the late 1990s as part of a broader movement towards open access and digital preservation. According to Crow (2022), the establishment of Institutional repositories was driven by the need to provide unrestricted access to scholarly work and address issues related to the high cost of journal subscriptions. Initially, Institutional repositories were designed to manage and disseminate electronic theses and dissertations (ETDs), but their scope has since expanded to include a wide range of research outputs.

The development of Institutional repositories was supported by various initiatives and organizations, including the Digital Library Federation (DLF) and the SPARC (Scholarly Publishing and Academic Resources Coalition) (Lynch, 2023). Universities in different countries began adopting Institutional repositories in the early 2000s, driven by the desire to increase the visibility and accessibility of their research outputs. The growth of Institutional repositories was further supported by advancements in digital technologies and the increasing emphasis on open access and institutional accountability.

The availability of institutional repositories in universities has increased significantly over the past two decades. According to Pinfield et al. (2024), many universities have established institutional repositories to manage and disseminate their research outputs. This growth is part of a broader trend towards the digitalization of academic resources and the promotion of open

access. Universities have recognized the importance of Institutional repositories in enhancing research visibility and supporting academic communication.

Enhancing Academic Output using Institutional Repositories

Academic output is a key to the growth and development of societies through the creation of new knowledge and use of existing knowledge in a creative way so as to generate new concepts, methodologies and understandings. In the academia, the concept of academic output is taken seriously in which the promotion of lecturers is dependent on the number of publications they have. This requirement makes it a mandate for them to be productive scholars and the extent to which this mandate is achieved is used to determine the level of productivity lecturers. Academic output is viewed as the measure of an academic's achievement viewed in terms of quantity or quality of publications over a given period of time and considered in terms of the totality of research activities performed by lecturers over a given period of time (Basiru, 2018). On the other hand, the measurement of the quantity of academic output of lecturers is viewed in terms of the numbers of publications in learned, globally accepted indexed databases, number of patents produced, number of chapters in books or books published locally or internationally which are believed to be accepted by high impact refereed or learned journal, publications in conference proceedings, research oriented books, staff bulletins, subject books, technical reports, articles in refereed journals, pamphlets and monographs (Gunawan et al., 2018).

Academic output can be measured using certain methodology and exercises such as the number of published works, chapter contributions in books, book publications including citations in web platforms and monographs. According to Cheng-Cheng Yang (2018), issues such as institutional-related, infrastructural- related, information resources-related and management-related and policy-related factors, among others have been observed and pointed out in other scholarly works as having the tendencies to influence academic output of lecturers in Nigerian universities. Meanwhile, this study is focusing on one of the sub-components of the factors highlighted which is the use of institutional repositories as a key determinant of academic output of lecturers. The use of institutional repositories is a key component of information-resources related factors relating to academic output of lecturers in Nigerian universities.

Institutional repositories (IRs), according to Bamigbola (2018) is an archive for the collection of intellectual outputs of an institution, recorded in a form that can be preserved, exploited and disseminated in a digital form. University libraries have overtime been involved in establishing institutional repositories to acquire, process, store, preserve and disseminate intellectual outputs of lecturers in digital forms to community members and the global community. It is usually an electronic store of web-based scholarly digital documents of theses, journals, books and conference papers owned by the institutions; hence it can be referred to as an extension of digital library which has now become a platform for sharing of knowledge (Bamigbola, 2018).

Extent of use of institutional repository by agricultural lecturers

Institutional repositories (IR) are digital collections designed to capture, store, and disseminate the scholarly output of academic institutions. These repositories have become essential tools in enhancing the visibility, accessibility, and impact of academic research. For agricultural lecturers in universities, Institutional repositories offer an invaluable platform to share research findings on critical agricultural issues, improve accessibility to their work, and comply with open access mandates.

Institutional Repositories (IR) have become integral components of academic institutions, significantly transforming the landscape of scholarly communication. Emerging in the early 2000s, Institutional repositories were developed in response to the rising costs of journal subscriptions and the growing open access movement (Lynch, 2023). This literature review examines the extent of use of Institutional repositories by agricultural lecturers in universities, with a focus on Nigeria.

The concept of Institutional repositories originated as a solution to the crisis in scholarly communication. As journal subscription costs soared, access to academic publications became increasingly limited, prompting universities to seek alternative dissemination methods (Lynch, 2023). Early initiatives, such as DSpace at MIT and EPrints at the University of Southampton, were pioneers in this domain, setting a precedent for the development and adoption of Institutional repositories worldwide.

These early Institutional repositories aimed to provide open access to scholarly outputs, thus enhancing the visibility and impact of academic research. Over the past two decades, the proliferation of Institutional repositories has been notable, with a significant rise in their establishment globally. Developing countries, in particular, have embraced Institutional repositories to improve academic visibility and foster international collaboration (Johnson, 2022).

In Nigeria, the adoption of Institutional repositories has been a gradual yet impactful process. The Nigerian University Commission (NUC) has been instrumental in promoting the establishment of Institutional repositories across universities as part of their academic infrastructure (Adewumi, 2019). This initiative has led to a substantial increase in the number of Institutional repositories in Nigerian universities, facilitating better management and dissemination of scholarly outputs.

Concept of Continuous Professional Development (CPD):

Continuous Professional Development (CPD) refers to the systematic maintenance, improvement, and broadening of knowledge, skills, and personal qualities necessary for professional practice (CPD Standards Office, 2020). It involves ongoing learning and development to enhance performance, stay updated with industry trends, and adapt to changing environments. That is to say, the decisions and actions of teachers in classrooms are influenced by their beliefs. Through CPD, teachers are exposed to new ideas and recent developments in the education field (Mann, 2021).

As such, it is essential to ensure teachers' CPD experiences are positive because then it is more likely that they will want to continue to learn and try new things out in their classrooms (Mann, 2021). The author further added that because effective CPD can positively impact learning gains, it is, internationally, viewed as vital and seen by many as one of the best ways to improve the quality of teaching. Many teachers who engage in CPD are more committed to the profession and to developing and extending their teaching skills.

Conceptual Framework

In explaining the relationship of conceptual model in Figure 2.1, the arrow shows a natural flow among various indicators of the model. The phenomena of the constructs explain the relationship between the dependent and independent variables. Use of institutional repository and continuous professional development are the independent variables, while academic output is the dependent variable. A positive correlation between two variables is when an increase in

one variable leads to an increase in the other variable and a decrease in one variable sees a decrease in the other. Academic output which is the dependent variable should depend on all the independent variables, while the independent variables would positively impact the dependent variable. Each of the independent variable has direct relationship with the dependent variable because they would all enhance the academic output of agricultural lecturers in universities. The conceptual construct of this study is to examine the influence of use of institutional repositories and continuous professional development on academic output of faculty of agriculture lecturers

In Figure 2.1, the conceptual model shows linkages and relationship between influence of use of institutional repository and continuous professional development on the academic output of agricultural lecturers in universities.

The aim of this study is to conceptualise and design a framework on the influence and use of institutional repository and continuous professional development on academic output of agricultural lecturers in universities. Therefore the study will build on the following hypothesis:

Ho1: There is no significant influence of use of IR on academic output of Agricultural lecturers in universities
Ho2: There is no significant influence of CPDs on academic output of Agricultural lecturers in universities
Ho3: There is no composite influence of use of IR and CPDs on academic output of Agricultural lecturers in universities
Ho4: There is no relative influence of use of IR and CPDs on academic output of Agricultural lecturers in universities

Conceptual Model Illustrating the Relationship between use of institutional repositories, agricultural lecturers and academic output.

Recommendations

Given the comprehensive analysis of the multifaceted influence that the use of institutional repository and continuous professional development on academic output of agricultural lecturers in universities have been undertaken in the evolution and enhancement of the dynamics of academic activities within the nation, it is imperative that the government undertakes concerted initiatives to host seminars, workshops, and conferences that ardently emphasize the necessity of lecturer's continuous education across all levels in universities. Additionally, robust financial support from the government is essential to incentivize agricultural lecturer's pursuit of educational attainment. It is an opportune moment for all agricultural lecturers in Nigeria to leverage their positions and successful academic pursuit across various agricultural sectors especially in the Nigerian universities to improve their academic output.

Conclusion

In conclusion, the roles, statuses, and contributions of the use of institutional repository and continuous professional development of agricultural lecturers in universities to the advancement and development agricultural lecturers within the academic sector have significantly enriched the academic profession in Nigeria. Although the institutions repositories and resources used by agricultural lecturers in various capacities and the services they provide exhibit an effective result, which can only be authentically interpreted through a natural lens, the agricultural lecturers in universities have diligently endeavored to propel

academic progress. Consequently, agricultural lecturers in universities have harnessed their strengths and capabilities and achieved recognition not through positions but through the steady and quiet manifestation of actions that epitomize the essence of continuous professional development.

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A REVIEW ON THE USE OF ARTIFICIAL INTELLIGENCE COUNSELLING CHATBOT AMONG SECONDARY SCHOOL STUDENTS IN NIGER STATE, NIGERIA

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Abstract

The paper present a review on the use of Artificial Intelligence Counselling Chatbot among Secondary School Student in Niger State, Nigeria. Artificial intelligence counselling Chatbot (AICC) are computer programs design to stimulate human speech through text or voice interactions. It can be describe as artificial constructed soft were using natural language as input and output to communicate with human. The primary purpose of a Chatbot, which can participate in written or spoken conversation, is to stimulate intelligent human speech to the need of learners. Thus the students can have opportunity to experience a real like Chat process. Various name are given to Chatbot such as AI assistant, smart virtual assistants, digital assistants, speech agents, virtual agents, achievement bot. creative bot candy, harmony, amazebot, helper bot, the botfather, lovely bot, smiles bot happiness, jokester bot good vibes bot joy bot amusing bot hearty bot joyous, helpy, happy bot chuck and Russell. This review summarise relevant research on meaning of overview guidance and counselling, artificial intelligence counselling Chatbot. The paper also underscores the future of artificial intelligence technologies in education and benefit of artificial intelligence in education which consist of access to personalized learning improvement of student's performance were also identified in the study. The paper concluded by advocating for further researches on the use of artificial intelligence counselling Chatbot (AICC) for teaching guidance and counselling in secondary schools. Government organizations, agencies and non-governmental organization should fund more researches on the use of artificial intelligence counselling Chartbot in Nigeria School, procure technologies that can enhance the use of AICC for teaching and learning in schools. Schools authorities and management should provide enabling environment for counsellors, teachers and students for effectively use of AICC for their teaching activities more seminars conference and workshops should be organized for educational stakeholders to meet up with global technologies.

Key words: Artificial Intelligence Counselling Chartbot

Introduction

With Development of modern technology in the 21st century, educators and learners of all stripes now have access to an abundance of electronic gadgets and innovative applications, through Technology which has created opportunities for rich and creative ways to address problems in education and offer answers to the growing demands on learning resources like Artificial Intelligence (AI).

Artificial Intelligence (AI) powered devices are gaining popularity, from self-driving cars to customer service with virtual assistants like chartbot (Nayak *et al.*, 2023). The development of AI is going beyond what people can imagine, chatbot is increasingly asserting its important

role in many areas of life. Artificial Intelligence plays an essential role in developing a chatbot that can learn how to understand humans and make a decision. The most important components of the artificial intelligence that can make a successful chatbot are natural language processing (NLP) and Machine Learning (ML) (Khan and Rabbani, 2021; Bird *et al.*, 2021). Chatbots are being researched and developed at a rapid pace. The application of chatbots in career guidance and admissions consulting is increasingly attracting the attention of secondary schools (Su *et al.*, 2020). Furthermore, the construction and completion of chatbot tools based on information technology enrollment data, and career counselling data contribute to the effective support for enrollment counselling at secondary schools throughout the country.

Counselling chatbots are defined as conversational tools that represents a counsellor in providing students with instant services and responses. According to Su *et al.* (2020). a counselling chatbots is a tool that combines artificial intelligence (AI) and natural language processing or other technology, which enables it to interact to a certain level of conversation with a human interlocutor through text or voice.

Counseling chatbots have been gaining popularity in a variety of industries because of their ability to mimic human conversation, which results in automated services and, consequently, reduced human labor. A counselling chatbot structure for guidance and counselling students would need to be able to take input from the student, such as questions, concerns, or personal information. This might be through text input, audio input, or a combination of both. The possibilities offered by counselling chatbot as an educational tool encourages students to use this technology.

Counselling chatbot can be used to encourage student engagement and participation in class discussions or activities, by asking questions or providing feedback in a non-judgmental and interactive way without or with little support of their school counsellors. Students are encouraged by their school counsellors to take responsibility for learning and develop self-regulation skills by having autonomous conversations with the counseling chatbot (Ait Baha et al., 2023).

Overview of Guidance and Counselling

Guidance and counseling are crucial tools in the educational line for guiding children away from the harmful notions in a child induced by his/her peers or environment to a positive perspective. Hence, every school needs a guidance counselor to help modify the children's future through counseling therapy. There is high regard and admiration given to the school guidance counselor by the students. Counselors are expected to become friends with schoolchildren, listen to their complaints and shortcomings, and provide them advise to mould them into the appropriate path for their future endeavours (Nkechi *et al.*, 2016). There are various guidance services that the school guidance counsellor is expected to follow to help solve student's educational problems, these services are the basic elements of the guidance and counselling programs; they are the official schedules or steps the school guidance counsellor takes to make guidance and counselling operational and available to students (Lasisi and Ibrahim, 2024).

Overview of Artificial Intelligence Counseling Chatbot

Artificial intelligence (AI) refers to the ability of a computer to exhibit human-like intelligence. An AI chatbot is a natural-language processing system that uses artificial intelligence technology to independently engage in conversation with humans. Chatbots are software programs designed to interact like humans. They are distinguished by their use of machine

learning and deep learning, which enable them to process data more efficiently and improve the quality of their responses through repeated learning (Wilson and Marasoiu, 2022). Digital intervention platforms are taking various forms, such as mobile applications, telehealth, and web-based interventions. AI chatbots represent the latest innovation being employed in health interventions (Kim, 2024).

Future of Artificial Intelligence Technologies in Education

As technological change accelerates, there is an urgent need for supporting education systems in managing new opportunities and risks. If managed well, technology – particularly artificial intelligence (AI) – offers a unique opportunity to help education systems enable Education 4.0 – teaching and learning approach that focuses on providing learners with the abilities, skills, attitudes and values fit for the future (World Economic Forum, 2024). UNESCO (2024) mandate calls inherently for a human-centred approach to AI. It aims to shift the conversation to include AI's role in addressing current inequalities regarding access to knowledge, research and the diversity of cultural expressions and to ensure AI does not widen the technological divides within and between countries. Furthermore, UNESCO has developed within the framework of the Beijing Consensus a publication aimed at fostering the readiness of education policy-makers in artificial intelligence. This publication, Artificial Intelligence and Education: Guidance for Policy-makers, will be of interest to practitioners and professionals in the policy-making and education communities.

Benefits of artificial intelligence technologies in education

For the past decade, chatbots have been increasingly integrated into various facets of education, including assessments, admissions, consultations, and campus life. Using AI-driven virtual assistants may improve efficiency and create leaner workflows. By automating routine tasks such as course registration and student inquiries, staff can attend to more complex and pressing issues. Chatbots can potentially enhance student engagement and retention by providing personalised recommendations, proactive reminders, and timely interventions.

Conclusion

The use of artificial intelligence counselling Chatbot (AICC) will enable learners solve their emotional problems, maintaining their good mental health, facilitating their behavioural changes, enhancing their decision making and enhancing their personal effectiveness with the aid of the Chatbot. Hence, need for further researches on the development of AICC for teaching guidance and counselling among secondary students. Government organisations, agencies and Non-Governmental Organisations should fund more researches in AICC in Nigeria, procure technologies that can enhance the use of AICC for teaching and learning in schools. School authorities and management should provide enabling environment for teachers and students to effectively use AICC for their teaching and learning activities. More conferences, seminars and workshops should be organised for Nigerian educational stakeholders to meet up with the global technologies. Research institutes in Nigeria should consider the designing and development of AICC for educational purposes to improve education among guidance and counselling students in Nigeria.

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THE USE OF EDCAMP PLATFORM FOR TEACHER PROFESSIONAL DEVELOPMENT: A BRIEF REVIEW

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Abstract

This paper examines a review on the use of Edcamp platform for Teacher Professional Development (TPD). Edcamp platforms are participatory professional development events where educators lead their learning and professional networking through collaboration and shared experiences, rather than traditional sit-and-get professional development presentations. This review summarises relevant research on use of Edcamp for TPD. The paper also highlights the benefits of Edcamp which consists of participant-centered approach, career development and building professional connections. Participating in an Edcamp event contributes to an educator's professional growth and development. Educators can acquire new knowledge and strategies by participating in sessions that align with their interests. These learned new skills can help to enhance their effectiveness as a teacher and may even lead to new opportunities or enhanced student performance. Additionally, Edcamps can inspire educators by being with like-minded people who motivate them to further their career development. Government organisations, agencies and Non-Governmental Organisations should fund more researches in TPD in Nigeria. School authorities and management should provide enabling environment for teachers to effectively use Edcamp platform for their TPD. More conferences, seminars and workshops should be organised for Nigerian educational stakeholders to keep them abreast with the emerging model of TPD.

Keywords: Edcamp Platform, Teacher Professional Development

Introduction

Educators' work is dynamic and complex. To keep pace with changes in students, technologies, and education policies, teachers must pursue professional learning beyond their pre-service preparation. Teachers need to continuously improve themselves professionally in order to keep abreast with the latest trends in teaching approaches and techniques in the field of education. Definitely, keeping up-to-date and relevant is key to adequately address adequately students' learning needs and helping them successfully attain their full potential. Improving and maintaining qualified teachers is very important to provide quality education at all levels of education, especially in the primary schools. Teacher professional development (TPD) which is a programme designed to improve the quality of teachers has moved away from traditional face-to-face, single-location training and towards developmental activities in advanced web-based environments in times of Information Communication Technology (ICT). Bragg *et al.* (2021) stated that online groups, whether institutionally based or not, have a lot of potentials for offering online teacher professional development. Online professional development refers to any web-based form of learning or process of professional growth that teachers can participate in, with the aim of enhancing their job performance in areas such as content knowledge, skills, or pedagogical abilities (Elliott, 2017). Technologies can be used as channels of delivering professional development.

The developments in learning technology have had an influence on professional development courses (Wilson *et al*., 2022). The value of using online TPD as a model for teacher professional development is becoming increasingly clear, especially when it comes to assisting teachers and educators in reflecting on their practice in a supportive and collaborative learning environment. TPD is however viewed as something virtual due to rising globalization and the Internet's rapid development, growth, and accessibility (Kavoshian *et al.*, 2022). Moodley, (2019) argued that a community of practices is more than just a website, database, or group of best practices; he asserted that it is a collection of people who interact, share knowledge, form connections, and are engaged in a process of belonging and interdependence. As a result, web-based professional development model can not only enhance teachers' professional knowledge and experience, but also assist them in breaking location boundaries (Elliott, 2017). One of such web-based professional development model is Edcamp.

Edcamp is an "un-conference" model of professional development created by teachers for teachers. The model is built on the idea that teachers can learn from and inspire one another to enhance their professional skills with the goal of improving student learning outcomes. Organized by teacher volunteers, Edcamps are participatory professional development events where educators lead their learning and professional networking through collaboration and shared experiences, rather than traditional sit-and-get professional development presentations (Noakes, *et al*., 2022).

Overview of teacher professional development

Teacher Professional Development (TPD) refer to a wide range of activities in which teachers participate, such as information meetings, study days, 1-day workshops and training sessions; coaching and mentoring, classroom observations, participation in a network, offsite team training sessions, book and study clubs; and research projects. Most of the current TPD activities can be characterized as traditional forms of TPD. Traditional refers to the way TPD was organized for the last decades: mainly through lectures, 1-day workshops, seminars and conferences, which were not situated at the workplace, in which teachers played a passive role, and in which the content was not adjusted to the problems and issues in the daily teaching practice. Innovative forms refer to all those interventions in which teachers do play an active role, and the issues in their own teaching practice determine the content. Some examples are collaboration of colleagues, study and book clubs, mentoring, coaching and research by teachers. It also includes the discourse on professional learning communities in which the emphasis is on the collective responsibility of teachers for the learning of their students and insights on teaching and TPD (Borko, 2019).

In this present dispensation, teachers need to continuously improve themselves professionally in order to keep abreast with the latest trends in teaching approaches and techniques in the field of education. Definitely, keeping up-to-date and relevant is key to adequately address adequately students' learning needs and helping them successfully attain their full potential. Improving and maintaining qualified teachers is very important to provide quality education at all levels of education, especially in the primary schools. Teacher professional development (TPD) which is a programme designed to improve the quality of teachers has moved away from traditional face-to-face, single-location training and towards developmental activities in advanced web-based environments in times of Information Communication Technology (ICT). Bragg *et al*. (2021) stated that online groups, whether institutionally based or not, have a lot of potentials for offering online teacher professional development. Online professional development refers to any web-based form of learning or process of professional growth that

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Benefits of edcamp platform

Edcamps offer several benefits for educators to learn, grow, share, and connect in a laid-back atmosphere. The benefits of using among others include: The unique features of Edcamps that make them so widely popular is that they are driven by the interests and needs of the participants. Since Edcamps are informal and follow no real structure or agenda, topics are decided by attendees unlike in a professional development workshop where they are decided by a committee or the presenter. All participants whether they are first-year teachers, or an administrator are encouraged to choose topics that are relevant to them. This type of personalized experience makes these events more engaging because learning is aligned with the needs of the individual attendee. Edcamps provide a space for educators to collaborate and network with others. Participants are encouraged to share their knowledge and experience on the topics that are relevant to them. Since there is no main expert presenter, participants share and collaborate with one another fostering a sense of community and professional support all while networking. These informal interactions with others from various educational

backgrounds lay the foundation for collaborative networking that will help contribute to an enriching learning experience.

Participating in an Edcamp event contributes to an educator's professional growth and development. Educators can acquire new knowledge and strategies by participating in sessions that align with their interests. These learned new skills can help to enhance their effectiveness as a teacher and may even lead to new opportunities or enhanced student performance. Additionally, Edcamps can inspire educators by being with like-minded people who motivate them to further their career development.

Influence of edcamp platform on teacher performance

Edcamps have come into existence during a time in which technology has increased many educators' access to a variety of new approaches to professional learning. Today, it is relatively common for educators to reach beyond their schools and districts to find and share resources and to collaborate with far flung colleagues (Ramdani *et al.*, 2023). For example, more than half of the respondents from a survey of 20,000 U.S. teachers indicated that they utilized technology to collaborate with colleagues with whom they probably would not have interacted otherwise (Carpenter and Green, 2017). Twitter, Facebook, Edmodo, Voxer, and other platforms provide spaces for educators to connect and pursue professional learning that aligns with their needs and interests (Scot, 2021). Sharing ideas and virtually mentoring colleagues beyond one's school is appealing to some educators who seek to contribute to their profession (Wiesehahn, 2024).

Technology often plays an important role in many new approaches to professional learning, educators also interact across traditional boundaries in blended and face-to-face settings (Ramdani *et al.*, 2023). Recent research suggestted participants often have quite positive perceptions of grassroots informal, participant-driven forms of professional learning; however, their impact upon teaching and learning remains largely uncertain and under-researched. Informal learning is often unstructured (Yurkofsky *et al.*, 2019), and educators can at times be unaware of their own informal learning (Yudi *et al.*, 2023), both of which can make it challenging for researchers who are trying to explore such professional learning. So while there appears to be interest in and enthusiasm for new approaches to educator professional learning, it remains unclear what factors contribute to or hinder their impact upon teaching and learning. Edcamp platform offers teachers unique platform to help them share new insights and practices for teaching. Enhancing its well-established, participant-driven model for teachers by teachers, the Edcamp team develop a series of online Edcamps infusing learning sciences principles centered on Learning framework to help educators better understand how learning happens and how to apply this knowledge to learning design. The series combined insights from research with the Edcamp model and invited educators into the co-design process to create spaces for educators to learn relevant, immediate, and essential skills while connecting with one another to surface challenges and share insights into what is working for their learners (Noakes *et al.*, 2022).

Conclusion

The use of Edcamp platform will enable teachers have access to innovative and contemporary TPD, increase their pedagogical performance, interest and job satisfaction. Government organisations, agencies and Non-Governmental Organisations should fund more researches in TPD in Nigeria. School authorities and management should provide enabling environment for teachers to effectively use Edcamp platform for their TPD. More conferences, seminars and workshops should be organised for Nigerian educational stakeholders to keep them abreast

with the emerging model of TPD. Research institutes in Nigeria and Teacher Professional Department should consider the use of Edcamp platform for training and re-training of teachers to improve communication and collaboration among themselves which will in turn enhance pedagogical performance.

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AI FOR CREATIVITY AND INNOVATION IN LIBRARY AND INFORMATION SCIENCE

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Abstract
The integration of Artificial Intelligence (AI) into Library and Information Science (LIS) services has brought about significant transformations in the way libraries manage and provide access to information. This article examines the impact of AI technologies on various aspects of LIS, including cataloging, information retrieval, user services, and data analysis. This paper presents a literature review on the application of Artificial Intelligence (AI) in libraries and its impact on library operations and media studies. It aims to illuminate the current state of employing AI applications in libraries to enhance knowledge management, elucidating the correlation between AI applications and their capacity to advance technical and administrative processes in knowledge management libraries. It provides researchers with a comprehensive understanding of AI in the library science and media studies context. Additionally, the paper highlights AI's advancements, challenges such as privacy concerns and algorithmic biases which must be addressed to ensure responsible AI implementation in Library and Information Science (LIS) and media studies. Finally, this paper listed key developments, benefits, challenges, and future implications of AI on LIS and media studies. It highlights its potential to enhance library operations and improve information access for diverse user communities. It recommends that AI-driven tools can provide service such as recommendation systems, chatbots, and natural language processing, it can enhance user experiences by enabling personalized recommendations and efficient information retrieval.

Keywords: Artificial Intelligence, AI in Libraries, AI in Media Studies, AI in Library Services, AI Chatbots, AI Review, Robots in Libraries, Intelligent Libraries, Smart Libraries

Introduction
According to Vagdal (2022), the contemporary world has undergone significant technological transformations that impact the lives of individuals and institutions alike. This change is not restricted to a specific group but permeates every aspect of society. Technological advancements have become integral to daily life, offering substantial benefits to everyone. Amidst the information explosion, various applications have emerged to streamline operations, with artificial intelligence (AI)applications standing out as a significant development.

AI applications have revolutionized and simplified numerous human processes, repltcating actions through specially designed systems. These applications encompass all processes that emulate the ingenuity and innovation of electronic computers. The ongoing evolution of modern information and communication technologies plays a crucial role in knowledge management across diverse fields. Consequently, institutions handling information must adapt to these changes and effectively respond in their communication services to cater to the needs of beneficiaries (Vagdal, 2022).

Statement of the Problem

The sectors of Creativity and Library and Information Science have been confronted with the challenges of realizing its functions, such as, Expert Systems, Reference Services, Natural Language Processing, Pattern Recognition, Robotics, etc and quality of LIS services in general. Also, Creativity and LIS sectors are faced with the problems of using adequate and latest library and information science (LIS) management tools to support various activities that are involved in these sectors. These challenges posed a serious hindrance to the achievement of LIS sector's development in Nigeria. However, the paper addresses these challenges, that all LIS staff can change these challenges in terms of implementation of AI in Creativity and Library and Information Science to enhance the delivery of services and related activities in the library. Therefore, the paper highlights the relevance of AI utilization in Creativity and Library and Information Science development in Nigeria. The paper delves into AI's adoption in Creativity and Library and Information and Science (LIS) in Nigeria for future professional landscapes in Nigeria.

Objectives of the Study

The paper investigates the utilization of AI to facilitate creativity in Library and Information Science services and development in Nigerian libraries. It ascertains the extent of application and effective utilization of artificial intelligence in AI-driven LIS in Nigeria. It also highlights the applications, advantages and disadvantages of artificial intelligence and identify factors affecting the adoption of Artificial Intelligence in Creativity and Library Science in Nigeria. Finally, the paper pinpoints the hindrances and proffers solutions to the implementation of AI in Creativity and Library Science in Nigeria.

Literature Review

Definitions of AI

Librarians, like many professionals in various fields, encounter both opportunities and challenges with the integration of AI services into their work. Here are some of the key issues that librarians may face with AI services, particularly concerning ethics and accuracy:

Algorithmic bias: AI systems can inherit biases present in the data used to train them. Librarians may need to be cautious about the potential biases in the datasets that power AI tools, especially regarding information retrieval. If the training data contains biases, the AI system may perpetuate and amplify those biases, leading to biased search results.

Privacy concerns: AI tools often rely on vast amounts of data to improve their performance. Librarians must consider the privacy implications of collecting and using patron data to enhance AI services. Ensuring compliance with privacy regulations and protecting user data from misuse is crucial.

Ethical use of AI: Librarians are responsible for ensuring that AI services are ethically deployed and aligned with professional and ethical standards.

Accuracy and reliability: Librarians need to assess the accuracy and reliability of AI-generated information.

User education: Librarians may face the challenge of educating users about the limitations and capabilities of AI services.

Limited understanding of AI: Some librarians may have limited understanding of AI technologies, which can pose a challenge in effectively integrating these tools into library services.

Resource allocation: Implementing and maintaining AI services may require additional resources, including financial investments, training programs, and ongoing support.

Digital divide: The use of AI services in libraries may exacerbate existing digital divides if certain user groups lack access to technology or have limited digital literacy skills. Librarians need to be mindful of inclusivity and work towards providing equitable access to AI-enhanced services.

Representation in training data: If the training data used to develop AI services lacks diversity, it can result in biased algorithms. Librarians should advocate for diverse and representative datasets to mitigate the risk of perpetuating racial biases in AI systems.

Fairness and equity: Librarians must ensure that AI services are designed and deployed with fairness and equity in mind.

Transparency: Librarians should advocate for transparency in AI algorithms and decision-making processes. Understanding how AI systems work is crucial for identifying and addressing potential biases, including race-related ones.

Community engagement: Librarians can engage with their communities to understand their perspectives and concerns related to AI and racial bias.

Education and awareness: Librarians play a role in educating both staff and users about the potential biases in AI systems and how they can impact different racial and ethnic groups.

Ongoing monitoring and evaluation: Librarians should continuously monitor and evaluate the performance of AI services to identify and address any emerging issues related to racial bias.

AI and Creativity

According to Fortino (2023), the emergence of artificial intelligence (AI) has brought a new dimension to the creative process, allowing artists to explore uncharted territories and push the boundaries of their imagination.

AI's Role in the Creative Process

Artists have always sought innovative ways to express their ideas, and AI is now enabling them to do just that. Whether you're a painter, musician, writer, or any other type of creative, AI has the potential to enhance your artistic journey in numerous ways:

Inspiration and Idea Generation: AI can analyze vast amounts of data and generate unique concepts that might inspire an artist's next masterpiece. It can create unexpected connections between diverse concepts, fueling the artist's creative spark.

Visual Exploration: For visual artists, AI-generated images can serve as starting points for new creations. AI algorithms can create abstract patterns, morph images, or generate unique compositions that artists can incorporate into their work.

Music Composition: Musicians can harness AI to compose melodies, harmonies, and even entire pieces of music. AI can analyze existing compositions and generate original musical ideas, freeing artists to experiment with new genres and styles.

Textual Creativity: Writers and poets can benefit from AI-generated text prompts, which can kickstart the writing process. AI can generate sentences, ideas, or even entire paragraphs that serve as springboards for crafting engaging narratives.

Yet, working with AI presents a novel set of challenges that artists must navigate. While AI can be a powerful tool, the balance between human intuition and technological assistance remains delicate to achieve. Key challenges include:

Maintaining Artistic Authenticity*:* One of the foremost challenges is preserving the artist's unique voice and authenticity. AI-generated content might sometimes dominate the creative process, losing the artist's individuality and emotional depth in the final artwork.

Over-reliance on AI: Relying too heavily on AI-generated elements can hinder an artist's own creative skills. Artists might become dependent on AI for ideas, stifling their ability to innovate and think critically.

Balancing Skill Development: Using AI might tempt artists to skip traditional skill-building processes. This could lead to a decline in manual techniques and artistic proficiency over time.

Limited Artistic Intuition: AI-generated content is based on patterns and data, often missing the intuitive leaps and creative insights that artists make. This can result in artworks that lack the spontaneity and imaginative leaps unique to human creativity.

Blurring of Boundaries: The line between what constitutes the artist's creation and the AI's contribution can become blurred. Artists must grapple with ethical concerns related to authorship and ownership of AI-generated content. Determining who owns the rights to the AI-enhanced artwork can be complex, especially when AI generates significant portions of the composition.
How can artists reap the benefits without becoming overly dependent on technology? Let’s dive in.

A Generalized Use of AI
The challenges of using AI in art underscore the difficult interplay between technological innovation and artistic expression. As artists embrace AI as a creative tool, they must navigate these challenges with mindfulness and creativity, finding ways to harness the benefits of AI while preserving their unique artistic identity and emotional resonance.

Bottomline: The transformational potential of artificial intelligence within the artistic domain is not about replacing the artist's touch but rather enhancing it. Despite AI-specific challenges, there are systematic ways to navigate the uncharted waters of AI-enhanced artistic expression without sacrificing the human touch. When working with AI, artists could use the following method:

Identify Your Objective*:* Determine the specific aspect of your creative process that you'd like to enhance using AI. Whether it's generating ideas, creating visuals, composing music, or something else, defining your objective is the first step.

Select the Right AI Tool: There are various AI tools and platforms designed for different creative domains. Research and choose the AI tool that aligns with your artistic goals. For instance, artists might consider tools like Google's DeepDream for image manipulation or Jukedeck for music composition.

Generate AI-Enhanced Content*:* Once you've selected your AI tool, start generating AI-enhanced content. For instance, if you're a painter, experiment with AI-generated images that can serve as the foundation for your artwork.

Integrate AI Output*:* Incorporate the AI-generated content into your creative work. This could involve blending AI-generated visuals into a traditional painting or weaving AI-generated melodies into a musical composition.

Iterate and Collaborate*:* Don't hesitate to experiment with multiple iterations of AI-generated content and integrate feedback from peers or mentors. Collaboration can help refine your creative vision and ensure a seamless integration of AI elements.

Add Your Artistic Touch*:* While AI can enhance the creative process, remember that your artistic touch remains crucial. Use AI-generated content as a foundation, and then infuse it with your unique style, emotions, and personal narrative (Fortino, 2023).

Vagdal (2022) mentioned that various domains of AI find application in library management systems for the processing of digital information. These include:

AI and Library Information Science

AI can offer several benefits to librarians and their patrons, such as improving the efficiency and accuracy of library data, increasing the relevance and diversity of resources and services, expanding access to information, and supporting innovation and learning. AI can reduce manual and repetitive tasks for librarians, minimize errors and inconsistencies in data, provide tailored recommendations to patrons, enable interactions with the library anytime and anywhere, and facilitate the discovery of new knowledge (Library Science, 2024).

Expert Systems in Library Systems: Expert systems, a component of Artificial Intelligence (AI), play a crucial role in library systems by serving as advanced decision-making tools. These systems are designed to emulate the decision-making capabilities of human experts in specific domains. In the context of library management, expert systems contribute by providing intelligent solutions to complex problems and aiding in decision support.

Vagdal (2022) listed some of the application of expert systems in library systems, which involves the following key aspects:

Knowledge Representation: Expert systems encode and store knowledge from domain experts, creating a knowledge base that encompasses various aspects of library management, including cataloging, user queries, and resource allocation.

Inference Engine: The inference engine of an expert system processes the stored knowledge and applies logical reasoning to draw conclusions or make decisions. In library systems, this facilitates efficient problem-solving, aiding in tasks such as recommending relevant resources or suggesting classification methods.

User Interaction: Expert systems in libraries often incorporate user interfaces that allow librarians or patrons to interact with the system. Users can input queries, and the expert system utilizes its knowledge base and inference engine to generate intelligent responses or recommendations.

Decision Support: One of the primary roles of expert systems in library management is to provide decision support. Librarians can rely on these systems to make informed decisions regarding resource acquisition, cataloging procedures, and user assistance, among other functions.

Continuous Learning: Some expert systems in libraries are designed to adapt and learn from new information or user interactions. This adaptability ensures that the system remains up-todate and responsive to evolving library needs.

Reference Services as AI in Library Systems:
Reference services, integrated as part of Artificial Intelligence (AI) in library systems, play a pivotal role in providing intelligent and personalized assistance to users. These services leverage AI technologies to enhance the efficiency and effectiveness of information retrieval, user support, and knowledge dissemination within the library environment. Also, Vagdal (2022) listed some key aspects illustrating how reference services function as AI in library systems:

1. User Queries and Natural Language Processing (NLP): Reference services often incorporate Natural Language Processing (NLP) capabilities, allowing users to pose queries in a natural language format. AI algorithms then analyze and interpret these queries, facilitating more accurate and contextually relevant search results

2. Knowledge Base: Reference services utilize a comprehensive knowledge base that encompasses diverse subject areas, databases, and resources. This knowledge base is continuously updated to ensure relevance and accuracy, enabling the system to provide well-informed responses to user queries.

3. Recommendation Systems: AI-powered reference services often incorporate recommendation systems. These systems analyze user preferences, past interactions, and search patterns to suggest relevant resources, books, articles, or other materials, enhancing the user experience.
4. Multimodal Search: Advanced reference services may support multimodal search capabilities, allowing users to search using various formats such as text, images, or voice commands. AI algorithms then process and interpret these inputs, delivering comprehensive and contextually rich results.

5. User Assistance and Chatbots: AI-driven reference services may feature virtual assistants or chatbots that engage with users in real-time. These chatbots can answer routine queries, provide navigation assistance, or guide users in accessing specific library resources, freeing up human staff for more complex tasks.

6. Data Analytics for Usage Patterns: AI algorithms in reference services can analyze usage patterns, identifying trends in user behavior. This data-driven insight helps libraries optimize resource allocation, collection development, and service improvements based on user preferences.

7. Continuous Learning and Improvement: AI-driven reference services often incorporate machine learning algorithms, enabling continuous learning and improvement. The system learns from user interactions, feedback, and evolving information landscapes, ensuring that it adapts to changing user needs over time.

Natural Language Processing (NLP) in Library Systems:

Natural Language Processing (NLP) serves as a cornerstone of Artificial Intelligence (AI) in library systems, revolutionizing the way users interact with information and resources. NLP technologies enable machines to understand, interpret, and generate human-like language, enhancing the efficiency and accessibility of library services. Additionally, Vagdal (2022) mentioned how NLP functions as AI in a library system:

1. **User Query Understanding**: NLP algorithms are employed to comprehend user queries in natural language. This capability allows library systems to accurately interpret the intent behind user questions, enabling more precise and contextually relevant search results.

2. **Semantic Search**: NLP facilitates semantic search, going beyond simple keyword matching. By understanding the semantic meaning of words and phrases, library systems powered by NLP can retrieve information that aligns with the user's intent, even if the exact terms are not used.

3. **Automated Cataloging and Indexing**: NLP plays a crucial role in automating cataloging and indexing processes. By analyzing textual content, NLP algorithms can identify key concepts, themes, and metadata, streamlining the organization of library resources and enhancing discoverability.

4. **Content Summarization**: NLP technologies can be applied to automatically generate concise summaries of lengthy documents. This aids users in quickly understanding the essence of a resource, helping them decide whether it meets their information needs.

5. **Multilingual Support**: NLP enables library systems to support multiple languages, allowing users to interact with the system in their preferred language. This inclusivity enhances accessibility for diverse user groups.

6. **Chatbots and Virtual Assistants**: NLP is integral to the development of chatbots and virtual assistants in library systems. These AI-driven interfaces can engage in natural language conversations with users, answering queries, providing information, and assisting with various library-related tasks.

7. **Sentiment Analysis:** NLP can be employed for sentiment analysis to gauge user reactions and feedback. This insight helps libraries understand user satisfaction, identify areas for improvement, and tailor services to meet user expectations.

8. **Automatic Document Classification**: NLP algorithms can automatically classify documents based on their content. This classification simplifies the organization of resources within the library, making it easier for users to locate relevant materials.

9. **Accessibility Improvements:** NLP can contribute to making library services more accessible. For instance, it can assist in converting text to speech, aiding users with visual impairments in accessing written content.

Pattern Recognition in Library Systems:
Pattern recognition, a key facet of Artificial Intelligence (AI), is instrumental in shaping the capabilities of library systems. By employing advanced algorithms, pattern recognition contributes to the efficient organization, retrieval, and analysis of information within a library environment. Here's how pattern recognition functions as AI in a library system:

Content Classification: Pattern recognition algorithms are utilized to automatically classify and categorize diverse types of content within the library's collection. This includes books, articles, multimedia, and other resources. Automated content classification enhances the efficiency of library cataloging processes.

Facial Recognition for User Authentication: In the context of library security and user authentication, pattern recognition is applied in facial recognition systems. This technology helps verify the identity of users, ensuring secure access to restricted areas or personalized library services.

Book Cover Recognition: Library systems may employ pattern recognition to identify and recognize book covers. This aids in creating visual catalogs, enhancing the user experience, and facilitating quick identification of resources based on visual cues.

Anomaly Detection in User Behavior: Pattern recognition algorithms can identify anomalies in user behavior, such as unusual borrowing patterns or access requests. This helps in detecting potential security threats or unauthorized activities within the library system.

Handwriting and Text Recognition: For handwritten notes or annotations within library resources, pattern recognition is applied to convert these handwritten elements into machine readable text. This enhances the accessibility and searchability of handwritten content.
User Preferences Analysis: Pattern recognition algorithms analyze user interactions and borrowing history to identify patterns in user preferences. This information can be leveraged to provide personalized recommendations and improve the overall user experience.

Text Mining and Analysis: Pattern recognition is employed in text mining to analyze large volumes of textual information. This includes extracting key concepts, identifying trends, and uncovering valuable insights from textual data within the library's digital resources.

Shelf Reading and Inventory Management: Libraries utilize pattern recognition for efficient shelf reading and inventory management. Automated systems can recognize the placement of books on shelves, identify missing items, and streamline the process of maintaining an up-to-date inventory.

Visual Search: Pattern recognition enables visual search capabilities within library systems. Users can initiate searches using images or visual cues, and the system employs pattern recognition algorithms to identify and retrieve relevant resources based on visual patterns.

Robotics in Library Systems:

The integration of Robotics as part of Artificial Intelligence (AI) in library systems introduces innovative approaches to automate and enhance various tasks. Robotics in libraries involves the deployment of physical machines capable of performing specific functions to improve efficiency and user experiences.

Vagdal (2022) highlights how Robotics functions as AI in a library system:

1. **Automated Book Retrieval**: Robotics can be employed to automate the process of retrieving books from shelves. Robotic systems equipped with sensors and actuators can navigate library aisles, locate specific books based on user requests, and retrieve them efficiently.

2. **Shelf Management:** Robotic systems assist in maintaining organized shelves by ensuring that books are correctly arranged. They can scan shelves for misplaced items and autonomously reposition books, contributing to efficient library inventory management.

3. **Book Sorting and Returns**: process. Automated systems can categorize returned books, reshelve them based on predefined criteria, and update the library database in real

4. **Interactive Guiding and Assistance**: provide interactive guidance and assistance locate specific sections, offer information about library services, and even engage in natural language interactions to answer queries.

5. **Security and Surveillance**: deployment of autonomous surveillance robots. These robots can monitor the library environment, detect anomalies, and ensure the safety of both patrons and library resources. **6. Maintenance and Cleaning Tasks**: maintenance and cleaning tasks within the library. This includes tasks such as dusting shelves, vacuuming, and ensuring the overall cleanliness of the library space.
7. **Inventory Auditing**: Robotic systems equipped with inventory can conduct regular audits of library collections. This ensures accuracy in the catalog and helps identify any discrepancies between the physical inventory and the digital database.

8. **Collaborative Learning:** within libraries. Interactive robots equipped with educational content can engage users in interactive learning sessions, making the library a dynamic educational space.

9. **Specialized Services:** Libraries can deploy specialized robots designed for specific tasks. For example, robots with built contributing to the creation of digital archives and expanding accessibility.

10. **Event Support:** Robots can assist in organizing and supporting events within the library. This includes setting up equipment, managing logistics, and providing information to attendees during library

Theoretical Framework

Diffusion of Innovations Theory

According to Oyedeji and Uthman (2024), the Diffusion of Innovations Theory by Everett Rogers (1995) provides a robust framework for understanding the adoption of AI in journalism

within the Nigerian context (Rogers, Singhal, & Quinlan, 2014). This theory explains how new technologies spread across cultures by examining the innovation's characteristics, communication channels, time, and the social system involved. While journalism in its entirety is not "material culture," it does have its own intricate professional culture, which makes it stand out as a profession. All professions have their own cultures, which refer to the dynamics and realities of operations within such fields, and of course, the standards of practice and behaviour vary across professions. Given the proliferation and adoption of AI-integrated technologies, the landscape of media communication has changed significantly (Kothari & Cruikshank, 2022). AI technologies offer a significant relative advantage over traditional journalism methods by enhancing news gathering, content creation, fact-checking, and operational efficiency (Diakopoulos, 2019). Their compatibility with Nigeria's existing digital infrastructure and journalistic practices, along with their user-friendly designs that reduce complexity, increase their likelihood of adoption (Marconi & Siegman, 2020). Trialability, or the ability to experiment with AI tools on a limited basis, and observability, where visible success stories influence broader adoption, also play crucial roles in this process (Haenlein & Kaplan, 2019). Effective communication channels are critical for disseminating information about AI technologies. Professional journals, conferences, workshops, and training programmes provide in-depth analysis and practical insights, helping journalists understand and engage with AI applications. Additionally, social media platforms like Twitter and LinkedIn facilitate discussions and share success stories, thereby influencing adoption decisions (Schrøder, 2020).

The adoption process itself involves several stages: knowledge, persuasion, decision, implementation, and confirmation. Raising awareness through educational campaigns and training sessions fosters knowledge, whereas demonstrating tangible benefits and providing trial opportunities can influence positive decisions. Successful implementation requires support, resources, and possibly reconfiguration of existing processes to integrate AI tools effectively. The Nigerian media landscape comprises various stakeholders, including journalists, media houses, regulatory bodies, and the audience, whose interactions shape the adoption of AI technologies. Influential figures and early adopters can act as champions for AI, advocating its benefits and addressing potential concerns such as job displacement or ethical implications (Autor, 2015; Floridi, 2018). Peer networks and social interactions among journalists facilitate the spread of information and best practices. Understanding and addressing the cultural and social context within Nigeria is crucial for widespread adoption.

Applying the Diffusion of Innovations Theory suggests that media organisations, policymakers, and other interested parties can come up with targeted plans to make the most of AI's potential while navigating its challenges. This could ultimately change the way journalism is done in Nigeria (Cited by Oyedeji & Uthman, 2024).

The 5 Segments of Technology Adoption

According to OnDigitalMarketing.com (2023) reported from Rogers' research, says that not everyone will immediately adopt a disruptive idea despite obvious benefits. Over years of research, Rogers identified some fascinating personality traits that help us organize how people will accept a new innovation. It turns out we approach innovations in the following ways.

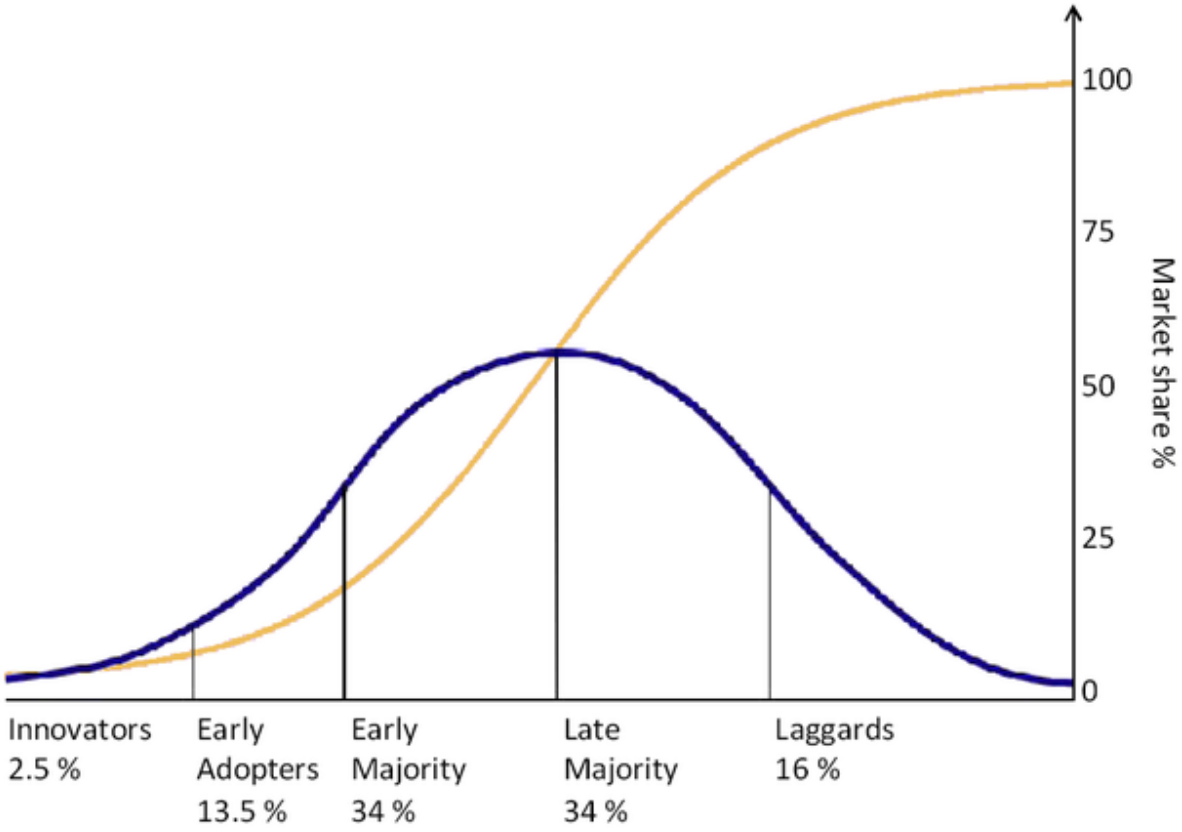

Figure 1: THE 5 SEGMENTS OF TECHNOLOGY ADOPTION

Innovators (2.5%) – Innovators are the first individuals to adopt an innovation. Innovators are willing to take risks, youngest in age, have the highest social class, have great financial lucidity, very social and have closest contact to scientific sources and interaction with other innovators. Risk tolerance has them adopting technologies which may ultimately fail. Financial resources help absorb these failures. (Rogers 1962 5th ed, p. 282)

Early Adopters (13.5%) – This is the second fastest category of individuals who adopt an innovation. These individuals have the highest degree of opinion leadership among the other adopter categories. Early adopters are typically younger in age, have a higher social status, have more financial lucidity, advanced education, and are more socially forward than late adopters. More discrete in adoption choices than innovators. Realize judicious choice of adoption will help them maintain central communication position (Rogers 1962 5th ed, p. 283).

Early Majority (34%) – Individuals in this category adopt an innovation after a varying degree of time. This time of adoption is significantly longer than the innovators and early adopters. Early Majority tend to be slower in the adoption process, have above average social status, contact with early adopters, and seldom hold positions of opinion leadership in a system (Rogers 1962, 5th ed, p. 283)

Late Majority (34%) – Individuals in this category will adopt an innovation after the average member of the society. These individuals approach an innovation with a high degree of skepticism and after the majority of society has adopted the innovation. Late Majority are

typically skeptical about an innovation, have below average social status, very little financial lucidity, in contact with others in late majority and early majority, very little opinion leadership. **Laggards (16%)** – Individuals in this category are the last to adopt an innovation. Unlike some of the previous categories, individuals in this category show little to no opinion leadership. These individuals typically have an aversion to change-agents and tend to be advanced in age. Laggards typically tend to be focused on "traditions", likely to have lowest social status, lowest financial fluidity, be oldest of all other adopters, in contact with only family and close friends, very little to no opinion leadership.

Technological Determinism

The study was anchored on technology-determinism theory. The theory was coined by Thorstein Veblen and holds that technology is a determining factor in communication. It is medium-centred and the appropriate of technology in use will affect the message(s). As a medium-centred theory, it supports that the effectiveness of message delivery is determined by the appropriateness of technology.

Adler (2006) observes that some technologies are intrinsically less 'flexible' than others and thus might be expected to have more determinate effects: large complex hard-wired systems can be contrasted on this dimension with more decentralized, flexible, malleable computer-based technologies. The theory supports advanced industrial civilization. Danesi (2009) states that that technology shapes the course of human evolution. Innovations appear at a rate that increases geometrically, unhindered by geographical limits or social systems. These innovations tend to transform traditional cultural systems, frequently with unexpected social consequences.

Some social critics therefore define technology as both a creative and a destructive process. Studies on adopting artificial intelligence in broadcast media in Nigeria is premised on the advantages of the adoption of robotised media equipment and processes that will make efficient broadcasting possible. Today's communication has gone beyond analog transmission and media of developed economies are integrating artificial intelligence in carrying out some communication tasks; for example, uplink stations need some aspects of robotics and artificial intelligence. Communication satellites sent to the orbit are directed and manipulated from downlink stations through advanced programming instructions. Although much aspects of artificial intelligence maybe conceptualised from hardware components, the actual intelligence is specified by coded programming language that are executed by technological devices (Ogbuoshi, 2021).

Methodology

The research adopts a descriptive method, employing content analysis of literature reviews that encompass crucial works focused on AI applications in knowledge management within information organizations.

Challenges of AI in Library Science and Media Studies

According to Library Science (2024), AI can be applied to various aspects of library services, such as cataloging, classification, recommendation, reference, discovery, and preservation. For example, AI can help librarians automate the process of metadata creation and extraction, enhance the quality and consistency of bibliographic records, and identify and correct errors and inconsistencies. AI can also help librarians provide personalized and relevant recommendations to their patrons, based on their preferences, behavior, and context. AI can also assist librarians in answering complex and diverse queries, using natural language

processing and semantic analysis. Furthermore, AI can help librarians discover new and emerging topics, trends, and patterns in the information landscape, using data mining and machine learning. Additionally, AI can help librarians preserve and digitize their collections, using image recognition and optical character recognition.

AI poses a range of challenges for librarians and their patrons, such as raising ethical and social issues, requiring technical and professional skills, and demanding organizational and cultural changes. Librarians must ensure AI systems respect the rights and values of patrons, as well as be aware of potential biases and limitations. They must also acquire and update data literacy, programming, analytics, and problem-solving skills to design, implement, evaluate, and maintain AI systems. Additionally, librarians need to collaborate with data scientists, software engineers, and AI experts to leverage their expertise and resources. Lastly, librarians must develop a clear vision and strategy for the future that aligns with the opportunities and challenges of AI while fostering a culture of innovation, learning, and collaboration within their organizations and communities (Library Science, 2024).

Also, the following are the challenges of artificial intelligence in library management:

- Ethical challenge: It's possible that artificial intelligence has prejudices, mistakes, or covert objectives that compromise the reliability, impartiality, and quality of the data and services offered in school libraries. It is imperative for school librarians to guarantee that the artificial intelligence systems they employ are transparent, accountable, and in harmony with the library's and the students' objectives.
- Legal challenge: Artificial intelligence systems may give rise to legal concerns pertaining to data protection, copyright, privacy, and liability. To respect the rights and interests of the pupils concerned, school librarians must abide by the applicable rules and regulations that control the use and development of artificial intelligence systems.
- Social challenge: Artificial intelligence systems could affect society in ways like widening digital gaps or moulding the tastes and behaviours of pupils. School librarians must guarantee that artificial intelligence systems uphold human dignity, diversity, and inclusion by evaluating the social implications of the technologies they use or develop.
- Technical challenge: Technical constraints of artificial intelligence systems could include complexity, unpredictability, or vulnerability. To make sure that artificial intelligence systems are dependable, strong, and secure, school librarians must be aware of the advantages and disadvantages of the systems that are currently in use or being developed.
- Financial challenge: Financial issues are also included among the main hurdles that can hamper the transformation and development of smart services to obtain all the necessary equipment needed for the implementation of the artificial intelligence system in the library (Henry & Chetachi, 2024).
- Poor Content Digitization Process: The majority of academic libraries continue to struggle with the process of digitizing their local materials, which are primarily in hard copy formats. To influence the use of the artificial intelligence system effectively, school libraries need to digitize their resources, but due to financial limitations and other constraints, the digitization process has been facing a lot of challenges (Ogwo, Ibegbulem, & Nwachukwu, 2023).

- Phobia for Job Displacement: Implementing artificial intelligence system tools in academic libraries may present a challenge due to job displacement. These systems have the ability to automate regular library functions like inventory management, customer service, and cataloguing, which may result in a reduction in the number of staff members required for the library.

- Poor Maintenance Culture: Because of employment displacement, using artificial intelligence system technologies in university libraries can be difficult. Regular library tasks like cataloguing, customer service, and inventory management can be automated by these systems, potentially lowering the number of employees needed for the library.

- Poor Network Connectivity: The lack of adequate network bandwidth in Nigerian academic libraries is the bane of successfully using artificial intelligence. Low internet connectivity caused by inadequate bandwidth in school libraries makes it challenging to access and download the necessary datasets

Prospects for Solutions in Library's AI Adoption

The following are solutions for each of the issues raised with the application of AI in library management systems:

- Ethical Challenge: To address biases and ensure transparency, librarians should demand transparency and accountability from AI vendors. They should also advocate for diverse data sets to train AI systems, implement bias detection algorithms, and regularly audit AI systems for fairness and accuracy.

- Legal Challenge: Librarians need to ensure compliance with privacy laws by implementing robust data protection measures and obtaining consent for data collection and processing. They should also respect copyright laws by obtaining proper licenses for digitized content and enforcing usage restrictions.

- Social Challenge: Librarians should conduct thorough impact assessments to understand how AI systems might affect different student groups. They should actively promote digital literacy to bridge the digital divide and advocate for inclusive design principles to ensure AI systems cater to diverse needs and preferences.

- Technical Challenge: Librarians should invest in ongoing training for staff to understand AI technologies and their limitations. They should also prioritize security measures to protect AI systems from cyber threats and invest in robust infrastructure to ensure reliability and scalability.

- Financial Challenge: Librarians can seek funding opportunities from government grants, private foundations, or collaborative partnerships to support the implementation of AI systems. They should also prioritize budget allocation for AI development and maintenance to ensure long-term sustainability.

- Poor Content Digitization Process: Librarians can explore cost-effective digitization solutions such as crowdsourcing or collaborative partnerships with other institutions. They should prioritize digitization efforts based on user needs and available resources, leveraging student volunteers or interns if possible.

- Phobia for Job Displacement: Librarians should emphasize the role of AI as a tool to enhance rather than replace human librarians. They can focus on retraining and up skilling staff to adapt to new roles and responsibilities in the digital age, such as curating digital collections or providing personalized research assistance.

- Poor Maintenance Culture: Librarians should develop and enforce maintenance protocols for AI systems, including regular updates, backups, and troubleshooting procedures. They should also promote a culture of responsibility and ownership among staff to prioritize the upkeep of AI infrastructure.

- Poor Network Connectivity: Librarians should advocate for improved internet infrastructure and bandwidth allocation from relevant authorities. They can also explore alternative connectivity solutions, such as satellite internet or mobile hotspots, to ensure reliable access to online resources.

Conclusion

In summary, expert systems play a pivotal role as a form of AI in library systems, utilizing knowledge representation, logical reasoning, user interaction, and decision support to optimize various management processes. Similarly, reference services function as AI in libraries, employing advanced technologies for more responsive, personalized, and efficient information services, ultimately elevating the overall user experience. Natural Language Processing stands as a crucial AI component, enabling machines in library systems to comprehend, process, and generate human language, thereby enhancing user interactions, search capabilities, and overall accessibility. Additionally, pattern recognition serves as a critical AI component, contributing to task automation, improved user experiences, and enhanced efficiency in library operations. Meanwhile, Robotics as AI introduces automation and efficiency to diverse library tasks, revolutionizing the traditional library into a technologically advanced and user-friendly space, from automating routine tasks to providing interactive assistance, enhancing both operational capabilities and user experiences in the library setting.

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EXPLORING VOCATIONAL AND TECHNICAL EDUCATION LECTURERS' EFFICACY ON VIRTUAL REALITY WORKSHOP FOR ENHANCING STUDENTS' ENTERPRENUERIAL INTENTION IN NIGERIAN UNIVERSITIES: IMPLICATIONS FOR EDUCATIONAL TECHNOLOGY

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Abstract
This paper explored how effective Vocational and Technical Education (VTE) lecturers are in utilising Virtual Reality (VR) workshops to boost students' interest in starting their own trades in universities across Northern Nigeria. A thematic approach was adopted, and experienced VTE lecturers were purposefully chosen as participants through this method. Information was collected through structured, semi-open-ended interviews, with the discussions being recorded, transcribed, categorized, and thematically analyzed to reveal important insights. The results showed that VTE lecturers believe VR workshops are a valuable resource for offering hands-on, immersive training, which could help mitigate the issues caused by poor and old-fashioned physical learning spaces common in many Nigerian educational institutions. Lecturers also acknowledged the VR's ability to replicate real-life situations, thereby improving students' practical abilities and their desire to become entrepreneurs. Nonetheless, the study highlighted several impediments, such as the expensive nature of VR equipment, the requirement for adequate facilities, and the importance of training both lecturers and students on how to use the technology effectively. Despite these obstacles, lecturers identified numerous benefits in incorporating VR workshops, especially in enhancing the quality of VTE and filling the gaps in conventional teaching approaches. The research suggests a need for more funding in VR facilities, training for lecturers, and the creation of policies to facilitate the incorporation of VR into VTE curricula. Implementing these strategies could improve students' entrepreneurial abilities, leading to increased self-sufficiency and economic growth in Nigeria.

Keywords: Vocational and Technical Education (VTE), Virtual Reality Workshop, Efficacy, Entrepreneurial Intention.

Introduction

In the fast-paced world of science and technology, Virtual Reality (VR) has emerged as a promising and transformative tool for education, particularly in vocational and technical learning (VTE). Advances in technology have led to swift changes in the educational landscape, creating opportunities for new learning experiences and high-quality teaching methods (Voogt & Knezek, 2018). Lately, virtual reality (VR) has stood out as a game-changing technology in education, opening up new possibilities for engaging and interactive learning (Pottle, 2019). At its heart, VR offers a break from the physical, allowing learners to explore environments that go beyond the ordinary (Brooks, 1999; Jeong *et al.*, 2019). The core of VR lies in three key elements: presence, interactivity, and immersion (Lee *et al.*, 2017). Presence allows learners to access 3D environments that were once out of reach, providing a unique, experiential learning opportunity (Poux et al., 2020). Interactivity sparks learners' curiosity, making learning dynamic. VR workshops provide an interactive, immersive

environment where students can learn practical skills in a safe, controlled setting. The significance of virtual reality technology in engaging students fully in cognitive, behavioral, and emotional aspects of learning, and its growing use in educational settings, highlights its trendiness (Mystakidis *et al.,* 2021). This makes VR workshops an ideal tool for enhancing practical skills needed in vocational and technical education, as they allow students to practice real-world tasks and entrepreneurial goals. The potential of VR workshops in boosting students' entrepreneurial goals is crucial, as it fosters essential skills like problem-solving, innovation, and decision-making. Virtual reality is seen as a unique interactive medium that replaces the traditional screens of devices like laptops, smartphones, and tablets with a more natural interface, enabling interaction with an immersive virtual environment that feels entirely natural (Koumpouros, 2024).

Virtual reality (VR) environments also cater to a wide range of student types, including those that struggle academically or prefer digital learning, enhancing their confidence and ability to perform tasks. VR technologies offer a multi-sensory learning experience, allowing students to derive meaning from their experiences (Pang, 2021). This immersive technology serves as a valuable resource for students to apply their scientific knowledge in realistic scenarios, thereby improving the transfer of learning to real-world situations. However, the effectiveness of integrating VR workshops into educational settings in Nigerian tertiary institutions largely hinges on the skill and effectiveness of VR teaching staff. In Nigerian universities, the role of lecturers is crucial in shaping the learning experiences of VR students. Their views on the success and challenges of using VR workshops for enhancing students' entrepreneurial aspirations are critical for the successful integration of this innovative technology. Investigating how lecturers view the role of VR in promoting entrepreneurship is essential to ensure that VR workshops are designed and executed in a manner that aligns with students' aspirations and the objectives of the VR teaching program.

The desire to pursue entrepreneurship is influenced by whether an individual sees the profession as a good match for their skills and interests. If the fit is not strong, the entrepreneurial intention may be low, and vice versa (Hsu *et al.,* 2019). The motivation to start a business may also stem from the support and background one comes from. Individuals from entrepreneurial families often have a positive outlook on choosing entrepreneurship as a career path (Zellweger et al., 2011). A key reason for this is the freedom entrepreneurship offers in designing a job that suits one's needs (Wiklund *et al.,* 2017). Regarding psychological needs, individuals facing financial difficulties may be more inclined to see entrepreneurship as a way to innovate and earn money to cover their living expenses (Shantz *et al.,* 2018). Nonetheless, VR workshops are interactive computer-generated environments that have become a staple in the educational sector.

Despite the growing interest in VR workshops in the field of education, there are still several obstacles standing in the way of their general adoption in Nigeria, particularly in the colleges that provide VTE in the country's northeastern states. The primary obstacles include things like low infrastructure, low access to technology, and expensive VR workshop teaching resources. But there are also a lot of opportunities for schools to have an impact on VR when it comes to students' aspirations to start their own businesses. The purpose of this study is to get important insights into how VR workshops can be enhanced to increase VTE students' entrepreneurial ambitions in Northern Nigerian institutions by learning about the obstacles, possibilities, and opportunities perceived by VTE lecturers. The study's goal is to investigate how instructors in vocational and technical education view the possible application of virtual.

Statement of the Problem

Preparing students for self-reliance is one the core goal of Vocational and Technical Education (VTE) in Nigeria. However, many universities skirmish with antiquated, inadequate infrastructure that is frequently broken as a result of limited funding for education. Workshops utilising virtual reality (VR) present a workable answer to this issue. The National Business and Technical Education (NBTE) (2019) lists the following as the core challenges facing TVET: low societal recognition, which results in low enrolment and a shortage of skilled workers; outdated instructional facilities; inadequate funding; inadequate staffing; weak connections with industry; and a general lack of quality. Virtual reality workshops can replace the real workshops in TVET with low cost. Virtual reality workshops are still rarely used in Nigerian VTE programmes, despite their apparent advantages. Investigating how VR can effectively close the gap left is obviously necessary.

Objectives of the study

1. explore vocational and technical education lecturers' perceptions of the potential use of virtual reality workshop packages in enhancing students' entrepreneurship intention in Northern Nigerian universities.
2. explore lecturers' perception on the anticipated effectiveness of virtual reality workshop in promoting students' entrepreneurial intentions and skill development.
3. explore the challenges and opportunities lecturers perceive in adopting virtual reality workshop for VTE in Northern Nigerian universities.

Research Questions

1. What are vocational and technical education lecturers' perceptions of the potential use of virtual reality workshop packages in enhancing students' entrepreneurship intention in Northern Nigerian universities?
2. How do lecturers perceive the effectiveness of virtual reality technology in improving students' entrepreneurial intentions and skill development in Northern Nigerian universities?
3. What challenges or opportunities do lecturers foresee in adopting virtual reality for vocational and technical education in Nigerian universities?

Scope of the Study

This study focused on Vocational and Technical Education (VTE) lecturers in Northern Nigerian universities. It explored their perceptions of Virtual Reality (VR) workshops for enhancing students' entrepreneurial intentions. The study examined lecturers' views on the effectiveness, challenges, and opportunities of using VR workshops in VTE programmes. Data were collected through interviews with selected VTE lecturers in Northern Nigeria, while the study did not include other regions or students' perspectives.

Theoretical Framework

Theory of Planned Behavior (TPB) to explain Entrepreneurial Intention (EI) for a long time (Al-Jubari, 2019). However, nowadays this theory not only is being used in only this field but also other field or researches such as marketing , psychology ,leisure studies, health sciences and so on (Sahut *et al*, 2015).Using the Theory of Planned Behavior (TPB), the efficacy of vocational and technical education (VTE) lecturers in using virtual reality (VR) workshops can significantly enhance students' entrepreneurial intentions in Nigerian universities. Optimistic attitudes towards VR from lecturers stimulate students' insight of entrepreneurship. Lecturers' effective incorporation of VR makes a supportive learning setting, endorsing promising subjective norms. Enhanced lecturer efficacy improves students' innovative skills and self-

confidence, increasing perceived behavioral control over entrepreneurship. Implications for Educational Technology include using VR to bridge the gaps between theory and practice, developing contemporary entrepreneurial innovative skills, and encouraging experimental learning. Drilling VTE lecturers efficiently in VR can consequently foster VTE students' entrepreneurial ambitions.

Literature Review

The research on virtual reality's effects on practical abilities is still in its early stages, despite the increasing interest in its application in scientific and engineering education. Numerous researches demonstrate how VR improves students' practical skills whereas other studies like Darrah *et al.,* (2014) find no appreciable improvement in VR environments. Augmented Reality Application (APA) technology has focused apparatuses that occupy students' understanding and initiate them to study and handover knowledge more effectively. ARA characteristically entail of webcams, cameras on computers or eyewear. The audio, animation and video features of three-dimensional stuffs are fused into the exhibition or presentation technique. This feature permits the smartphone to scan the desired camera towards the focal point of the intended image, even when fixed at a plane surface. As a result, the user can observe the 3D object and content as if it were real (Sahrim *et al.,* 2023). The inconsistent results imply that in order to guide educational policy and practice, a more thorough understanding of VR's efficacy is required. As such, it is imperative to acquire conclusive information from a new quantitative angle in order to evaluate the overall impact of VR on students' competence in practical skills.

Methodology

In order to investigate how Vocational and Technical Education (VTE) lecturers perceive the usage of Virtual Reality (VR) workshops, a phenomenological design was used in this study. All Northern Nigerian VTE lecturers were included in the study. To choose respondents that were informed and experienced in VTE and VR workshops, a purposive sample technique was used. The chosen respondents were questioned using interview methods in order to get comprehensive information. The interviews were audio recorded, and transcriptions were made from the recordings thereafter. After then, the transcriptions were coded to find recurrent themes and trend. The results of the thematic analysis of the coded data shed light on lecturers' opinions and perceptions of VR workshops, as well as the opportunities and problems they see in implementing them in VTE programmes.

Discussion of Findings

The study's conclusions showed that virtual reality (VR) workshops were generally seen by Vocational and Technical Education (VTE) lecturers at Northern Nigerian universities as a viable tool for boosting students' entrepreneurial intents. The lecturers agreed that virtual reality (VR) could offer immersive, practical learning opportunities, particularly in situations where traditional training facilities are insufficient or nonexistent. This is consistent with other research showing VR's potential to replicate real-world settings for learning new skills (Didanda, and Puyate, 2024).

Nevertheless, the research also revealed noteworthy obstacles in implementing VR workshops. Lecturers voiced worries about the high implementation costs of VR technology, a prevalent problem in underfunded educational institutions such as the one in Nigeria (NBTE, 2019). The inadequacy of the infrastructure and technical support was also highlighted, indicating a lack of preparation for VR integration. Professional development opportunities were also emphasised. In order to fully utilise the potential of virtual reality technology in their lectures,

lecturers realised they needed instruction on how to use it. This is consistent with findings from other studies that highlight how crucial educator readiness is for the uptake of new technologies (Lin, 2024). The study's overall findings indicate that although VR workshops have the potential to greatly enhance VTE results and entrepreneurial abilities, their successful implementation will depend on how well infrastructure, training, and cost issues are resolved. These results offer educators and legislators useful information when attempting to include VR into VTE programmes.

The first theme is technical and vocational education. Lecturers' opinions about how a virtual reality workshop package might improve students' intentions to pursue entrepreneurship in Universities in Northern Nigerian. In an attempt to respond to study question 1 as theme 1, it examines how virtual reality workshop packages are perceived and experienced in relation to boosting VTE students' intention to pursue entrepreneurship in Northern Nigerian universities. Using the following interview questions, the participants were invited to share their opinions and experiences on the virtual reality workshop package in fostering VTE students' entrepreneurial aim that addresses the viewpoints of VTE lecturers:

i. Which particular infrastructure obstacles do you anticipate when putting VR Workshop into practice at your organisation?
ii. What worries you about obtaining funding, and how do you see the financial consequences of using VR workshop technology for educational purposes?
iii. What difficulties do you foresee with regard to instructors' and students' technical proficiency in utilising VR workshop technology?
iv. Do you believe that implementing VR Workshop will encounter resistance from lecturers or students? If yes, what elements do you think are involved in this resistance?
v. What obstacles do you see in creating VR workshop content that is appropriate and in line with the vocational and technical education curriculum?

The following sub-themes under these categories emerged as a result of this theme's analysis of the interview replies in an effort to answer these questions:

a) Infrastructure Restraints
b) Expense and Resources
c) Technical Proficiency Gap
d) Opposition to Change
e) Enhance Relationship between instructor
f) Students Development of Content

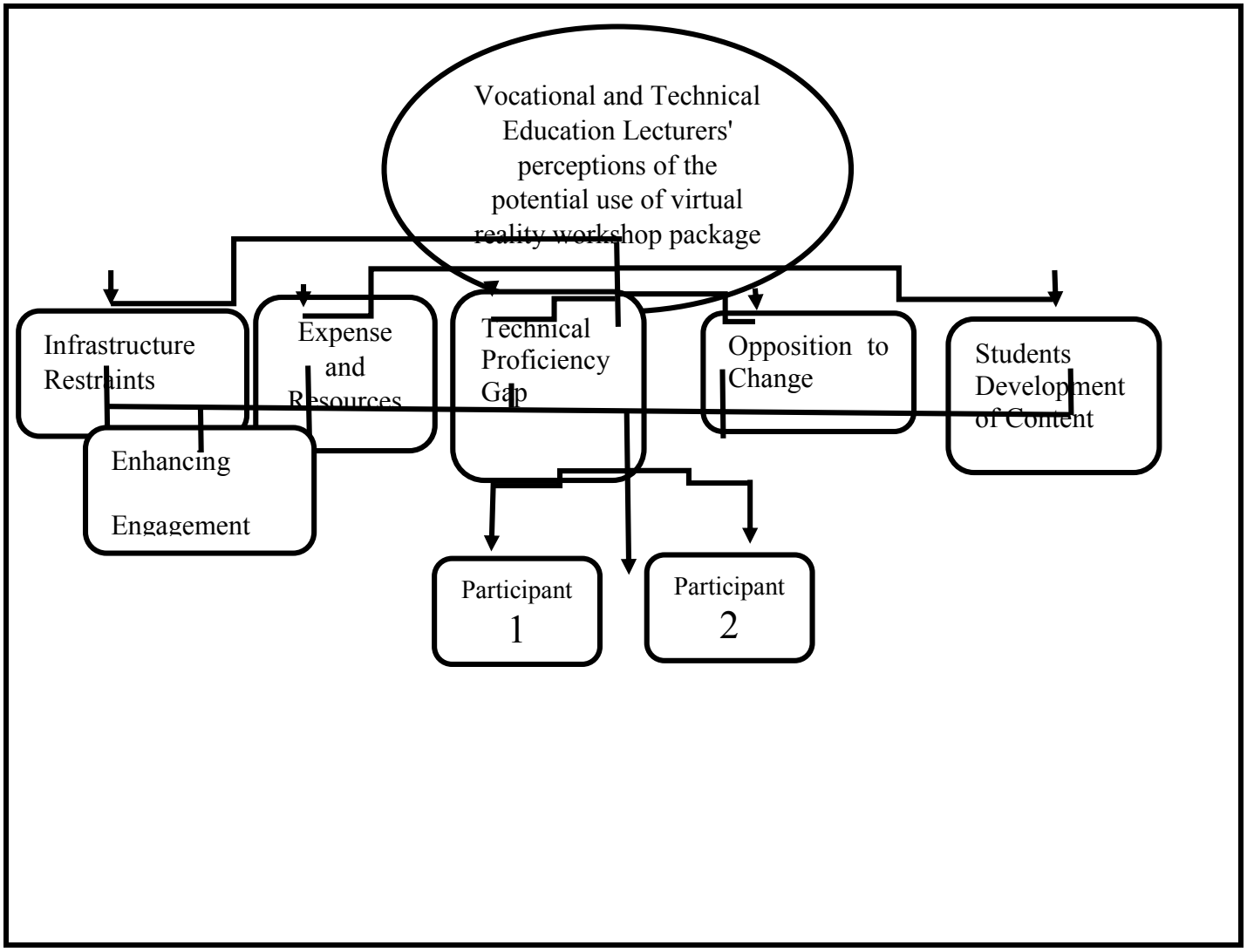


Figure 1: Model of experiences and perceptions of VTE lecturers Experts

The VTE instructor expressed cautious optimism in response to the second research question, which asked about how the VR workshop would encourage entrepreneurial inclinations among VTE students.

> "*Yes, I believe VR workshop could foster entrepreneurial intention among VTE students as it would enable them to be active learners always rather than passive,*". (participant 1).

Noting that it would be challenging to duplicate the virtual, hands-on experiences that VR simulations could offer students in their current workshop setting. The participant thought that this was a good method to foster entrepreneurial and technical skills. When asked what the biggest barrier was to introducing VR, the participant said that it was expense.

> *"Yes, there is a big problem with the cost of VR equipment. Because, immersive virtual reality requires head mounted display and controllers for each students couple with internet facilities to support the VR"* (participant 2).

They emphasised how challenging it is for universities in underdeveloped Northern Nigeria to implement such technologies. They emphasised how crucial institutional assistance is to delivering the lectures via VR.

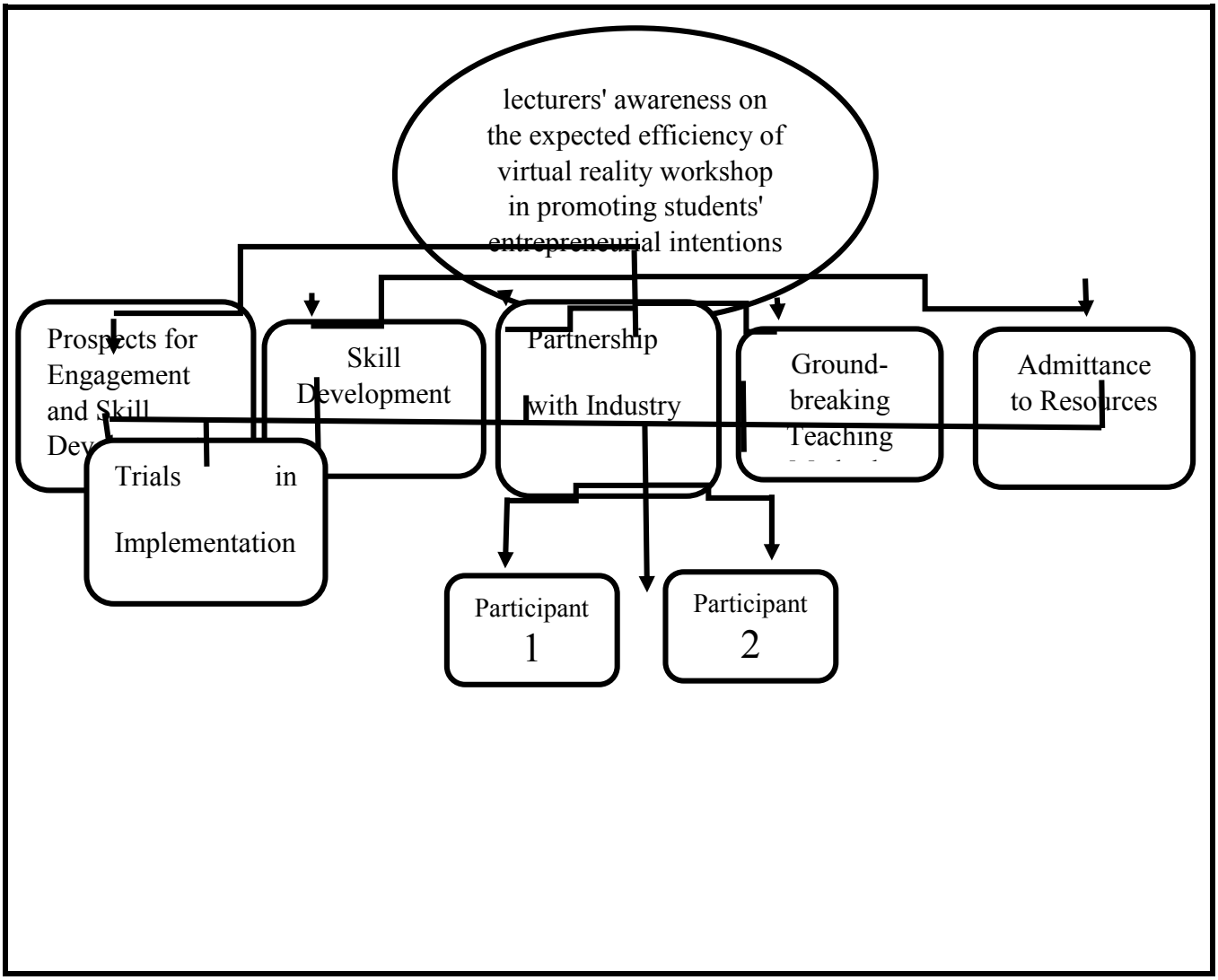


Figure 2: lecturers' awareness on the expected efficiency of virtual reality workshop in promoting students' entrepreneurial intentions

The second theme examines how instructors see the virtual reality workshop's potential to support students' aspirations for entrepreneurship and their skill development.

In an attempt to respond to theme 2 of study question 2, which examines how virtual reality workshop packages are perceived and experienced in relation to boosting VTE students' ambition to pursue entrepreneurship in Northern Nigerian universities. Using the following interview questions, the participants were invited to share their opinions and experiences on the virtual reality workshop package in fostering VTE students' entrepreneurial aim that addresses the viewpoints of VTE lecturers:

i. How well-versed in virtual reality (VR) technology are you, and how much have you used it in educational settings—especially for technical and vocational education—?
ii. What are the possible advantages, in your opinion, of utilising a virtual reality workshop package in technical and vocational education to encourage students' entrepreneurial goals and abilities?

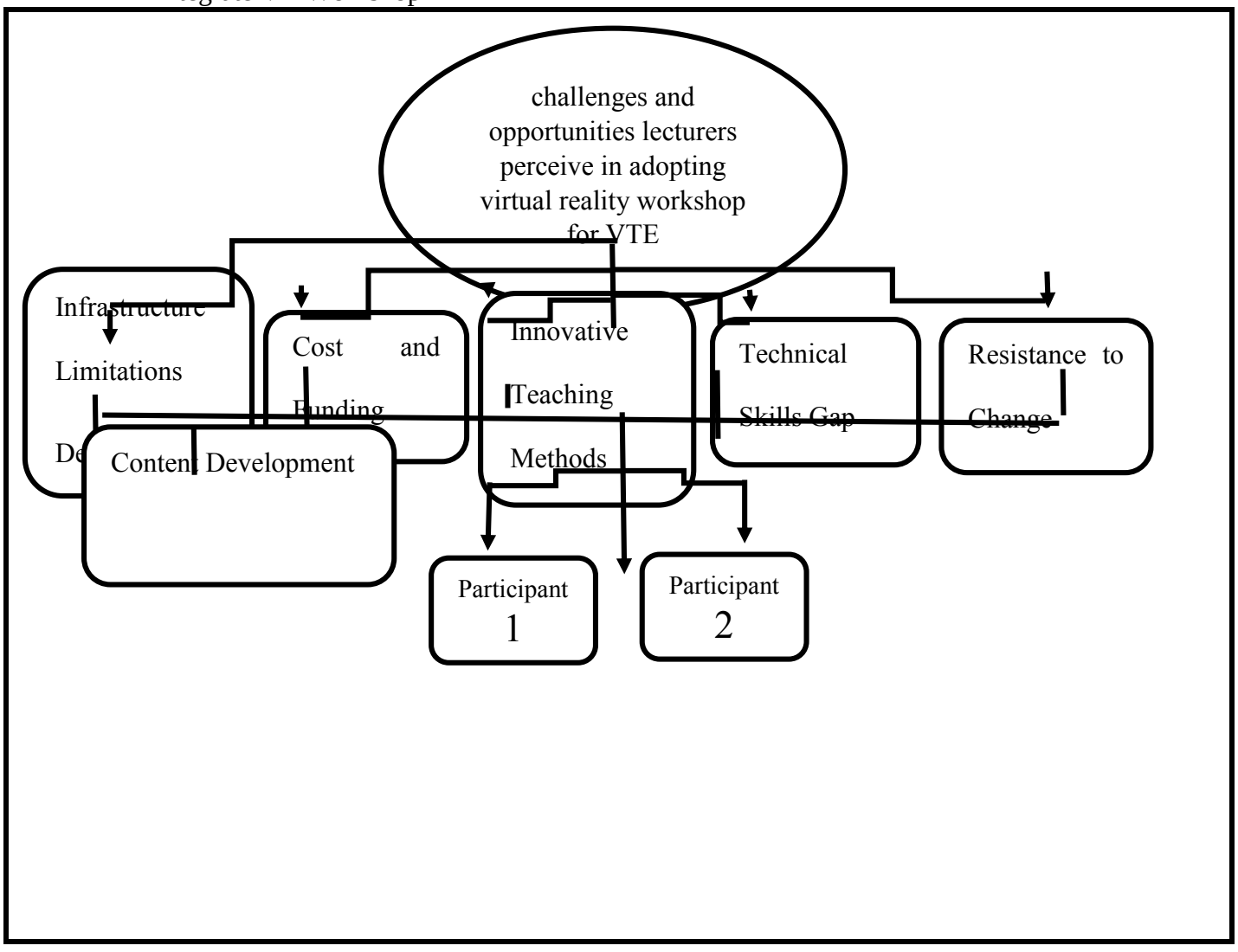
iii. What obstacles or restrictions do you anticipate when incorporating virtual reality workshops into your present methods of instruction to encourage student entrepreneurship?

iv. Based on your experience, what kind of response do you anticipate from students in terms of participation and their capacity to generate business ideas for virtual reality-based workshops?

v. What kind of assistance, instruction, or materials would you need to successfully execute virtual reality workshops to improve students' entrepreneurial abilities in vocational and technical education?

The following subthemes emerged as a result of this theme's analysis of the interview replies in an effort to answer these questions.

i. lecturers' overall knowledge of VR workshop
i. lecturers perceive in using VR workshop for entrepreneurial intention
ii. Technical hitches, inadequate of resources, or struggle to accepting new technologies
iii. lecturers' perceptions into how universities students might engage with VR workshop technology enhance teacher and student relationship
iv. Exercise or infrastructure that universities lecturers feel would help them effectively integrate VR Workshop



Theme 3. explore the challenges and opportunities lecturers perceive in adopting virtual reality workshop for VTE in Northern Nigerian universities.

In an effort to answer research question 3 as theme 3, which exploring the challenges and opportunities lecturers perceive in adopting virtual reality workshop for VTE in Northern Nigerian universities. The participants were asked to express their views and experiences on the challenges and opportunities lecturers perceive in adopting virtual reality workshop for VTE in Northern Nigerian universities that address the challenges and opportunities of VTE lecturers using the following interview questions;

1. What specific infrastructural challenges do you foresee in implementing VR Workshop in your institution?
2. How do you perceive the financial implications of adopting VR workshop technology for educational purposes, and what concerns do you have about securing funding?
3. What challenges do you anticipate regarding the technical skills of both lecturers and students in using VR workshop technology effectively?
4. Do you think there will be resistance among faculty or students to adopting VR workshop? If so, what factors do you believe contribute to this resistance?
5. What challenges do you foresee in developing appropriate VR workshop content that aligns with the curriculum for vocational and technical education?

This theme attempts to address these questions by analyzing the responses of the interview led to the emergence of the following sub themes under these categories;

1. Opportunities
2. Enhancing Engagement
3. Skill Development
4. Collaboration with Industry
5. Innovative Teaching Methods
6. Access to Resources

For the first research question, the second participant, that has used VR to attend conferences and seminars, was more confident about its potential.

> "*Yes, I have personally used VR and I believe it could be a game-changer for VTE. But issue is that most of our students lack discipline in the sense that they may abuse the opportunity of personalized learning by also engaging in chatting Facebook and WhatsApp*". (interview with participant 1).

The lecturer tinted how VR could substitute insufficient workshops facilities and provide students with a high-quality, hands-on learning experiences. They were persuaded that VR could meaningfully enhance learning outcomes.

On enhancing entrepreneurial intentions, the participant was excited.

> "*Yes, immersive VR learning modes could link up the vacuum between theory and practice, which is vital for enhancing entrepreneurial intentions among VTE students at universities level,*". (interview with participant 2).

They claimed that VR could promote invention and entrepreneurial intention and skills among students at universities level, mainly in technical fields, by offering genuine virtual settings where VTE students could perform experiment and develop innovative skills.

When deliberating challenges, the participant accepted that there would be issues but saw them as manageable.

"Yes, there are challenges, especially in terms of cost and technical training. More so, both lecturers and students' efficacy may be low towards utilizing VR because it has side effect". (interview with participant 2).

Though, they have believed that with the appropriate venture, these challenges could be solved, making VR a treasured tool for technical education in Nigerian universities.

Recommendations

1. Government should organize a comprehensive training programmes for VTE lecturers to enhance their understanding and operative use of VR workshops. This will aid lecturers to self-confidently integrate VR into their teaching and learning activities, enhancing the quality of innovative skill acquisition for students.

2. Policymakers and other educational stakeholders should focus on funding and infrastructure development for VR technology in VTE programmes. Passable financial and technical instructional resources are essential to minimise the challenges acknowledged by lecturers, such as high costs of emerging technologies and inadequate facilities.

3. Institutions should explore companies with technology benefactors and international organizations to access VR apparatus and software at abridged costs. This would aid capitalize on the prospect's lecturers perceive in accepting VR workshops to improve students' entrepreneurial intentions and innovative skills.

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A SYSTEMATIC REVIEW ON THE ASSESSMENT OF EDUTAINMENT FOR ENHANCING HIGHER-ORDER THINKING SKILLS IN LEARNING BIOLOGY AMONG COLLEGES OF EDUCATION STUDENTS IN NIGER STATE

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Abstract
This paper presents a review on the assessment of edutainment for improving higher- order thinking skills in learning biology among colleges of education students in Niger State. This paper highlights the relevance of edutainment in teaching and learning process. This paper also summarises relevant research on meaning of edutainment and higher order thinking skills. The paper also underscores the relevance of edutainment and the essence of higher-order thinking skills. The paper concluded by advocating for further researches on the development of edutainment for teaching different subjects and levels of education. Government organisations, agencies, curriculum planners, research institutes should fund more researches on technological platforms such as edutainment in other to enhance instructional delivery, more conferences, seminars and workshops should be organised for Nigerian educational stakeholders to keep them with the current merging technologies.

keywords: Edutainment, Learning, higher-order thinking skills

Introduction
Globally, there is a paradigm shift in most all facets of human endeavour as a result of advancement and use of technology. Technology in the 21st century is an indispensable tool for enriching the quality of human life and a vital component of our everyday lives, communication, work, entertainment, and education in particular. Hence, the need to use technology in education in the 21st century is indispensable. Several innovative technologies are been developed and used in education. Edutainment is an innovative technology that entails the combination of education and entertainment refers to content or activities that are design to be both educational and entertaining that makes learning enjoyable by incorporating games, interactive media or storytelling, television program (Anuar, 2017).

Edutainment is the component of the execution of technology of modern forms of entertainment in traditional classes, lessons, workshops, and lecture (Stapa and Ibaharim, 2020). Similarly, Isika (2021) defined edutainment as the process by which learning and amusement are woven seamlessly together with no clear dividing line between the two. In the same vein, Yadav (2023) asserted that edutainment is a transformative approach in higher education, leveraging on the power of entertainment to enhance student learning and development. Edutainment is a learning technology that involves the use of entertainment to outline and deliver media message to teach and engage the students in relation to meet the educational goals to expand the students' knowledge on educational issues.

Edutainment interactively and cognitively educate students through the concept of play and trigger creativity of student in pursuing their subject areas well (Jumanti and Bahri, 2022). Edutainment can be used with hands-on approaches to enhance higher-order thinking skills.

Example of such hands-on approach is the Problem Based Learning (PBL) which is described as a learner-centered pedagogy that provides learners the autonomy to solve authentic problems that are similar to the type's practitioners face (Tawfik *et al.,* 2021). In PBL, students learn about through the experience of solving an open-ended problem found presented to them. The role of the teacher in a PBL classroom is that of a facilitator or coach. The teacher does not just present information or directly control the progression of work. Instead, the teacher provides students with appropriate problems to work on, assists them in identifying and accessing the materials and equipment necessary to solve the problems, gives necessary feedback and support during the problem-solving process.

It is paramount for Nigerian students to develop thinking abilities so that they can be prepared for future jobs opportunities especially from preschool to post-secondary. This is because, the development of higher order thinking skills facilitates knowledge transfer process, strengthen the possible roles and functions of students in society, enable students to become more successful in academics and equipping them to realize their potential and to contribute to the development of the society and nation. Students with Higher Order Thinking Skills (HOTS) are equipped with high capacity of thinking out of the box which will enable them to succeed in this 21st century life and careers (Stapa and Ibaharim, 2020). Hence, HOTS are important for students to acquire in educational institutions in order for them to face challenges in academic life and job responsibilities on a daily basis. Rachmawati *et al.* (2023) also emphasized that higher order thinking skills such as critical, logical, metacognitive, creative thinking and reflective thinking can be achieved when learners face uncertain problems and ambiguous questions which in returns help in promoting growth and other intellectual skills.

The utilization of higher-level questions which requires students to incorporate and utilize different ideas level that will enhance their learning to acquire knowledge or skills towards a learnt concept that can cause behavioural changes. HOTS refer to the last three levels of the cognitive domain in Bloom's taxonomy revision, namely analysis, evaluation, and synthesis (Djidu *et al.,* 2021). A student ability to think at a high level is measured by using standards in accordance with these characteristics (analysis, evaluation, and synthesis). In this case, the ability to analyze, evaluate, and synthesize (create) can be seen as aspects of HOTS. The analysis involves students' ability to sort a given material or component into several small parts and determine the relationship between parts and between each part and its overall structure. This aspect can be seen from the ability to distinguish relevant and irrelevant information related to problems, and the ability to describe appropriate procedures for solving problems. Evaluation refers to students' ability to make decisions based on criteria which can be measured by their ability to judge the truth of a statement, assumption and ability to interpret the solution to a problem. Synthesis or creation involves students' process of arranging the elements into a coherent or functional unit which can be measured by their ability to make inferences or patterns, draw conclusions based on data, and modify data to fit criteria.

HOTS are thought processes that help students connect information in meaningful ways and use those connections to solve problems. These thought processes tend to be innovative in that they apply knowledge in new, creative ways. Hence, the need to inculcate higher level thinking skills in students in order for them to think critically and creatively, make relevant decisions is paramount since low-level thinking skills are no longer sufficient for the 21st-century graduates to thrive in the digital world. However, for teachers to effectively develop HOTS in students it is paramount to alter traditional learning methods to innovative learning activities. One of the most recent innovative technologies for increasing students' active participation in their learning and to make them lifelong learners is Edutainment.

Concept of Edutainment

Edutainment is one concept proposed to increase students' critical thinking skills in an enjoyable social science classroom environment. Edutainment is derived from the words: education and entertainment (Makarius, 2017). In terms of the language, edutainment is an enjoyable education, typically accomplished through games, role-playing, humor and demonstrations (Sutrisno, 2005). Essentially, edutainment tries to enable and build a social connection with learners by incorporating known forms of entertainment with varied topics. Forms of entertainment include television shows, computer games, video games, movies, music, websites, and other multimedia devices (Hamid, 2013). Similarly, it can take the form of instruction outdoor, where learners can learn and have fun.

Edutainment, like infotainment, entrainment, educational electronic games, is a new term coinage edutainment is a hybrid game genre that relies heavily on visuals and narratives or game formats but also incorporates some type of learning objective. In edutainment, digital information such as text, images, and video are layered and blended into the perception of the real world. Nwokocha *et al.* (2022) reported that edutainment is a computer (augmented) package of video games/simulation, audio (CD/ Cassette) and computer game (animation) in which students can learn while they are playing and thereby improve their ability to learn Biology. Gamble (2007) defined edutainment videos as those audio-visual electronic devices that are used to educate students on numbers and numeracy, colours, drawing, the alphabet, literacy, and vocabulary.

Edutainment with a technological approach will provide new opportunities for students to explore knowledge in various ways/variations. Thus, in developing edutainment in learning is also necessary to develop the Technological Pedagogical Content Knowledge (TPACK) approach. Makarius (2017) showed that edutainment leads to effective learning outcomes such as involvement, motivation to learn, enjoyable experiences, and the desire to learn more and apply knowledge. Edutainment not only tends to be more exciting but also more memorable for students. Anikina and Yakimenko (2015) research results revealed that edutainment provides new opportunities to gain knowledge interestingly, enabling students trained with different abilities to obtain information. Edutainment technology is a fascinating combination of traditional content and teaching methods in a new technological context. This system is helpful on many levels because in edutainment, there is a creative approach to teaching students and students can see the practical results of their activities (Kurniawati *et al.*, 2023).

There are four things that characterize the edutainment concept. First, the concept of edutainment is a series of approaches to learning to link the teaching and learning processes. Second, the edutainment concept strives for learning to take place in a conducive and enjoyable atmosphere. Third, the edutainment concept offers a learning system that is designed with an efficient relationship, including students, teachers, the learning process, and the learning environment. Fourth, the edutainment concept learning process and activities do not appear in a frightening face, but in a humanist form (Shodiqin, 2016).

History and Trends in Edutainment

Edutainment was first used by The Walt Disney Company, which applied it to its True Adventures series. However, the technology itself was not new (Chilingaryan and Zvereva, 2020). During World War II, the animated series "Private Snafu" was released in the United States, in which viewers were informed of the necessary security measures in time of war thanks to the main character, a soldier, in various situations. In 1973, Robert Hayman first used the concept of ‘edutainment’ in a report for the National Geographic Society (Dyakonova,

2012). In the 1970s, the principles of the new technology were transferred to the healthcare field in the United States and Great Britain. Through exciting and visual plots, analytical work was carried out among the population on the dangers of drugs, the devastating consequences of AIDS and cancer and alike. Subsequently, the idea of educational and entertainment programmes for children became more popular. Examples of this were Sesame Street, Teletubbies. In Russia, the projects of this kind have also been popular: "ABVGDeyka" and "Good night, kids." These programs have become an example of the introduction of gaming pedagogical technologies in children's entertainment programmes. The Experimentation Museum of Entertaining Sciences has been opened in Moscow, organized on the principle of an entertainment and educational centre in which everyone (adults and children) can learn complex chemical and physical laws in the entertainment area, carry out various experiments (even independently), see shows and attend workshops.

The use of gamification and digital game-based learning in the classroom, discussing their impact on student engagement, motivation and learning outcomes in science and mathematics education (Spires *et al.*, 2019). Wang (2017) examined the literature on education and technology, including the integration of edutainment, over 15 years. It provides insights into the current state of research and highlights the advancements and challenges in utilizing technology-enhanced learning approaches. Clark *et al.* (2016) reviewed and meta-analysis investigated the effectiveness of digital games as educational tools. It examines their impact on student learning outcomes, engagement, and motivation, providing evidence-based insights into the benefits and limitations of incorporating digital games in higher education.

The use of virtual reality (VR) in higher education and its impact on student learning and engagement (Calderon *et al.*, 2020). It examines VR's benefits, challenges, and potential applications in various disciplines, shedding light on its effectiveness as an edutainment tool. Groff *et al.* (2010) investigated the impact of console games on student learning in Scottish schools. It examines the effects of game-based learning on student engagement, motivation and academic performance, providing insights into the practical implications of integrating edutainment through console gaming in the classroom. Huang *et al.* (2020) investigated how game-based learning can enhance learner motivation, providing insights into motivation factors in game-based learning environments and offered recommendations for designing practical edutainment experiences. Randler *et al.* (2017) investigated the impact of severe games on learning effectiveness, knowledge retention and student engagement, proffering insights into the potential benefits and limitations of using edutainment in the classroom. Boyle (2016) provided an updated systematic literature review on the impacts and outcomes of computer games and serious games in education. It examines the empirical evidence on the effectiveness of edutainment in learning outcomes, engagement and motivation. De Araújo *et al.* (2016) discussed the potential of virtual reality (VR) in enhancing learning processes in higher education. It explores the benefits and challenges of using VR as an edutainment tool and highlights its potential impact on student engagement, knowledge acquisition, and skill development.

The concept of gamification in learning and instruction. It provides insights into how game-based methods and strategies can be effectively applied in educational settings to enhance student learning, motivation, and engagement (Kapp, 2012). Saha and Bhattacharya (2020) studied the role of educational entertainment in improving learning outcomes from an Indian perspective. It examines the potential of edutainment approaches to enhance student learning and development in the Indian higher education system. Chari and D'Silva (2019) investigated the impact of gamification on student engagement and learning in an Indian university context,

exploring how gamified approaches in higher education can contribute to improved student outcomes and experiences. Sreedharan and Saha (2018) examined the role of edutainment in the skill development of higher education students in India. It discusses how edutainment approaches can support acquiring essential skills for success in the Indian higher education system and beyond. Distance learning and e-learning are two viable approaches to teaching in today's world.

Development of edutainment learning model

Effectiveness in learning means achieving learning goals in the teaching and learning process, one of the effective learning strategies is the Bio edutainment strategy. Pleasant conditions are one of the factors that enhance students' interest in participatory learning (Wahyuningsih *et al.*, 2020). Bio edutainment is a learning strategy that is designed in such a way with educational and entertainment content that is combined harmoniously so that learning feels more enjoyable. Fun learning is an atmosphere of teaching and learning that focus students' attention in full while learning so that time on task is high (Trinova 2012). The bio edutainment strategy contains elements of science learning, scientific processes, work skills, collaboration, educational games, competence, challenges, and sportsmanship.

Concept of Higher Order Thinking Skills

Educational institutions help develop students' intelligence, preparing them for work after school. This preparation involves developing skills in students that will enable them effectively solve problems that will encounter in their workplace. Ahmad (2021) defined higher-order thinking skills as a series of mental activities that the brain performs when exposed to a stimulus that is received by one or more of the five senses. they are practical skills to describe something using perception or retrieval, but using information about one thing to get to something else through innovation. Al-Asmari and Al-Shehri (2021) also defined higher-order thinking skills as thinking skills that seek to invent things and find solutions to different situations, find alternatives and move away from the usual stereotypes, and expand abilities through imagination and intuition. Higher-order thinking skills enhance students' ability to overcome some life challenges and make them more prepared and able to adapt to the circumstances and to overcome the challenges of the twenty-first century.

Conclusion

The importance of edutainment in improving higher-order thinking skills cannot be over emphasis as this platform help to increase participation in classroom, arose student interest, boost their motivation, enhance their performance and develop their technological skills. there is need for further researches on the development and assessment of edutainment for teaching different subjects and levels of education. Curriculum planners, educational administrators, Government organizations, and research institutes should fund more researches in edutainment in improving hiher-order thinking skills in Nigeria, more conferences, seminars and workshops should be organized for Nigerian educational stakeholders to keep them with the current emerging technologies. Curriculum planners should include the use of these current technologies in higher institution in order to enhance and promote effective instructional delivery.

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INFLUENCE OF GENDER AND SCHOOL LOCATION ON THE PERFORMANCE OF CHEMISTRY STUDENTS TAUGHT ELECTROLYSIS USING JIGSAW CO-OPERATIVE LEARNING STRATEGY IN MINNA, NIGER-STATE, NIGERIA

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Abstract
The study investigated the influence of gender and school location on the performance of chemistry students taught electrolysis using jigsaw co-operative learning strategy in Minna, Niger-state, Nigeria. The study was guided by two research questions and two research hypotheses and employed Quasi-experimental design using pretest-posttest non-randomized, non-equivalent control group design. The target population was Senior Secondary School (SSS) class two Chemistry students with a total population of 7385 students from 36 secondary schools in Minna made up of 5126 male and 2259 female students in the 2018/2019 academic session. Multi-stage sampling technique was employed in the study. Electrolysis Performance Test developed by the researchers made up of 25-item multiple choice questions was used for data collection. The instrument was validated by nine experts and piloted on 55 SSS Two students using test-retest method and the data obtained were analysed using Pearson Product Moment Correlation and a coefficient of 0.820 was obtained. Mean and standard deviation were used to answer the research questions and ANCOVA was used to test the research hypotheses. Finding of the study revealed that male and female students taught Jigsaw Cooperative Learning Strategy and conventional method performed equally well. Students taught Electrolysis with Jigsaw Cooperative Learning Strategy in Urban location performed better than those in Semi-urban and Rural areas respectively. In light of the findings, it was recommended among others that the use of Jigsaw Cooperative Learning Strategy should be encouraged in the classroom to enhance male and female performance in Electrolysis at SSS level.

Keywords: Gender, School Location, Performance, Chemistry, Electrolysis, Jigsaw Co-Operative Learning Strategy.

Introduction
The technological development of any nation depends on the study of science (Anaeato *et al.*, 2016). Through science, natural resources have been well utilized and transformed into meaningful resources for a better living in the world. Science education provides students with knowledge, training, and learning experience that stimulate their physical and mental growth. The goals of science education in Nigeria include among others, cultivating knowing, inquiring, and rational mind for the conduct of good life and democracy; producing scientists for national development; and providing understanding of the complexity of the physical world, the forms and the conduct of life (FRN, 2013). Given this, Chemistry is an important aspect of science which is very important in the production of scientist for rational development. Chemistry has been identified as a very important science subject and its importance in scientific and technological development of any nation has been widely reported. It was as a result of the recognition given to Chemistry in the development of the individual and the nation that it was made a core – subject among the natural sciences and other science – related courses

in Nigerian education system. It has been a pre-requisite subject for offering most science-oriented courses at the tertiary level of education. This makes effective teaching of chemistry a necessity.

Despite the prime position chemistry occupies in the educational system and despite effort by researchers to enhance performance, students' performance in chemistry and sciences in general is still low. Ghuluze and Joda (2021) identified some factors for this poor state to include laboratory inadequacy, teachers' negative attitude, examination malpractice, time constraint for practical, non-coverage of syllabus, class size, non-professionalism and general harsh school environment. What these amounts to is that practical component in chemistry in schools which is aimed at giving the students the opportunity to gain meaningful learning, acquire appropriate skills and attitudes that enable them live and contribute to the development of society is generally lacking.

Chemistry concepts that were found to be difficult to understand by chemistry students in senior secondary schools in Nigeria. Akofang and Baituti (2017) identified electrolysis as one of the four concepts in chemistry that students find difficult. Chongo *et al.* (2021) sought to find the extent to which chemistry students failed to solve electrolysis problems. The analysis of the researchers' result confirmed that learners generally find solving problems in electrolysis difficult. This was also confirmed by findings from the present study. As pointed out by Chongo *et al.* (2021) abstract concepts can be made simple and easily understood if innovative instructional approaches are included in the learning process.

Cooperative learning is an innovative instructional approach that entails the use of small groups so that students work together to maximize their own and each other's learning. Johnson and Johnson (2018) and Le *et al.* (2018) added that co-operative strategy requires a small number of students to work together on a common task, supporting and encouraging one another to improve their learning through interdependence and cooperation with one another. A type of cooperative learning strategy is the Jigsaw cooperative instructional strategy. Aronson (1978) defined jigsaw as a grouping strategy in which the members of the class are organized into "jigsaw" groups. The students are then reorganized into "expert" groups containing one member from each jigsaw group. The members of the expert group work together to learn the material or solve the problem, then return to their "Jigsaw" groups to share their learning. In this way, the work of the expert groups is quickly disseminated throughout the class, with each person taking responsibility for sharing a piece of the puzzle. Jigsaw can be used for sharing different solutions to the same problem or for dividing up research responsibilities. Jigsaw is an efficient way for students to become engaged in their learning, learn a lot of material quickly, share information with other groups, minimize listening time, and be individually accountable for their learning. Since each group needs its members to do well in order for the whole group to do well, Jigsaw maximizes interaction and establishes an atmosphere of cooperation and respect for other students irrespective of gender.

Gender has been identified as one of the factors influencing students' performance in sciences at senior secondary school level (Nja *et al.,* 2019). Researchers (Anih & Egbo, 2017) have shown that males performed better than females in science and technology concepts. In the contrary, Peter *et al.* (2020) reported that females scored significantly higher than males. Furthermore, Amed (2015) reported that gender has no effect on academic performance of students. In view of the inconclusiveness of gender influence on students' performance. Hence, gender is considered a moderating variable in this study as well as school location.

School location refers to a school's site, type of buildings, usage, capacity, teachers, students, environment and other parameters for rationalization of both rural and urban school map (World Bank Guidelines, 2014). The extent to which school location determines students' performance lies with the particular type of school, its size and whether it is near or far away from another school. Generally, teachers have preference for urban schools where social amenities avail, to the detriment of rural schools where population is low and only subsistence livelihood prevails (Ronfield *et al.,* 2016). Rural schools suffer more from this gender influence on teachers' distribution, since most married women serve in urban schools. Parents complain of sub-standard form of instructional strategy especially in rural schools. The resultant effect of these factors on secondary schools is that qualified teachers refuse posting to rural locations, rural dwellers refuse sending their children to schools because they rely on them for subsistence living and help, where parents hesitate to entrust their daughters to male teachers, fearing promiscuity (Tumwebaze, 2016).

Researchers reported significant difference in students' performances between rural and urban located schools in favour of urban schools (Faisal *et al.,* 2016). In addition, Ronfeldt *et al.* (2016) observed a significant positive relationship between size and location of schools and performance, where large schools in urban locations performed better than small schools in rural locations. Based on these premises, there is need to investigate the influence of school location among chemistry students. The effect of gender and school location do to influence academic performance in general and chemistry in particular. It is on this basis that this study has been undertaken to determine the influence of gender and school location on performance of secondary school Chemistry students' using Jigsaw Cooperative learning in Minna Metropolis, Niger State.

Statement of the Problem

Despite the importance of chemistry in Nigerian schools, students' poor performance at internal and external examination has been a major concern. Students encounter problems in some abstract concepts such as electrolysis. Electrolysis is one of the aspects that students find difficult to pass, thereby, leading to poor performance whenever questions on the concept were asked. This problem cut across the performance of the students in Nigeria secondary schools in the West African Senior Secondary Certificate Examination (WASSCE) results. The poor performance was evident in the WAEC and NECO examination of 2014 to 2019 where many students could not secure admission into universities due to the failure in chemistry.

This dismal performance has been partly attributed to ineffective and unproductive strategies used by practicing teachers (Anthony *et al.,* 2019). The instructional strategies employed by the teachers are essential in the implementation of the curriculum contents. Persistent use of ineffective teaching strategies employed by chemistry teachers lead to abstractness of the concepts which forces students to memorize and regurgitate during examinations (Nja *et al.,* 2017). Over dependent on traditional method of teaching (teacher-centred) has been identified as one of the ineffective instructional strategies responsible for poor academic performance in Nigerian schools.

The need to determine a suitable strategy for solving this problem is no longer merely desirable but compelling. This has precipitated the efforts to use the Jigsaw Cooperative learning strategy for the teaching of the Electrolysis concept. Also, studies that consider the influence of gender and school location using Jigsaw cooperative learning strategy to determine chemistry students' performance in electrolysis are very scanty. Therefore, this study investigated the

influence of gender and school location on chemistry students' performance' using Jigsaw cooperative learning strategy in electrolysis in Minna, Niger State.

Research Questions

The following research questions were raised and answered:

(i) How do male and female secondary school chemistry students taught Electrolysis with Jigsaw Cooperative learning strategy differ in their performance?

(ii) Do school locations (Urban, Semi-urban and Rural) have any influence on the performance of senior secondary school chemistry students taught Electrolysis with Cooperative learning strategy?

Research Hypotheses

The following null hypotheses were tested at 0.05 significance level:

HO_1: There is no significant difference in the performance of male and female chemistry students taught Electrolysis with Jigsaw Cooperative learning strategy.

HO_2: There is no significant difference in the performance of secondary school Chemistry students taught Electrolysis in Urban, Semi-urban and Rural schools with Jigsaw Cooperative learning strategy.

Research Methodology

This research employed Quasi-experimental design using pretest-posttest non-randomized, non-equivalent control group design. Two levels of independent variables (Jigsaw & Conventional Method), two levels of moderating variables of gender (male and female) and school locations (Urban, Semi-urban and Rural schools); one dependent variable (academic performance) were employed in the study.

Population of the Study

The population for this research was made up of all senior secondary school Chemistry students in Minna, Niger State. The target population was senior secondary school class (II) Chemistry students with a total population of 7385 students from 36 secondary schools in Minna, made up of 5126 male and 2259 female students in the 2018/2019 academic session.

Sample and Sampling Technique

Multi-stage sampling technique was employed. The sample was drawn from 36 co-educational senior secondary schools in Minna, Niger State. Firstly, purposive sampling technique was employed in selecting the six senior secondary schools and this was done based on criteria such as: equivalence (school facilities and manpower), gender composition (mixed schools), school location (urban, semi-urban, and rural), school type (public and private school), and candidates' enrolment (enrolling students for Secondary School Certificate Examination for a minimum of ten years). Eighteen senior secondary schools met the above criterion; therefore, simple random sampling technique was also used in selecting six of the senior secondary schools.

Secondly, the six selected schools were randomly assigned to experimental and control groups using simple random sampling technique. Two schools from each location were assigned into experimental and control groups. Thirdly, in each school, one stream of SSII class was randomly selected from five streams. Therefore, an intact class of each stream was used for the study. Table 1 shows the sample distribution of the study.

Research Instruments

The concept of electrolysis (Ionic, Mechanism of electrolysis, Uses of electrolysis, and Electroplating) was taught to both experimental and control group. The experimental group was taught using Jigsaw, each topic was sub-dived into three sub-topics for each team member to study as expert before teaching the team members. Furthermore, the control group was taught with conventional method of teaching using comprehensive lesson plans and chalkboard summaries. These lesson plans and board summaries were prepared by the researcher with reference to the approved textbooks.

Electrolysis Performance Test (EPT) was developed by the researchers and made up of 25-item multiple choice objective questions with four options A – D, with only one correct answer and three distracters. EPT was drawn from past WAEC and NECO chemistry past examination question papers which are specifically based on SSII chemistry curriculum. It covered four topics which include, (i) Ionic, (ii) Mechanism of electrolysis, (iii) Uses of electrolysis, and (iv) Electroplating. EPT was administered to the experimental and control groups as a pretest and later administered as posttest to the six selected senior secondary schools in Minna, Niger state. To reduce the pre-test effects, the questions were reshuffled and administered as the posttest. Students were required to indicate the correct answer by ticking the right answer that corresponds to each question. Each test item attracts one mark for correct answer and zero for wrong answer. The marks obtained by each student were scored and converted into percentage for easy computation.

Validation of Test Instruments

The content of electrolysis (instructional content) and Electrolysis Performance Test (EPT) were validated by subject specialists. Three senior lecturers from Chemistry Department, Federal University of Technology, Minna, Niger State validated the electrolysis instructional content (manuscripts) and Electrolysis Performance Test (EPT). The instructional content and EPT were also validated by three Chemistry Secondary School teachers from the selected schools, and three subject officers from National Examination Council (NECO) Headquarters, Minna. The specialists assessed the face and content validity of the instructional content and EPT. From the validation report, some spelling errors, language and grammar errors, formatting errors, structure of the contents among others were pointed out. All corrections pointed out were effected as reflected in the final copy of the instrument.

Reliability of Test Instruments

A pilot test was conducted in the study to ascertain the reliability of the Electrolysis Performance Test (EPT). It was carried out on 55 senior secondary school class two (SSII) students from Government Day Secondary School (GDSS), Minna Niger state which is part of the study population but not among the sampled schools using test-retest method. The EPT was administered for 30 minutes duration on students from intact class. After two weeks the test was administered to the same students. The data obtained from the pilot test were analysed using Pearson Product Moment Correlation (r) (PPMC) coefficient and 0.820 reliability coefficient was obtained which was considered reliable.

Results and Discussion

Research question one: How do male and female secondary school chemistry students taught electrolysis with Jigsaw cooperative learning strategy differ in their performance? In answering research question two, mean and standard deviation were used as shown in Table 1

Table 1: Pretest, Posttest and Mean Gain Scores of Male and Female Students taught Electrolysis using Cooperative Learning Strategy

Group	N	Pretest		Posttest		Mean Gain
		Mean	SD	Mean	SD	
Male	49	10.88	4.684	20.20	4.646	9.32
Female	59	8.69	3.616	20.75	3.502	12.06

Table 1 shows the mean and standard deviation of the pretest and posttest scores of male and female students taught Electrolysis using Jigsaw Cooperative Learning Strategy. The result revealed that male students had 10.88 mean scores with standard deviation of 4.684 at pretest, and mean score of 20.20 with standard deviation of 4.646 at posttest respectively. The male students had mean gain of 9.32. Similarly, the mean scores of female students were 8.69 with standard deviation of 3.616 at pretest, and posttest mean score of 20.75 with standard deviation of 3.502. The female students in Jigsaw cooperative learning strategy group had a mean gain of 12.06. This implies that the female students had higher mean gain than male students in the same group. The graphical representation of the student performance in the group is illustrated in Figure 1.

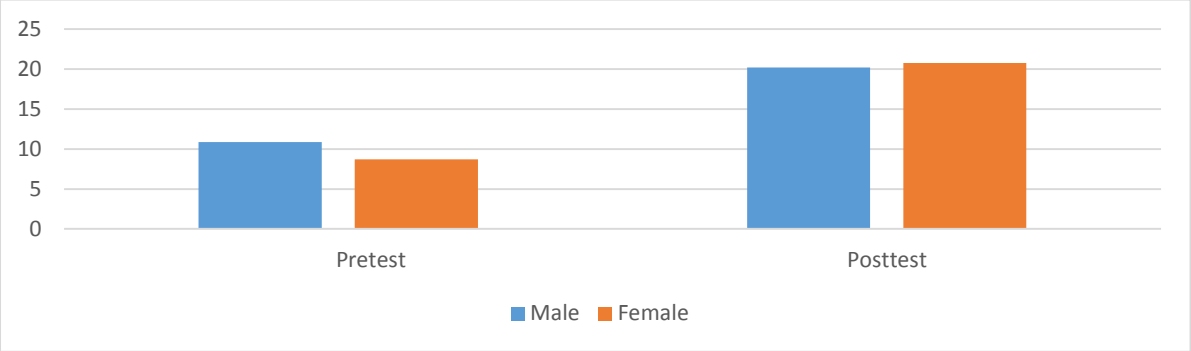


Figure 1: Performance of male and female students taught Electrolysis using Jigsaw Cooperative learning strategy

Research question two: Do school locations have any influence on the performance of senior secondary school chemistry students taught electrolysis with cooperative learning strategy? To answer research question three, mean and standard deviation were used as shown in Table 3.

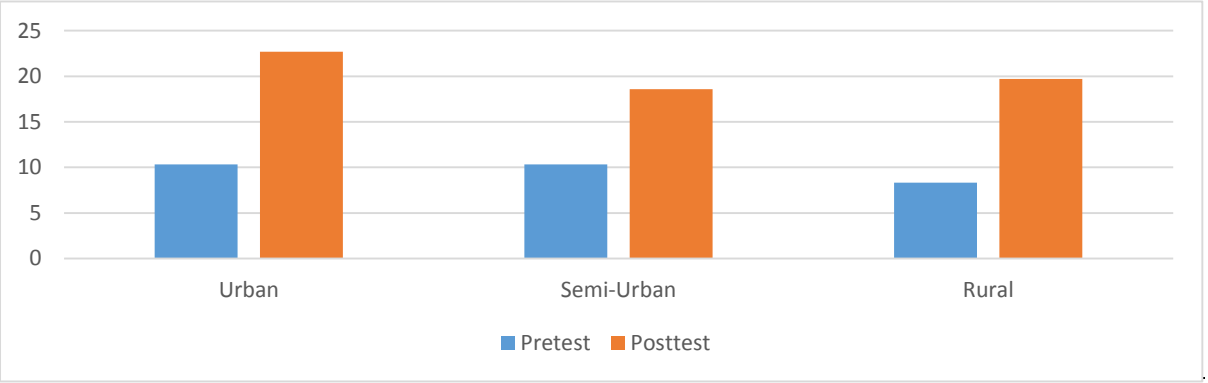
Table 3: Pretest, Posttest and Mean Gain Scores of Students in Urban, Semi-urban and Rural Areas in Minna

Group	N	Pretest		Posttest		Mean Loss
		Mean	SD	Mean	SD	
Urban	41	10.32	3.677	22.68	2.252	12.36
Semi-Urban	32	10.34	5.289	18.59	5.459	8.25
Rural	35	8.34	3.589	19.69	2.938	11.35

Table 3 shows the mean and standard deviation of the pretest and posttest scores of students taught with cooperative learning strategy based on school locations (Urban, Semi-urban, and Rural) areas. The result revealed that the students in Urban area had a mean score of 10.32 with standard deviation of 3.677 at pretest and mean score of 22.68 with standard deviation of 2.252 at posttest. This gives a mean gain of 12.36 for students in Urban area. Similarly, the results also revealed that the students in Semi-urban area had the mean score of 10.34 with standard deviation of 5.289 at pretest, and 18.59 as the mean score with standard deviation of 5.459 at the posttest. This gives a mean gain of 8.25 for students in Semi-urban area. In addition, the results also revealed that the students in Rural area had 8.34 mean score, with standard

deviation of 3.589 at pretest, and 19.69 mean score with standard deviation 2.938 at the posttest. This gives a mean gain of 11.35 for students in Rural area. The graphical representation of the students' performance based on location is illustrated.in Figure 3.

Figure 3: Performance of students taught Electrolysis using Cooperative learning strategy in Urban, Semi-urban and Rural Areas



Hypothesis one: There is no significant difference in the performance of male and female chemistry students taught electrolysis with cooperative learning strategy. Hypothesis one was analysed using ANCOVA as shown in Table 4.

Table 4: ANCOVA results of performance scores of male and female students in Cooperative learning strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	240.082[a]	2	120.041	8.320	.000
Intercept	4630.662	1	4630.662	320.954	.000
Pretest	232.228	1	232.228	16.096	.000
Gender	43.780	1	43.780	3.034	.084[ns]
Error	1514.918	105	14.428		
Total	47142.000	108			
Corrected Total	1755.000	107			

ns: not significant at $p > 0.05$

Table 4 shows the ANCOVA results of the performance scores of male and female students taught Electrolysis using Jigsaw Cooperative Learning Strategy. From the table, there is no significant difference in the mean performance scores of the male and female students at 0.05 level of significance $F(1,105) = 3.034$, $p > 0.05$. The results of the analysis indicate that hypothesis four was not rejected on the basis that the univariate effect of gender was not statistically significant on the posttest mean score of male and female students taught Electrolysis using Jigsaw Cooperative Learning Strategy. On this basis, hypothesis four is therefore not rejected. This implies that male and female students performed equally well when Jigsaw Cooperative Learning Strategy was used in teaching Electrolysis at Senior Secondary Schools.

Hypothesis two: There is no significant difference in the performance of secondary school chemistry students taught electrolysis with cooperative learning strategy based on school location. Hypothesis two was analysed using ANCOVA as shown in Table 5.

Table 5: ANCOVA Results of Performance Scores of Students taught Electrolysis using Jigsaw Cooperative Learning Strategy based on school location

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	506.179[a]	3	168.726	14.051	.000
Intercept	5032.661	1	5032.661	419.113	.000
Pretest	171.319	1	171.319	14.267	.000
Location	309.876	2	154.938	12.903	.000
Error	1248.821	104	12.008		
Total	47142.000	108			
Corrected Total	1755.000	107			

ns: not significant at $p > 0.05$

Table 5 shows the ANCOVA results of performance scores of students taught Electrolysis using Cooperative Learning Strategy. From the table, there is significant difference in the mean performance scores of students at Urban, Semi-urban, and Rural areas at 0.05 level of significance $F_{(2,104)} = .12.903$, $p > 0.05$. The results of the analysis indicate that the hypothesis was rejected on the basis that the univariate effect of school location was statistically significant on the mean performance scores of students from different location that were taught Electrolysis. On this basis, hypothesis six is therefore rejected. This implies that location of schools influence students' performance when taught Electrolysis using Cooperative Learning Strategy. Furthermore, Sidak's post-hoc analysis was done to determine the direction of the difference in the school location and the result is shown in Table 6

Table 6: Sidak Post hoc analysis of significant difference among students of different locations taught using Cooperative Learning Strategy

					95% Confidence Interval for Difference	
(I) Location	(J) Location	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Urban	Semi-Urban	4.097*	.817	.000	2.114	6.081
	Rural	2.396*	.813	.012	.422	4.369
Semi-Urban	Urban	-4.097*	.817	.000	-6.081	-2.114
	Rural	-1.702	.863	.146	-3.795	.392
Rural	Urban	-2.396*	.813	.012	-4.369	-.422
	Semi-Urban	1.702	.863	.146	-.392	3.795

Table 6 shows the Sidak post hoc analysis on performance of students taught Electrolysis with Jigsaw Cooperative Learning Strategy based on school location. From the Table, significant difference was established between the mean scores of students in Urban and Semi-urban areas because the mean difference of 4.097, $p < 0.05$). Similarly, significant difference in the mean performance scores of students in Urban and Rural areas was established with mean difference of 2.396 in favour of students in Urban location. However, there was no significant difference in the mean performance scores of students in Semi-urban and Rural areas with mean difference of 1.702, $p > 0.05$. This result implies that students taught Electrolysis with Jigsaw Cooperative Learning Strategy in Urban location performed better than those in Semi-urban and Rural areas respectively. However, no significant difference between the performance of students in Semi-urban and Rural areas.

Discussion of Findings

Findings of this study revealed that male and female students taught Jigsaw Cooperative Learning Strategy and conventional method performed equally well. This finding is in agreement with that of Gambari *et al.* (2013) reported that gender had no effect on academic performance of students in cooperative learning. In another study by Ajayi and Ogbeba (2017) revealed that there is no significant difference in the mean performance scores between male and female students taught stoichiometry using hands-on activities. In addition, study by Irungu, *et al.* (2019) reported that there is no statistically significant difference between male and female interactions and academic performance of learners in Chemistry. However, this finding contradict the findings by Okorie and Ezeh (2016) revealed that female students performed better than male students in chemical bonding concept. Study by Jegede and Olu-Ajayi (2017) discovered that the female students performed better than their male counterparts in mentoring relationship and study by Melkonian and Areepattamannil (2018) reported that the female students attained significantly higher levels of mathematics, reading and science performance than their male counterparts.

Students taught Electrolysis with Jigsaw Cooperative Learning Strategy in Urban location performed better than those in Semi-urban and Rural areas respectively. This finding is in line with the study by Opoku-Asare and Siaw (2015) who found that urban schools perform better than rural and semi-urban schools in visual art. In another study by Alordiah *et al.* (2015) who reported that students in urban location performed better than those in rural location. In addition, study by Faisal *et al.* (2016) revealed that students in urban location perform better in pharmacology than those in rural location and study by Akinwumi (2017) revealed that students in urban school's location performed better than those in the rural school's location in reading comprehension. However, the finding disagrees with Okorie and Ezeh (2016) who revealed that the performance of students in rural location was higher than that of the students in urban location when taught using Jigsaw cooperative learning strategy. Similarly, study by Fasasi (2017) revealed that students in rural location performed better than those in urban location.

Recommendations

In light of the findings of the research, the following recommendations were made:

(i). the use of Jigsaw Cooperative Learning Strategy is gender friendly, therefore, it should be encouraged in the classroom to enhance male and female performance in Electrolysis at senior secondary school level.

(ii). Chemistry teacher should use Jigsaw Cooperative Learning Strategy especially in Urban locations.

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EFFECTS OF METACOGNITIVE INSTRUCTIONAL STRATEGY ON ACADENIC ACHIEVEMENT AND RETENTION IN ARCHITECTURAL DRAWING AMONG TECHNOLOGY EDUCATION STUDENTS IN NIGERIA UNIVERSITIES

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Abstract
Modern instructional strategy allows students to actively engage in learning, exploring new ideas, and grasping the concept of learning in a deeper and more meaningful way. This can be achieved if students are aware on how to regulate and monitor their cognitive strategy that leads to higher order thinking for their learning process. The study examined the effects of metacognitive instructional strategy on academic achievement and retention in architectural drawing among technology education students in universities in Northern States, Nigeria. The study adopted a Pre-test, Post-test, post-post-test quasi-experimental design. The study used 245 (218 males and 27 females) final year students of building technology education. The experimental group consisted of 55 (45 males and 10 females) students, while the control group consisted of 180 (163 males and 17 females) students. The researcher developed and validated three instruments: Architectural Drawing Pre-Test (ADPT), Architectural Drawing Achievement Test (ADAT), a four-item theory questions with reliability coefficient of 0.89 and Metacognitive Teaching Strategy (MTS). The experiment period lasted for 6 weeks for both control group and experimental group respectively. three research questions were answered and their corresponding three research hypotheses were tested. The research questions were answered using descriptive statistics of mean and standard deviation. Hypotheses testing one and three were tested using an independent sample t-test while hypothesis two, was tested using Analysis of Covariance (ANCOVA) at $p \leq 0.05$, level of significance. There is existence of a significant difference between the entry performance mean scores of the experimental and control groups in favour of the experimental group. There was a significant difference between the post-test mean scores and retention ability of the experimental and control groups in favour of the experimental group respectively. Hence, the strategy was effective in enhancing students' academic performance and ability to retain the information learned. It is recommended that lecturers should use metacognitive instructional strategy in teaching drawings. Technology/technical educators should appreciate metacognitive activity and develop ways to foster it within all students.

Kewords: Metacognitive Instructional Strategy, Architectural Drawing, Acadenic Achievement and Retention

Introduction
Choosing an instructional strategy in technology education is to impart knowledge that brings fundamental change in the learners. To facilitate the process of knowledge transmission, teachers need appropriate instructional strategies to improve students' learning processes that suit specific objectives. Metacognitive instructional strategy is an ordered processes used to control and monitor student's own cognitive activities and to ensure that a cognitive goal in solving problem and

other engagements have been met in the course of learning. Tobias and Everson (2009) hierarchical model of metacognition for metacognitive instructional strategy involves: planning, selecting strategies, evaluating learning and knowledge monitoring which can be control for learning processes. Learner with good metacognitive skills and awareness uses these components of metacognitive strategy to oversee his/her own learning process by planning, monitoring ongoing cognitive activities, and compare cognitive outcomes with internal or external standards (evaluation). Strategy instruction in metacognition enhances learners' independent learning and autonomous learning and help learners to take responsibility for their own learning (Zimmerman, 1995; Schraw, 1998; Andrade, 1999; Todd, 2002; Aliyu, 2016).

The components in metacognitive instructional strategy are interlocked with student's goals or objectives in the learning process (Tobias and Everson, 2009). It is important to distinguish between cognitive strategy, such as solving problem, and metacognitive strategy, such as evaluating whether the new knowledge has been obtained during instruction. Cognitive strategies are those strategies that are directly related to information processing and can be used to acquire, store and use information better. In contrast, metacognitive strategy is a method used by individuals to plan, monitor and regulate learning (Weinstein, Acee, Jung; Winne, 2011). In an attempt to make such a distinction clear, cognitive strategy 'facilitate' learning and task completion, whereas 'metacognitive' strategy 'monitor' the process of cognitive strategies during instruction. Students consciously or unconsciously engage in the stages of metacognitive strategy during instruction, strategy about learning rather than learning strategies themselves (Al-Khatib, 2010). Teachers use metacognitive strategy components as sequential processes to control students' cognitive activities to achieve cognitive goal, for example, understanding a text or problem situation has been met that is being aware of what to learn (Winne, 2011; Moghtaderi, and Khanjani, 2013; Cevat, 2014).

The strategy allows students to construct their own understanding (new knowledge) of the content as related to prior knowledge and develop a personal feeling about the learnt concepts. The student-learning strategy puts more emphasis on a student as a center point of learning where students can plan, monitor and regulate their learning processes known as metacognitive strategy (Kasimi, 2012; Stephen and Joshua, 2017). If this strategy is actively used in a strategic manner, can improve students' academic achievement and also, enhance students' memory to retain the previous knowledge as it relates to new knowledge in science, technology, engineering and mathematics subjects (Cook, Kennedy and McGuire 2013; Aliyu 2016). It is therefore essential for building technology education students to also develop their ability to gain knowledge of metacognitive strategy, and extend the application of this strategy to control their architectural drawing among other related technology courses.

Architectural drawing is one of the building technology education courses offers in both Federal and State-owned universities. Architectural drawing is synonymous as building drawing in some universities offering building technology education and other tertiary institutions that deal with drawing and its interpretation (National Universities Commission (NUC). Architectural drawing comprises of presentation of drawing (isometric, oblique and perspective), projection (plan, block plan, site plan, front elevation, rear-side elevation, left-side elevation and right-side elevation), section, architectural drawing and model with the use of drawing instruments: tools and equipment (Samuel, 2018). It requires motor skills that involve the manipulation of drawing instruments to construct jointed lines, skills that can navigate thinking from concrete knowledge into abstract knowledge towards a memorable and interesting one.

Students offering drawing are expected to create a visual representation that identifies and shows the interconnections among various jointed line during teaching-learning process of

constructing and interpreting architectural drawing. Hence, teachers of building technology education need to apply metacognitive instructional strategy to suit specific objectives of architectural drawing for academic achievement (Elvis, 2013; Ganyaupfu, 2013). To facilitate the process of knowledge transmission in architectural drawing, architectural drawing students need effective and active learning strategy to connect, construct and interpret the drawing rather than strategy that are passive in nature. It is of a necessity that a skillful teacher needs to be conversant with various instructional strategies which may be applied to subjects at different class situations.

With regard to architectural drawing, learners are expected to take active responsibility for their own learning and use a good learning strategy, which enable them to plan, monitor, manage and reflect on the process of learning. Metacognitive strategy is closely linked to the development of self-regulated learning. Hence, students who use self-regulated strategies are intrinsically self-motivated and prove to be autonomous learners (Rozilawati and Ganakumaran, 2013). These types of learners are metacognitively, motivationally and behaviorally active participants in their own learning process (Lucija, 2017). Such learners according to Aliyu (2016) successfully make use of cognitive and meta-cognitive strategies and they are always engaged in self-regulated learning to knowing what to do, how to do and when to do in order to achieve academic success.

Academic achievement reflects the outcome of teaching-learning process in terms of marks, grades and means scores and the skills possesses during instruction (Alburaidi and Ambusaidi, 2019). The extent to which a student, teacher or institution has achieved their short-term or long-term educational goal can be referred to academic achievement (Cevat, 2014; Gladys (2017). According to Owodunni (2014) metacognitive strategies play an important role in problem solving, attention, memory, social cognition, personality development, communication among others which are concerns for school academic achievement. Architectural drawing is a technical oriented course that involves psychomotor skills to connect, construct and interpret drawing techniques that needs metacognitive strategy to improve architectural drawing concepts. Skills in metacognitive strategy creates awareness that challenge students to 'learn how to learn' in order to achieve academic success (Asy'ari, Ikhsan and Muhali, 2019). According to Ganyaupfu (2013); Gladys (2017); Ozdemir and Sahal (2018) instructional strategies such as demonstration method does not really foster critical thinking, creative thinking and not flexible enough to lead to academic achievement unlike metacognitive instructional strategy.

Metacognitive instructional strategy is flexible when permeate into learning process to develop and enhance students thinking processes that will last for long time. Absorption of knowledge gained into a long-term memory is what technology education students need to activate in academics for successful achievement. If information is to be retained and retrieved for use over an extended amount of time, it must be stored in long-term memory as schemata (Adeniji, Ameen, Dambatta and Orilonise (2018). Hence, memory is essential for individuals to remember experiences and use them to respond to future events (retention).

Retention is the continued possession, use, or control of knowledge acquired. According to Gambari, Falode and Adegbenro (2014) learning retention is a direct correlate of positive transfer of learning. Students' learning retention is a process of ensuring student success. This means that high retention may lead to high academic achievement, which is a factor of many variables such as interval between learning and retrieval, teaching strategies, environment among others. Thus, understanding retention and what facilitates it can help teachers select strategy like that of metacognitive instructional strategy to improve the retrieval of information

among students. Building technology students' learning retention can be retained and sustained for either a short or a long period of time if a memorable learning strategy like that of Metacognitive strategy components are employed. (Aliyu, 2016). Hence, this study tends to investigate the effects of metacognitive instructional strategy on achievement and retention in architectural drawing among technology education students in Nigeria universities.

Statement of the Problem

The challenge of effectively teaching subject concepts has often been linked to the instructional methods employed by teachers, among other factors. Samaresh (2017) and Yildirim and Ortak (2021) suggested that traditional teaching strategies may fail to engage students, leading to a lack of interest in the subject matter. Similarly, Obioma (2011), Aliyu (2016), and Eşref and Cevat (2021) have highlighted that low academic achievement among students may stem from the use of inappropriate instructional strategies, students' inability to self-regulate their learning, and a lack of understanding of how to apply learning strategies effectively when needed.

Active instructional strategies, which bridge abstract and concrete knowledge, are essential for making the learning process memorable both during and after class. Beyond the issue of ineffective instructional strategies, the problem of student learning retention is also significant. The ability of students to retain, sustain, and recall knowledge when needed is closely tied to the teaching and learning strategies employed (Aliyu, 2016; Ozdemir and Sahal, 2018). Furthermore, empirical studies indicated that metacognitive instructional strategies can significantly enhance students' learning retention while improving academic achievement (Dunlosky and Metcalfe, 2009; Aliyu, 2016). This underscores the need for teachers in technology education to invest in the development and implementation of instructional methods that foster higher-order thinking in architectural drawing and related technical courses.

The discrepancies in students' awareness of their own learning abilities appear to be a critical gap in the teaching-learning of architectural drawing at the university level. This gap emphasizes the need for alternative instructional methods that can better enhance students' understanding and retention of architectural drawing concepts. Despite the recognized importance of metacognitive strategies in education, there has been little to no empirical research testing the effectiveness of these strategies within technology education courses (particularly drawing courses) at the university level. In response to this gap, the present study determines the effects of metacognitive instructional strategy on academic achievement and retention in architectural drawing among building technology education students in Nigeria universities.

Objectives of the Study

The objectives of the study are to determine the effects of metacognitive instructional strategy on academic achievement and retention in architectural drawing among technology education students in Nigeria universities. Specifically, the study sought to:

1. establish the building technology education students' entry behavious prior to the experiment.
2. determine the effect of metacognitive instructional strategy on students' academic achievement in architectural drawing.
3. determine the effect of metacognitive instructional strategy on students' learning retention in architectural drawing.

Research Questions

The following research questions guide the study.

1. What is the building technology education students' entry behavious prior to the experiment?
2. What is the effect of metacognitive instructional strategy on students' academic achievement in architectural drawing as against those taught with traditional method?
3. What is the effect of metacognitive instructional strategy on students' learning retention in building drawing compared to demonstration method?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 significance levels:

H_{01}: There is no significant difference between students' entry behavious prior to the experiment in both federal universities and state-owned universities.

H_{02}: There is no significant effect in the academic achievement of building technology education students taught architectural drawing using metacognitive instructional strategy and those taught using traditional method.

H_{03}: There is no significant effect in the learning retention of building technology education students taught architectural drawing using metacognitive instructional strategy and those taught using traditional method.

Methodology

The study adopted quasi-experimental design in which pre-test, post-test, postpost-test nonequivalent, non-randomized control group design involved. The study covers northern states of Nigeria. Northern region comprises of three zones which are: north-central zone, north-east zone and north-west zone that made of nineteen (19) states. North-central zone consists of six states (Benue, Kogi, Kwara, Nassarawa, Niger and Plateau states) and north-east zone has six states (Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe) while north-west zone comprises of seven states (Jigawa, Kaduna, Kano, Kastina, Kebbi, Sokoto and Zamfara).

Population of the Study

The study's population consists of all final-year building technology education students in universities across the northern states of Nigeria. According to statistics from the National Universities Commission (NUC, 2021), there are nine universities offering building technology education in these regions (seven federal universities and two state-owned).

Sample and Sampling Techniques

The study employed a multi-stage sampling technique. In the first stage, purposive non-probability sampling was used to select all the universities offering technology education (building technology education in particular) as suggested by Teddlie and Yu (2007). The universities offering technology education from the northern region of Nigeria are: Federal University of Technology, Minna; Abubakar Tafawa Balewa University, Bauchi; University of Jos; Benue State University, Makurdi; Kano University of Science and Technology, Wudil. Bayero University, Kano; Federal University, Wukari, Tabara State; Modibbo Adama University of Technology, Yola; and University of Ilori. These universities were sampled based on their structural characteristics, homogeneity in staffing, funding, facilities, and similarities in teaching and learning environments, such as the time allocated to teaching, teaching methods, staff qualifications and experience, and overall achievement in architectural/building drawing.

In the second stage, a random sample of four universities was selected using a table of random numbers. In the third stage, two universities: Federal University of Technology, Minna (34 students) and Modibbo Adama University of Technology, Yola (31 students) were randomly assigned to experimental group using a coin flip, as suggested by Bryman (2008). The remaining two state-owned universities: Kano University of Science and Technology, Wudil (154 students) and Benue State University, Makurdi (26 students) were directly assigned to the control group. In total, 245 students were sampled for the study.

Instrument for Data Collection

The instruments used for data collection are as follow: Architectural Drawing Pre-Test (ADPT), Architectural Drawing Achievement Test (ADAT), and Metacognitive Teaching Strategy (MTS) respectively.

i. Architectural Drawing Pre -Test (ADPT)

At the beginning of the study, the Architectural Drawing Pre-Test (ADPT) was administered to assess the students' prior knowledge in architectural drawing. The pre-test comprised four theory-based questions (building floor plans, elevations, cross-sections, and roof plans).

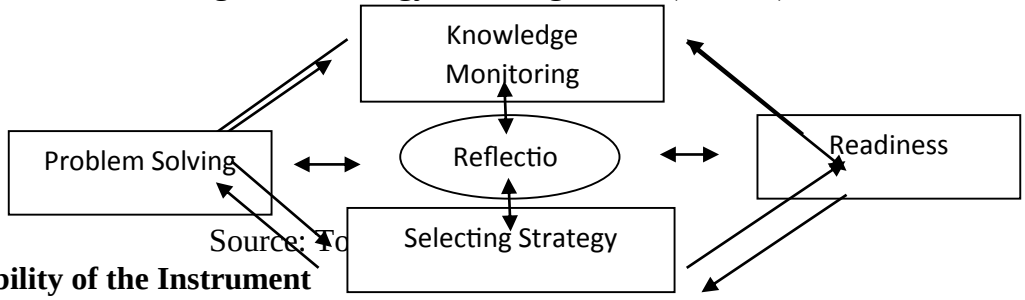
ii. Architectural Drawing Achievement Test (ADAT) (Post-Test)

Architectural Drawing Achievement Test (ADAT) was employed to measure students' achievement in architectural drawing. The test comprised of four theory questions (building floor plan, elevations, cross - section and roof plan).

iii. Metacognitive Teaching Strategy (MTS)

The metacognitive teaching strategy was developed based on Tobias & Everson's (2009) hierarchical model of metacognition. Their model, according to Erskine (2009), distinct from other theoretical models due to its emphasis on the incremental development of metacognitive skills, making it more appropriate for teaching purposes. Metacognitive Teaching Strategy is a five-stage non-linear, clockwise and anti-clockwise. The strategy started with knowledge monitoring, readiness, selecting strategy, problem solving and has reflection in the center.

Figure 2: Metacognitive Strategy Teaching Model (MSTM)



Source: To

Reliability of the Instrument

The drafted instrument was subjected to face and content validation by three experts, two from the Department of Industrial and Technology Education (Building Option), Federal University of Technology, Minna and Department of Vocational and Technology Education (Building Option), Faculty of Technology Education, Abubakar Tafawa Balewa University, Bauchi. A pilot testing of the instruments was conducted in Ekiti State University with 15 undergraduate final year students, comprising of 13 males and 2 females. Cronbach alpha formula was used to determine the internal consistency of the instrument. The reliability coefficient of the instrument was determined to be 0.89 with the aid of a research assistant (lecturer from the same university).

Method for Data Collection

Before the commencement of the experiment, students were assessed to ascertain their prior knowledge by administering a pre-test (ADPT) along with the help of research assistants. Treatment/non-treatment sessions for the experimental/control groups were conducted by the research assistants with the aid of lesson plans prepared by the researcher respectively after which a post-test (ADAT) was conducted. Two weeks after, the post-test (ADAT) was re-administered to assess students' retention ability.

Method of Data Analysis

Five research questions were answered using descriptive statistics in the form of mean and standard deviation. Hypotheses 1 and 3 were tested using an independent sample t-test, while hypothesis 2, was tested using Analysis of Covariance **(**ANCOVA) at .05 level of significance. Decisions on the hypotheses were based on comparing the significant values (level of significant) with ($P \leq 0.05$). If the significance value is equal or greater than ($P \leq 0.05$), the hypothesis is upheld or otherwise rejected.

Results

Research question one: What is the building technology education students' entry performance prior to the experiment? Answer to this research question is presented in table1.

Table 1: Descriptive statistic of building technology education students' entry performance prior to the experiment.

Variable	Group	N	Mean	Std. D	Mean Diff.
Pre-test	Metacognitive	65	14.35	2.786	1.065
	Traditional	180	13.29	1.919	
	Total	**245**			

Note: N= Number of Respondents Std. D= Standard Deviation, Mean Diff= Mean Difference

The result in table 1, indicates that there was existence of difference in the performance of building technology education students assigned to metacognitive instructional strategy (M = 14.35, Std. D = 2.786) and those assigned to demonstration method (M = 13.29, Std. D = 1.1919) prior to the experiment in favour of metacognitive instructional strategy group. This indicates that, students who were assigned to the metacognitive instructional strategy group performed better than those assigned to the demonstration method group even before the experiment started. However, the analysis of covariance would take care of this difference because it removes the initial difference between the groups and performs the normal variance analysis on the adjusted scores.

Research question two: What is the effect of metacognitive instructional strategy on students' performance in building drawing compared to traditional method? Answer to this research question is presented in table 2.

Table 2: Descriptive statistic of the effect of metacognitive instructional strategy on students' performance in building drawing compared to demonstration method.

Variable	Group	N	Mean	Std. D	Mean Diff.
Pre-test	Metacognitive	65	66.48	5.500	7.12
	Traditional	180	59.36	5.907	
	Total	**245**			

Note: N= Number of Respondents Std. D= Standard Deviation, Mean Diff= Mean Difference

The result in table 2, revealed that there was a difference in the performance of building technology education students taught using metacognitive instructional strategy (M=66.48, Std. D =5.500) and those taught using demonstration method (M=59.36, Std. D =5.907) in favour of metacognitive instructional strategy group. This indicates that the metacognitive instructional strategy was more effective in improving students' performance in building drawing compared to the traditional method.

Research question three: What is the effect of metacognitive instructional strategy on students' learning retention in building drawing compared to demonstration method? Answer to this research question is presented in table 3.

Table 3: **Descriptive statistic of the effect of metacognitive instructional strategy on students' learning retention in building drawing compared to demonstration method.**

Variable	Group	N	Mean	Std. D	Mean Diff.
Retention	Metacognitive	65	73.75	7.634	4.26
	Traditional	180	59.49	7.605	
	Total	**245**			

Note: N= Number of Respondents Std. D= Standard Deviation, Mean Diff= Mean Difference

The result in table 3, revealed that there was a difference in the retention scores of building technology education taught building drawing using metacognitive instructional strategy (M=3.96, Std. D =.511) and those taught using demonstration method (M=3.80, Std. D =.426). This indicates that, building technology education taught building drawing using metacognitive instructional strategy have better retention ability than their counterparts in taught using demonstration method.

Test of hypothesis 1: There is no significant difference between the entry performance of building technology education students assigned to metacognitive instructional strategy and those assigned to demonstration method prior to the experiment. The answer to this hypothesis is presented in table 4.

Table 4: Independent samples t-test for entry performance of building technology education students assigned to metacognitive instructional strategy and those assigned to demonstration method prior to the experiment

		Levene's Test for Equality of Variances						
Variable	Groups	N	F	Sig.	t-value	Mean	SD	Sig. (2-tailed)
Pre-test	Metacognitive	65	26.309	.000	2.847	14.35	2.786	.006
	Demonstration	180				13.29	1.919	

The outcome of independent-samples t-test in table 4 indicated that there is existence of a significant difference between the entry performance of building technology education students assigned to metacognitive instructional strategy (M = 14.35, Std. D = 2.786), and those assigned to demonstration method prior to the experiment (M = 13.29, Std. D = 1.1919), t (243) = 2.847, p = .006. Null hypothesis one was therefore, Rejected. This finding indicates that students in the metacognitive group started with a stronger initial understanding but ANCOVA appropriated the initial difference between the groups.

Test of hypothesis 2: There is no significant difference in the performance of building technology education students taught building drawing using metacognitive instructional

strategy and those taught using demonstration methods. The answer to this hypothesis is presented in table 5.

Table 5: ANCOVA Result of difference in the performance of building technology education students taught building drawing using metacognitive instructional strategy and those taught using demonstration methods

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4583.144[a]	2	2291.572	92.117	.000
Intercept	11362.669	1	11362.669	456.759	.000
Pretest	2161.298	1	2161.298	86.880	.000
Group	**1464.021**	**1**	**1464.021**	**58.851**	**.000**
Error	6020.162	242	24.877		
Total	929583.000	245			
Corrected Total	10603.306	244			

An ANCOVA was performed to compare the difference in the performance of building technology education students taught building drawing using metacognitive instructional strategy and those taught using demonstration methods. The result of ANCOVA presented in Table 5 shows that after controlling or adjusting for the initial difference in the building drawing performance of the students in the two groups, there was a significant difference in the performance of building technology education students taught building drawing using metacognitive instructional strategy and those taught using demonstration methods in favour of metacognitive instructional strategy F (1, 242) = 58.851, p = .000. This finding indicates that after controlling the initial differences in students' building drawing performance, the metacognitive instructional strategy proved to be more effective in enhancing the students' performance in building drawing compared to the demonstration method.

Test of hypothesis 3

There is no significant difference in the retention of building technology education students taught building drawing using metacognitive instructional strategy and that those taught using demonstration methods. The answer to this hypothesis is presented in table 6.

Table 6: Independent samples t-test for difference in the retention of building technology education students taught building drawing using metacognitive instructional strategy and that those taught using demonstration methods.

			Levene's Test for Equality of Variances					
Variable	Groups	N	F	Sig.	t-value	Mean	SD	Sig. (2-tailed)
Retention	Metacognitive	65	1.076	.301	12.944	3.96	.511	.000
	Demonstration	180				3.80	.426	

The statistical evidence presented the *independent-samples t-test* in table 6 indicates that there was a statistically significant difference in the mean retention of building technology education students taught building drawing using metacognitive instructional strategy (M=73.75, Std. D =7.634) and those taught using demonstration method (M=59.49, Std. D =7.605). t (243) = 12.944, p = .000. Null hypothesis four was, therefore, rejected. This finding suggests that the metacognitive instructional strategy is more effective not only in improving immediate performance and attitudes but also in helping students retain what they've learned over time.

Summary of the Major Findings

From the result of the analysis, the following major findings emerged from the study.

1. The students who were assigned to the experimental group performed better than those assigned to the control group prior to the experiment. The hypothesis affirmed that experimental group started with a stronger initial understanding of the drawing.
2. The students that received experimental group performed significantly better than the control group. This indicates that metacognitive instructional strategy was more effective in improving students' performance than control group.
3. The students taught building drawing under experimental group have better retention ability than their counterparts in the control group. The hypothesis revealed that metacognitive instructional strategy is more effective in helping students retain what they've learned over time.

Discussion of the Findings

The findings of research question one which is supported by test of its corresponding null hypothesis revealed that the students who were assigned to the experimental group performed better than those assigned to the control group prior to the experiment. The finding of this study agreed with that of Goldberg and Bush (2009) who examined the impact of teaching metacognitive strategies on third-grade students' metacognitive and problem-solving skills. The study established the prior knowledge among the experimental and control groups of the study. They affirmed that, there was existence of difference in the performance of students assigned to experimental group and those assigned to control group. In a related studies, the findings of Erkan (2019) investigated the effect of the metacognitive strategy on the writing skills of pupils in secondary education; Jody, Diana, Megan, Jessica, Matthew and Manuela (2019) examined the effects of different teaching strategies on metacognition and academic performance; Eze, Obidile and Akamobi (2019) worked on relative effectiveness of constructivism and meta-learning teaching methods on academic achievement and retention of basic electricity were all in agreement with the present study that there is significant difference in their pre-tests mean scores prior to the experiment due to the prior knowledge as regard to the build-up courses.

The findings of research question two and the test of its null hypothesis indicated that metacognitive instructional strategy was more effective in improving students' performance in building drawing compared to the traditional method. The findings of this study concurred with existing literature, such as the studies conducted by Bawa (2011); Javanmard, Hoshmandja and Ahmadzade (2012) and Moga (2012) who examined the effect of metacognitive strategy instruction in mathematical problem solving and students' achievement among other different dependent variables affirmed that the metacognitive teaching strategy perform better than traditional method. Similarly, Sırmacı and Tuncer (2013), Smith (2013), Eze, Obidile Akamobi (2019) and Jody, Diana, Megan, Amy, Jessica, Matthew and Manuela (2019) also in agreement in their various studies that metacognitive teaching strategy performed better than traditional method. Sırmacı and Tuncer (2013) investigated the effects of metacognition strategies applied in 7th grade mathematics course (Permutation and Probability) on students' achievement, metacognition skills, attitudes and permanence. The result indicated that teaching with metacognition strategies is more effective than the traditional teaching to increase the achievement of students in mathematics course and the result showed that metacognition strategies is significantly effective than traditional method. Also, the study of Jody, Diana, Megan, Amy, Jessica, Matthew and Manuela (2019) examined the effects of different teaching strategies on metacognition and academic performance. The result shown that there is significant effect of different metacognitive interventions than that of lecture method.

The researchers compared the results of their studies between metacognitive teaching strategy and lecture (traditional) method, there is no single research study that has relatively compared metacognitive teaching strategy with demonstration method. Meanwhile, Architectural drawing is a psychomotor skill course that can be taught by linking and joining lines together from one point to another through a demonstration way of teaching. This is likely so, because students have constant themselves with the demonstration method as regards to drawing courses.

The findings of research question three and the test of its corresponding null hypothesis revealed that, there was a statistically significant effect in the learning retention of students taught architectural drawing using metacognitive teaching strategy and those taught using traditional method. The finding in this study is in agreement with the findings of Eze, Obidile and Akamobi (2019), who conducted a study on relative effectiveness of constructivism and meta-learning teaching methods on academic achievement and retention of basic electricity among Technical College students. The study showed that meta-learning teaching method had a significant effect on students' retention ability against lecture method. Likewise, Bergstresser (2013) assessed the impact of a student's motivation and beliefs about calculus and their ability to retain mathematical skills after having practiced and developed metacognitive skills. The results of the study showed that there is a positive correlation between learning metacognitive skills and retaining content also, there is significant different among the variables which is in line with the present study.

The findings of this study agreed with the findings of Aliyu (2016) that investigated the impact of metacognitive strategy on attitude, retention and performance in calculus among colleges of education students. This study shown that metacognitive instructional strategy significantly improves students' achievement and retention abilities. In addition, the finding is also agreed with that of Yildirim and Ortak (2021), who studied the effects of the authentic learning approach in social studies on academic achievement, retention of knowledge, and attitude towards the course. Analyses of the result revealed that the students in the authentic learning approach exhibited better retention abilities.

Summary

The chapter highlights the summary of the research study, the conclusion and made some recommendations based on the findings discovered in the study. This study investigated the effect of metacognitive instructional strategy on achievement, retention, attitude and gender in architectural drawing among building technology education students in universities. The study is guided by five (5) specific objectives, five (5) research questions and five (5) null hypotheses. Relevant literature both conceptual and empirical are reviewed based on the focus of the study. The Population of the study comprises of 245 building technology education final year students offering architectural drawing (65 students for experimental group and 180 students for control group). The researcher manipulated the independent variable (metacognitive teaching strategy) and observed the effect on the dependent variables (performance, retention, attitude and gender). Four instruments were adopted for data collection are as follow: Architectural Drawing Pre -Test (ADPT), Architectural Drawing Achievement Test (ADAT), Metacognitive Teaching Strategy (MTS), and Attitude Towards Architectural Drawing Inventory (ATADI) respectively. The tests consist of four theory questions developed by the researcher covering the contents of building floor plan, elevations, cross-section and roof plan.

The study adopted quasi-experimental design in which pre-test, post-test and postpost-test non-equivalent, non-randomized control group design. Data collected were analyzed using

descriptive statistics of mean, standard deviation, analysis of covariance (ANCOVA) which is known as univariate analysis of variance and multivariate analysis of variance (MANOVA) were used to answer research questions and test the null hypotheses at 0.05 levels of significance for accepting or rejecting the hypothesis. Hypotheses 1, 3 and 4 were tested using an independent sample t-test, hypothesis 2, was tested using ANCOVA while hypothesis 5, was tested using MANOVA. The findings of the study revealed that metacognitive instructional strategy has significant effects on student's academic achievement, learning retention ability, positive attitude without gender bias. To the best of the researcher's knowledge, no published study was found to examine the effectiveness of metacognitive instructional strategy on achievement, retention, attitude and gender in architectural drawing among building technology education students in northern state universities, Nigeria.

Conclusion

Introducing a new method or alternative means of teaching-learning drawings in the new area of technology education as a means of innovation and novelty cannot be over emphasized for academic achievement. A main contribution of the present study was to examine the effectiveness of metacognitive instructional strategy on achievement and retention in architectural drawing among building technology education students in northern universities. It is important to know that metacognitive instructional strategy puts emphasis on how students can plan, monitor and regulate their learning processes in order to achieve academic goal. Based on the findings from the study, the following conclusions were drawn:

1. That due to the fact that student's exposure to metacognitive instructional strategy scored higher in the architectural drawing achievement tests, a conclusion can be made that the building technology education students' performance can be enhanced by receiving explicit instruction in metacognitive strategy.

2. Having metacognitive instructional knowledge for selecting and using relevant strategies means that, building technology education students are not only able to think but are also able to consciously decide about the process of learning. Therefore, the explicit instruction of metacognitive strategy seems to have contributed to the students' ability in learning of the architectural drawing concepts.

3. This study shows that teaching using metacognitive instructional strategy is effective in enhancing building technology education students' retention ability.

Recommendations

In view of the results of these findings, the following recommendations are hereby presented:

1. Since instructions in metacognitive strategy enhances students' independent and autonomous learning that allows learner to take responsibility for their own learning. However, Students of building technology education should always use the components of metacognitive instructional strategy to oversee his/her own learning process by planning, monitoring ongoing cognitive activities (learning), and compare cognitive outcomes with internal or external standards (evaluation).

2. Teachers of technology education and other trades related technical education involving drawings should be given on-the-job training opportunities such as short-term courses, seminars and workshop to enable the teachers to update their knowledge with the ever-changing scientific knowledge and various modern methods of teaching technology courses and trade subjects. Specifically, such seminars or workshop can be arranged for the

lecturers of technology education as regards to the strength of metacognitive instructional strategy that can serve as alternative method of teaching-learning architectural drawing.

3. Government and other relevant bodies should be implored to give enough grants to equip technology/technical drawing studios. Metacognitive teaching strategy cannot be effectively carried out in ill-equipped drawing studios.

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EFFICACY OF DIGITAL FLIPCHART ON LEARNING OUTCOME IN INDIVIDUALISE AND COLLABORATIVE SETTINGS AMONG SENIOR SECONDARY SCHOOL BIOLOGY STUDENTS IN MINNA METROPOLIS.

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ABSTRACT
This study investigated the efficacy of Digital Flipcharts on students' comprehension of biology concepts among secondary school students in Minna Metropolis, Niger State, focusing on both individualized and collaborative learning settings. The research employed a quasi-experimental design with 234 students from four selected schools, divided into experimental and control groups. Pre-tests, post-tests, and retention tests were conducted using a Biology Achievement Test (BAT) to measure comprehension and retention. The results revealed significant improvements in academic achievement, with individualized settings showing a mean score increase from 19.75 to 29.75, while collaborative settings demonstrated an even more substantial rise from 18.23 to 35.86, indicating that digital flipcharts are notably more effective in collaborative environments. For retention, students in individualized settings experienced a slight decrease in scores from 29.75 to 28.62, whereas collaborative settings showed an increase from 35.86 to 38.47. Hypothesis testing confirmed significant differences in both achievement and retention scores, with p-values of 0.00, leading to the rejection of the null hypotheses. The study concludes that Digital Flipcharts enhance both academic achievement and retention, especially in collaborative learning contexts, and recommends the integration of such technological tools into biology education to maximize student engagement and learning outcomes.

INTRODUCTION
The purpose of education is fundamentally aimed at the development of individuals and societies. Education, at its core, is the transfer of knowledge, cultivation of skills, and the fostering of personal growth and character traits that benefit society. Scholars such as Pea, (2018) view education as a societal construct, tailored to meet social demands at a particular time. This social perspective highlights the collaborative interaction between teachers and students, which serves as a crucial mechanism for behavioral development and positive societal contributions (Alam, 2022). Education equips individuals with essential tools like knowledge, skills, values, and social competencies, positioning it as a driving force for societal progress, as articulated by Pauley and Buseri (2019).

Moreover, science education plays a pivotal role in promoting critical thinking and analytical skills, equipping individuals with tools for scientific inquiry and innovation. According to Olatunde-Aiyedun and Adams (2022), integrating science education into Nigerian schools holds transformative potential for the nation's education system. Their research underscores the critical need for science programs that foster problem-solving abilities and prepare students for real-world challenges in an era increasingly dominated by science and technology. In this context, science education is seen not only as a contributor to academic success but as a key

driver of societal advancement through the promotion of scientific literacy and technological progress.

Biology, as a fundamental aspect of science education, contributes significantly to students' understanding of life processes, ecosystems, and biological diversity. It enables learners to grasp complex concepts, from cell structures to ecological interactions, fostering both scientific literacy and an appreciation of the living world. The Nigerian secondary school biology curriculum, as established by the Nigerian Educational Research and Development Council (NERDC, 2012), aims to impart practical and theoretical knowledge, equipping students with skills relevant to fields such as medicine and biotechnology (Ogbuze & Okoli, 2020). However, challenges such as a shortage of qualified teachers, large class sizes, and outdated teaching methods have led to a decline in biology students' performance, calling for innovative approaches to improve teaching and learning (Jeronen et al., 2017; Matazu, 2022).

Digital Flipcharts represent an innovative teaching tool that holds great potential for addressing these challenges in biology education. By combining traditional educational approaches with digital capabilities, they offer dynamic, multimedia-enhanced learning experiences. Studies suggest that Digital Flipcharts improve student engagement, foster collaborative learning, and enhance comprehension of complex biological processes (Muijs & Reynolds, 2017; Suwono, 2023). These tools also support differentiated instruction, allowing educators to cater to diverse learning styles, promote student-centered learning, and facilitate peer collaboration (Tomlinson, 2017; Liu & Lan, 2020). Despite these advantages, more empirical research is needed to assess the effectiveness of Digital Flipcharts in specific contexts, such as biology education in Nigerian secondary schools.

Statement of the Problem

Biology is essential for students pursuing science and health-related careers, yet recent years have seen a decline in students' interest and performance, particularly in the Senior Secondary Certificate Examination (SSCE) conducted by WAEC, NECO, and NABTEB. NECO results from 2020 to 2022 show that only 11.93% of students achieved distinction in biology, far below the rates for mathematics, chemistry, and physics. Additionally, WAEC Chief Examiner Reports from 2020-2022 highlight poor student performance in biology concepts such as the Digestive System and Alimentary Canal. Traditional teaching methods have proven ineffective, raising concerns among educators and parents. This study seeks to assess the effectiveness of Digital Flip charts in enhancing students' achievement and retention in these biology concepts in senior secondary schools in Minna metropolis.

Aim and Objectives

This study aims to investigate the efficacy of using Digital Flipcharts on students' comprehension of biology concepts among secondary school students in Minna Metropolis, Niger State. Specifically, the objectives is to;

1. determine the impact of digital flipchart on the academic achievement of secondary school biology for both individualized and collaborative learning.
2. examine the impact of digital flipchart on the retention of secondary school biology for both individualized and collaborative approaches.

Research Questions:

The following research questions were formulated to guide the study:

1. What is the impact of Digital Flipcharts on the academic achievement of secondary school biology students for both individualized and collaborative learning settings in Minna metropolis?
2. What is the impact of Digital Flipcharts on the Retention of secondary school biology students for both individualized and collaborative learning settings in Minna metropolis?

Research hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significant.

$H0_1$: There is no significant difference in the mean achievement score of students taught biology concepts in individualized and collaborative learning settings using Digital Flipcharts.

$H0_2$: There is no significant difference in the mean retention score of students taught biology concepts in individualized and collaborative learning settings using Digital Flipcharts.

Scope of the Study

This study evaluated the effectiveness of flip charts in teaching the Digestive System to senior secondary students in Minna, Niger State. Four schools were selected, with two as experimental and two as control groups. The research focused on SS II students, examining individual and collaborative learning styles. Key variables included achievement, retention, perception, and gender.

LITERATURE REVIEW

The literature will be reviewed under the following sub-headings: Conceptual framework, theoretical framework and empirical study.

Conceptual Model

In this model, Digital Flipcharts serve as the central node influencing various components of the educational process. Individualized Learning Settings and Collaborative Learning Settings are directly impacted by the use of Digital Flipcharts, as they provide the technological framework for personalized and group-based instruction. Academic Achievement and Retention of Biology Concepts are outcomes influenced by both learning settings, reflecting the effectiveness of Digital Flipcharts in facilitating learning outcomes. Additionally, students' Perceptions of Effectiveness and Utility are shaped by their experiences with Digital Flipcharts in both individualized and collaborative learning contexts, influencing their attitudes towards this instructional tool. Moreover, the variable of Gender introduces a potential moderating factor, indicating that the impact of Digital Flipcharts on academic achievement, retention, and perceptions may vary based on gender differences among students. This integrated model highlights the interconnectedness of key elements in the educational process, demonstrating how the use of digital technologies like Digital Flipcharts can influence learning outcomes and student perceptions in diverse learning environments.

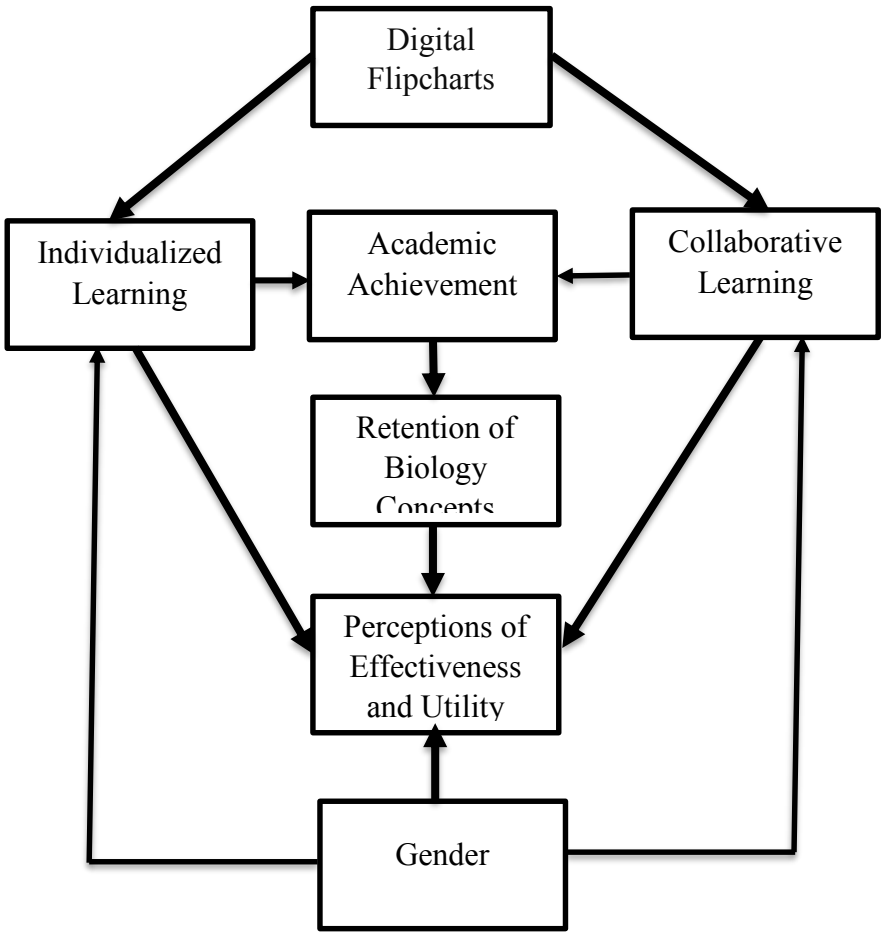

Figure 2.1 Conceptual model of all the variables indicating how they link and influence each other
Source: Author's Original Construct, 2024

Digital Flipcharts
Digital Flipcharts are interactive educational tools that enhance teaching by integrating multimedia content such as text, images, videos, and quizzes. They promote active student engagement and improve understanding and retention, particularly in science education. Research by Ahmed et al. (2020) supports their effectiveness in increasing student motivation and engagement, while Schönbrodt et al. (2022) emphasize their adaptability in individualized and collaborative learning environments. Digital Flipcharts also enhance teacher-student communication, creating a more interactive classroom experience that fosters knowledge construction and skill development. This study explores their potential to improve biology education.

Concept of Individualized Learning Settings
Individualized learning settings cater to students' unique learning needs by offering personalized, self-paced instruction. Research by Morris (2019) demonstrates that individualized learning improves academic performance compared to traditional methods. Hofer et al. (2021) highlight the importance of technology, like Digital Flipcharts, in supporting personalized instruction, enhancing cognitive development, and fostering self-regulation. This

study aims to evaluate how Digital Flipcharts support individualized learning in biology, promoting academic success by addressing diverse learning preferences.

Collaborative Learning Settings

Collaborative learning emphasizes student interaction and knowledge-sharing through group activities, fostering a sense of community and cooperation. Research by Wanis (2019) suggests that collaborative learning improves critical thinking, communication, and retention. Lipponen (2023) highlights its effectiveness in STEM education, where students engage in problem-solving and knowledge construction. This study examines how Digital Flipcharts facilitate collaborative learning, encouraging student interaction and improving learning outcomes in biology education.

Academic Achievement

Academic achievement reflects students' mastery of knowledge and skills, often measured through assessments. Research by Mazzetti et al. (2020) underscores its importance in predicting future success. Instructional methods, learning environments, and motivation influence academic achievement. Bai and Wang (2023) emphasize the role of self-regulated learning and intrinsic motivation. This study investigates how Digital Flipcharts impact academic achievement in biology, assessing their effectiveness in enhancing student performance.

Retention of Biology Concepts

Retention refers to students' ability to recall and apply learned concepts over time. Research by Gordon (2020) emphasizes that frequent retrieval practice and active engagement improve long-term retention. Schmidt et al. (2020) highlight the role of cognitive schema theory in organizing and retaining information. This study assesses how Digital Flipcharts contribute to the retention of biology concepts, exploring their potential to promote durable learning outcomes.

Concept of Gender

Gender differences in education influence academic achievement, learning styles, and technology use. Borgonovi and Greiff (2020) note that while gender gaps in achievement are narrowing, disparities persist in some subjects. Stark et al. (2020) highlight that gender may affect attitudes toward technology, with females often expressing lower confidence in using digital tools. This study explores gender-related differences in achievement, retention, and perceptions of Digital Flipcharts in biology education.

Bloom's Taxonomy

Bloom's Taxonomy classifies cognitive skills into six levels, from basic recall to critical evaluation. It serves as a framework for designing curricula and assessments that promote higher-order thinking. This study applies Bloom's Taxonomy to assess the effectiveness of Digital Flipcharts in fostering deep understanding and cognitive development in biology, enhancing students' ability to engage with concepts at various levels of complexity.

METHODOLOGY

This study employed a quasi-experimental research design to assess the impact of Digital Flipcharts on biology instruction and retention among Senior Secondary School II students in Minna Metropolis, Niger State. The sample consisted of 234 students from four selected schools, divided into experimental and control groups. The experimental groups received instruction using Digital Flipcharts, with one group utilizing individual-based learning and the other collaborative learning, while the control group was taught using traditional methods. Pre-

tests, post-tests, and retention tests were administered to both groups using a Biology Achievement Test (BAT) to measure student comprehension and retention. Additional instruments, such as the Digital Flipchart Impact on Student Retention in Biology (DFISRB) and a student perception survey, were employed. The instruments were validated by experts and subjected to reliability testing, yielding satisfactory coefficients. Data collection involved trained research assistants administering the tests and scoring them according to a predetermined scheme. Descriptive statistics, including mean and standard deviation, were used to answer the research questions, while inferential statistics, specifically Analysis of Covariance (ANCOVA), were used to test the hypotheses at a 0.05 significance level using SPSS version 27.

RESULT AND DISCUSSION

Results

Research Question one

What is the impact of Digital Flipcharts on the academic achievement of secondary school biology students for both individualized and collaborative learning settings in Minna metropolis?

Table 4.1: impact of Digital Flipcharts on the academic achievement of secondary school biology students for both individualized and collaborative learning settings in Minna metropolis

		Pre-test scores		*Post-test scores*		*Change in scores*	
Variables	*N*	*Mean score*	*Std. dev*	*Mean score*	*Std. dev*	*Mean score*	*Std. dev*
Individualised setting	125	19.75	5.815	29.75	5.815	10.00	.00
Collaborative setting	109	18.23	3.597	35.86	2.661	17.63	.94

The results presented in Table 4.1 reveal that the use of digital flipcharts significantly enhanced the academic achievement of secondary school biology students in both individualized and collaborative learning settings in Minna metropolis. Students in the individualized setting showed a mean score increase from 19.75 (pre-test) to 29.75 (post-test), with a mean score change of 10.00. In comparison, students in the collaborative setting exhibited a greater improvement, with their mean score rising from 18.23 (pre-test) to 35.86 (post-test), resulting in a mean score change of 17.63. These findings indicate that while digital flipcharts are beneficial in both settings, they are notably more effective in collaborative learning environments, suggesting that peer interaction and group work may amplify the positive impact of digital flipcharts on student learning outcomes.

Research Question two

What is the impact of Digital Flipcharts on the Retention of secondary school biology students for both individualized and collaborative learning settings in the Minna metropolis?

Table 4.2: impact of Digital Flipcharts on the Retention of secondary school biology students for both individualized and collaborative learning settings in Minna metropolis

		Post-test scores		Postpost-test scores		Change in scores	
Variables	N	Mean score	Std. dev	Mean score	Std. dev	Mean score	Std. dev
Individualised setting	125	29.75	5.815	28.62	4.844	1.13	0.971

Collaborative setting	109	35.86	2.661	38.47	1.675	2.61	0.986

The data in Table 4.2 indicates that the use of digital flipcharts positively impacts the retention of biology concepts among secondary school students in Minna metropolis, with notable differences between individualized and collaborative learning settings. In the individualized setting, students' mean scores slightly decreased from 29.75 (post-test) to 28.62 (postpost-test), showing a mean score change of -1.13. Conversely, in the collaborative setting, students' mean scores increased from 35.86 (post-test) to 38.47 (postpost-test), reflecting a mean score change of 2.61. These results suggest that digital flipcharts are more effective in promoting long-term retention of biology concepts when used in collaborative learning environments, highlighting the importance of peer interaction and group dynamics in reinforcing learning.

Hypotheses

Hypothesis one

There is no significant difference in the mean achievement score of students taught biology concepts in individualized and collaborative learning settings using Digital Flipcharts.

Table 4.7: significant difference in the mean achievement score of students taught biology concepts in individualized and collaborative learning settings using Digital Flipcharts.

Variables	*N*	*Df*	*Mean score*	*Std. dev*	*t-value*	*P-value*
Individualised setting	125		10.00	.00		
Collaborative setting	109	232	17.63	.94	10.086	0.00^{SG}

The result shows a significant difference in the mean achievement scores between students taught biology using digital flipcharts in individualized and collaborative settings. The mean score for the collaborative setting (17.63) is higher than that for the individualized setting (10.00), with a t-value of 10.086 and a p-value of 0.00. Since the p-value is less than 0.05, the null hypothesis is rejected.

Hypothesis two

There is no significant difference in the mean retention score of students taught biology concepts in individualized and collaborative learning settings using Digital Flipcharts.

Table 4.8: Significant difference in the mean retention score of students taught biology concepts in individualized and collaborative learning settings using Digital Flipcharts.

Variables	N	Df	Mean score	Std. dev	t-value	P-value
Individualised setting	125		1.13	0.971		
Collaborative setting	109	232	2.61	0.986	20.086	0.00^{SG}

The result indicates a significant difference in the mean retention scores between students taught biology using digital flipcharts in individualized and collaborative settings. The mean score for the collaborative setting (2.61) is higher than that for the individualized setting (1.13),

with a t-value of 20.086 and a p-value of 0.00. Since the p-value is less than 0.05, the null hypothesis is rejected, showing a significant difference in retention.

Summary of Findings

Research Question One: The impact of Digital Flipcharts on the academic achievement of secondary school biology students in both individualized and collaborative learning settings in Minna metropolis showed significant improvements. Students in individualized settings increased their mean scores from 19.75 (pre-test) to 29.75 (post-test), with a mean score change of 10.00. In collaborative settings, the mean score rose from 18.23 (pre-test) to 35.86 (post-test), resulting in a mean score change of 17.63. The greater improvement in collaborative settings suggests that digital flipcharts are more effective in group learning environments.

Research Question Two: The effect of Digital Flipcharts on retention of biology concepts revealed that collaborative learning settings resulted in better retention. In individualized settings, mean retention scores slightly decreased from 29.75 (post-test) to 28.62 (postpost-test), showing a mean score change of -1.13. In contrast, collaborative settings saw an increase from 35.86 (post-test) to 38.47 (postpost-test), with a mean score change of 2.61, highlighting that collaborative settings better support long-term retention of concepts.

Hypothesis One: An independent sample t-test revealed a significant difference in mean achievement scores between students in individualized and collaborative learning settings. Students in collaborative settings had higher mean achievement scores (mean difference of 6.110) than those in individualized settings, rejecting the null hypothesis.

Hypothesis Two: The independent samples t-test showed a significant difference in mean retention scores between individualized and collaborative learning settings. Collaborative settings yielded higher retention scores (mean difference of 9.844), indicating that digital flipcharts are more effective in collaborative environments, thus rejecting the null hypothesis.

Discussion of findings

Table 4.1 demonstrates that digital flipcharts significantly enhance the academic achievement of biology students, with a greater improvement observed in collaborative settings compared to individualized ones. This aligns with recent studies such as those by Erdal & Vural (2021) and Fadly & Zahran (2023), which found that collaborative learning tools often lead to higher academic gains due to increased interaction and peer support. The greater mean score change in collaborative settings (17.63) compared to individualized settings (10.00) suggests that the collective engagement and exchange of ideas facilitated by digital flipcharts contribute more significantly to academic improvement. These findings are consistent with research indicating that interactive technologies and collaborative approaches can amplify learning outcomes by leveraging group dynamics and shared knowledge (Kumar & Sharma, 2022)

.

As illustrated in Table 4.2, the retention of biology concepts was notably better in collaborative settings (mean score change of 2.61) compared to individualized settings (mean score change of -1.13). This suggests that while digital flipcharts aid retention across both settings, they are more effective in collaborative environments. This supports findings from recent studies such as those by Patel et al. (2022) and Jansen & Schmidt (2024), which highlight that collaborative learning not only enhances immediate learning outcomes but also improves long-term retention due to the reinforcement provided by peer interactions. The increase in retention scores in collaborative settings reflects the added benefit of group discussions and collective problem-

solving, which help solidify students' understanding and memory of the content (Hernandez et al., 2023).

Table 4.11 indicates no significant difference in mean retention scores between male (M = 28.74) and female (M = 28.49) students in individualized learning settings, with a mean difference of 0.780 (t = 0.280, p = .440). The acceptance of the null hypothesis suggests that gender does not significantly affect the retention of biology concepts in individualized learning settings. This result supports findings from Turner & Edwards (2023) and Evans & Roberts (2022), who reported that individualized learning tools, including digital flipcharts, are equally effective for both male and female students in terms of retention. The consistency in retention rates across genders reinforces the idea that individualized learning technologies can effectively support all students' long-term understanding, regardless of gender (Smith & Jackson, 2021).

Table 4.12 shows a slight or no significant difference in mean retention scores between male (M = 38.98) and female (M = 37.86) students in collaborative learning settings, with a mean difference of 1.123 (t = 3.685, p = .000). The acceptance of the null hypothesis indicates that gender has minimal or no significant influences on the retention scores in collaborative learning settings. The findings are supported by Zhou & Zhang (2021) and Al-Mansoori & Ali (2024), who found that gender differences can slightly or may not affect retention outcomes, particularly in collaborative environments where social dynamics and peer interactions play a significant role. The slight mean difference for male students suggests that there might be gender-related differences but it is of not much impact on retention in collaborative settings, potentially due to varying levels of engagement or interaction styles. This underscores the need for further research to explore these gender dynamics and how collaborative tools can be optimized to support all students effectively.

Conclusion

This study explored the impact of digital flipcharts on the academic achievement and retention of secondary school biology students in both individualized and collaborative learning settings within Minna metropolis. The findings indicate that digital flipcharts significantly enhance both academic achievement and retention of biology concepts, particularly in collaborative learning environments. Students in collaborative settings demonstrated significantly higher post-test scores and better retention compared to those in individualized settings. Moreover, the study found no significant gender differences in the effectiveness of digital flipcharts, suggesting that this technology provides equitable learning opportunities for male and female students alike.

The results of this study align with previous research highlighting the benefits of collaborative learning and digital tools in enhancing educational outcomes. By fostering interactive learning experiences and facilitating peer interaction, digital flipcharts contribute to a more engaging and effective learning environment. These findings underscore the potential of educational technologies to improve learning outcomes in secondary education, particularly in subjects like biology where conceptual understanding and retention are crucial for academic success.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

1. Schools should consider integrating digital flipcharts into biology classrooms, particularly in collaborative learning settings, to enhance both academic achievement and retention.

2. Educators should receive training on effectively utilizing digital flipcharts to maximize their potential in enhancing student learning outcomes.
3. Future studies should explore the long-term effects of digital flipcharts on student learning across different subjects and educational settings.
4. Educational policymakers should consider policies that support the adoption and implementation of digital technologies in secondary education to improve overall learning outcomes.

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A REVIEW ON THE EFFECTS CONVERSATIONAL NATURAL LANGUAGE PROCESSING MODEL FOR BIOLOGY INSTRUCTION AMONG SECONDARY SCHOOLS IN MINNA NIGER STATE.

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Abstract

This paper presents a review on the development and evaluation of conversational natural language processing model for biology instruction among secondary schools in Minna Niger State. Conversational Artificial Intelligent models are artificial intelligence systems designed to engage in natural language conversations with users these models have become increasingly sophisticated and versatile, enabling human-like interactions in various applications. This review summarised relevant research on the meaning of Conversation AI model. The paper also underscores some key characteristic of Conversational AI Model which include Natural Language Understanding (NLU), Natural Language Generation (NLG), Context Management, Multimodal Abilities, Multilingual Support and some applications like Chatbots, Voice Assistants, Content Generation, Translation Services and Pre-trained Models. The study also reviewed related empirical Studies on the effects of conversational NLP on Biology students' achievement, retention and interest based on gender, the Nature and scope of Biology were also identify. The paper concluded by advocating for further researches on the development of Conversational Neural Language Processing Model in multiple language for teaching different subjects and level of education Government Organization, agencies and Non-governmental organization, should fund more researches in AI for teaching and learning in schools school Authorities and management should provide enabling environment for teachers and students to develop Conversational AI model for self-directed learning. More Conferences, Seminars and workshops should be organized for Nigerian educational stakeholder to keep them abreast with the global emerging technologies.

Keywords: Conversational Natural language processing Model, Biology.

Introduction

With the rapid advancement of technology and globalization of interconnectedness, artificial intelligence (AI) has substantially influenced many sectors, including education. In various ways, AI has the capability to promote advancement and innovation in educational settings (Zhai, 2022). Conversational Neural Language processing model is one of the emerging AI tools that can be employed for educational purposes. Education is an integral part of human life because it is a life-long process, as it is normally understood, it is not only what is taught to the students in schools, colleges, and universities, nor a method of reading books and memorizing concepts. It is how people encompass all the learning experiences they may have during their lives, it is also a never-ending development which can give them a new meaning and direction (Borsoto *et al.*, 2014). Researchers have investigated the limited use of Artificial Intelligent (AI) model in education field including conversational (AI) model (Kim *et al* 2019). In educational settings, ChatGPT not only can assist in designing assessment, producing essays, and translating languages, but it also enables users to pose and answer a variety of

questions, summarize texts, and interact with it like peers (Sok, 2023). Baidoo-Anu and Ansah (2023) claimed that such a model could also demonstrate creativity in writing on almost any topic from a single paragraph to a full research article that can be seen as convincing or almost convincing. Likewise, Atlas (2023) argued that tertiary education could benefit greatly from the usage of ChatGPT and other language models, which can be applied in a wide range of contexts, including writing aid, language acquisition, research, and administration. Thus, it could be argued that ChatGPT has the potential to be a useful tool for education and research. Conversational AI models have emerged as game-changers in the education system (Diachenko *et al.*, 2019). Su and Yang (2023) asserted that it enhances student's engagement, personalizing learning experiences and facilitate inquiry-based learning through interactive chatbot interactions. Models, like Chat GPT, have the ability to mimic human language and engage in conversation, providing students with a more interactive and natural learning experience (Leon & Vidhani, 2023). Chat GPT tool has received tremendous attention and, within two months of launching in November 2022, it has reached 100 million users (The Guardian, 2023).

Over View of Conversational AI Natural Language Processing Model

Conversational AI models are artificial intelligence systems designed to engage in natural language conversations with users. Chakrabort and Nath (2021) clarified that these models have become increasingly sophisticated and versatile, enabling human-like interactions in various applications. Wu *et al.* (2016) stated that some key characteristics and examples of conversational AI models include Natural Language Understanding (NLU), Natural Language Generation (NLG), Context Management, Multimodal Abilities, Multilingual Support and some applications like Chatbots, Voice Assistants, Content Generation, Translation Services and Pre-trained Models. Many conversational AI models are pre-trained on large datasets and can be fine-tuned for specific applications, which reduces the need for extensive training data. Open AI's GPT-3: is one of the most notable conversational AI models with 175 billion parameters, making it highly versatile and widely used for a range of conversational AI applications (Leon & Vidhani, 2023).

Conversational AI natural language processing (NLP) technologies, such as Chat GPT AI, provide a means through which computers may engage with human language. A crucial stage in NLP, known as tokenization, is transforming unstructured information into organized text appropriate for computing Chat GPT AI is interactive, able to comprehend what is being requested, and able to deliver it if it meets with application policies and data availability. For example, if you ask a search engine like Google to offer a list of questions connected to a particular topic, Google will send a link to a website that includes information relevant to the query you requested. When asking the same command to Chat GPT AI, the application will provide the question in that column (Hosseini et al., 2023).

Concept of Conversational NLP Model in Education

Given the fact that assessment is the backbone of quality education, Conversational Neural Language Processing (NLP) entails converting unstructured input into a machine readable format and processing it to generate the right response. Conversational NLP enables systems to understand human input and generate pertinent responses. ChatGPT an example of conversational NLP enables academic staff and teachers to have an innovative and flexible way to create learning assessments with real-time feedback and reports. Zhai (2022) contended that teachers could create learning assessment items using ChatGPT while saving time and effort and potentially improving the quality of the questions by adhering to a standard framework. With the abilities given by ChatGPT, teachers could develop open-ended question prompts that

are aligned with the learning objectives and success criteria of the teaching lessons (Baidoo-Anu & Ansah, 2023). Given that the majority of teachers spend plenty of time creating quizzes, monthly tests, and examinations, it is clear that there is an opportunity for educators to lessen the pressure of assessment by receiving assistance from ChatGPT.

ChatGPT can also offer an automatic grading system with helpful feedback, which is essential for improving students' learning outcomes. ChatGPT could be leveraged to semi-automate students' work grading through identifying both weaknesses and strengths of the task in question (Kasneci *et al.*, 2023). These could include research articles, academic essays, and a wide range of writing forms of assignments. It is useful for educators to adapt the reports produced by such a model to provide helpful feedback to students in formative or summative assessment contexts. Kasneci *et al.* (2023) added that a more accurate assessment of a student's learning obstacles and development can be made with the aid of ChatGPT, which can assist teachers in pinpointing the areas where learners face difficulties. As a result, it is preferable for teachers to reduce workloads and shift their primary attention to developing innovative lesson plans, participating in teacher professional development, and offering coaching and mentoring support to each student individually, all of which are essential to improve students' learning performance and can be supported by ChatGPT.

As there are a number of innovative features offered by ChatGPT, it is advantageous for teachers to improve pedagogical practices by designing and integrating interactive classroom activities. Rudolph *et al.* (2023) argued that with the assistance of ChatGPT, it is possible for educators to design teaching techniques creatively by adopting a flipped classroom approach. This method allows students to study both in the classroom and remotely, which encourages them to learn independently. Atlas (2023) claimed that not only could ChatGPT assist teachers in developing their quizzes, exams, and syllabuses, but it could also enable them to produce lesson plans, presentations, and other resources as well as to evaluate students' work. This perhaps encourages teachers to modify and edit these materials in more creative and engaging ways to meet students' learning needs because they have more time to reflect and develop new teaching techniques and activities.

The platform for interactive communication given by ChatGPT enables teachers to establish more classroom engaging activities. Herft (2023) noted that teachers could use ChatGPT to generate visual aids, such as slides or worksheets that clearly outline the learning objectives and success criteria for a lesson. It is worth noting that these instructional materials have a strong likelihood of attracting students to learn and involve themselves in a classroom learning environment. Moreover, questions and prompts generated by ChatGPT potentially encourage students' involvement with diverse levels of knowledge and skills, as well as stimulate their problem-solving and critical thinking skills (Kasneci *et al.*, 2023), which is pivotal for 21st century education. It is convinced that this emerging AI tool plays an essential role in promoting classroom interaction offering virtual personal tutoring

Unlike traditional tutoring methods, ChatGPT is a potential tool that can be used as an ideal personal tutor for students. Qadir (2022) and Mhlanga (2023) stated that students could receive feedback and individual answers by asking ChatGPT that can offer intellectual tutoring services virtually. In this sense, it is convenient for students to ask ChatGPT to assist them anytime they need with their homework, assignments, projects, and even math exercises. This approach may empower students to become autonomous and self-directed learners. Similarly, ChatGPT is capable of discussing a variety of topics in addition to responding to students' queries (Baidoo-Anu & Ansah, 2023). However, to gain the most of ChatGPT's assistance, it

is crucial for educational institutions to develop concrete guidelines and introduce them to students so that they are explicitly aware of how to use it efficiently and responsibly.

Researchers can provide prompts to ChatGPT and ask it to create an outline for an article or other forms of writing. Kasneci *et al.* (2023) argued that it is helpful for students to use such a model to help organize ideas for their research and writing. In this regard, students can effortlessly suggest prompts so that ChatGPT can generate an outline immediately. However, some of the contents may need to be adjusted by researchers or students for the outline to be usable. In fact, some researchers have already started using it to generate outlines for their writing (Qadir, 2022; Zhai, 2022). Moreover, ChatGPT can quickly create an outline of research articles, enabling researchers to quickly and precisely grasp the main points (Kasneci *et al.*, 2023).

Brainstorming ideas ChatGPT is crucial for research, particularly in helping to brainstorm ideas for writing. Some researchers have already begun to use ChatGPT to write research articles (King 2023). ChatGPT has shown a powerful ability to organize and draft components of articles (Zhai, 2022). Thus, there is no doubt that this newly developed AI-generated tool has a significant capacity to help researchers brainstorm ideas for research articles, although it is vital that researchers should adjust and verify the ideas generated by ChatGPT to avoid mistakes or misleading information (Gordijn & Have, 2023; Mogali, 2023).

Rudolph *et al.* (2023) added that ChatGPT has the potential benefits of enhancing students' learning experience and supporting teachers' work. ChatGPT could boost student learning and help them overcome barriers in the traditional classroom thereby improving transfer, breaking the illusion of explanatory depth, and training students to critically evaluate explanations. The use of ChatGPT can help teachers create new teaching materials and reduce their workload and improve student learning. It helped students understand difficult and abstract concepts through numerous examples; varied explanations and analogies that help students overcome common misconceptions; low-stakes tests that help students retrieve information and assess their knowledge; an assessment of knowledge gaps that gives instructors insight into student learning; and distributed practice that reinforces learning.

Algorithms driven by machine-learning technologies are now gaining maturity. ChatGPT is one of such innovation. ChatGPT is an interactive chatbot created by OpenAI, a California-based artificial intelligence (AI) startup (Shiri, 2023). OpenAI's ChatGPT is a comprehensive language model. ChatGPT AI was trained on a massive corpus of text data using a deep learning algorithm to create replies like those of a human for natural language questions. ChatGPT AI bot is now accessible at https://chat.openai.com/chat. AI natural language processing (NLP) technologies, such as ChatGPT AI, provide a means through which computers may engage with human language. A crucial stage in NLP, known as tokenization, is transforming unstructured information into organized text appropriate for computing (Hosseini *et al.*, 2023). ChatGPT AI is interactive, able to comprehend what is being requested, and able to deliver it if it meets with application policies and data availability. For example, if you ask a search engine like Google to offer a list of questions connected to a particular topic, Google will send a link to a website that includes information relevant to the query you requested. When asking the same command to ChatGPT AI, the application will provide the question in that column. The emergence of ChatGPT AI is similar to the emergence of other new innovative technologies that, if used appropriately, have the potential to benefit education. Despite the fact that ChatGPT AI has the potential to be utilized for activities that are not acceptable in the academic sector. Students, for example, utilize ChatGPT AI to generate

assignments such as essays. However, teachers may be able to use AI to spot AI-created works. Teachers can use ChatGPT AI in a variety of ways, including asking information-related questions, confirming the accuracy of data, reviewing topics, etc. Teachers can request ChatGPT AI to generate multiple-choice questions for tests. Obviously, with its current version, ChatGPT AI has not been able to create an assessment instrument that can accurately measure a learning objective if it is not given explicit instructions by an expert or teacher. However, it is not impossible that in the future ChatGPT AI may be able to generate complex questions if it has access to a huge amount of data and has received extensive training.

AI natural language processing (NLP) technologies, such as ChatGPT AI, provide a means through which computers may engage with human language. A crucial stage in NLP, known as tokenization, is transforming unstructured information into organized text appropriate for computing ChatGPT AI is interactive, able to comprehend what is being requested, and able to deliver it if it meets with application policies and data availability. For example, if you ask a search engine like Google to offer a list of questions connected to a particular topic, Google will send a link to a website that includes information relevant to the query you requested. When asking the same command to ChatGPT AI, the application will provide the question in that column (Hosseini et al., 2023).

Teachers can use ChatGPT AI in a variety of ways, including asking information-related questions, confirming the accuracy of data, reviewing topics, etc. Teachers can request ChatGPT AI to generate multiple-choice questions for tests. Obviously, with its current version, ChatGPT AI has not been able to create an assessment instrument that can accurately measure a learning objective if it is not given explicit instructions by an expert or teacher. Given the fact that assessment is the backbone of quality education, Conversational Neural Language Processing (NLP) entails converting unstructured input into a machine-readable format and processing it to generate the right response. Conversational NLP enables systems to understand human input and generate pertinent responses. Chat GPT an example of conversational NLP enables academic staff and teachers to have an innovative and flexible way to create learning assessments with real-time feedback and reports. Zhai (2022) contended that teachers could create learning assessment items using Chat GPT while saving time and effort and potentially improving the quality of the questions by adhering to a standard framework. With the abilities given by ChatGPT, teachers could develop open-ended question prompts that are aligned with the learning objectives and success criteria of the teaching lessons (Baidoo-Anu & Ansah, 2023).

Review on the Effects of Conversational NLP on Biology Students' Achievements

Generally, science subjects include more abstract phenomena and concepts; therefore, students have difficulties, such as the lack of ability to create concrete constructs in their own cognition system, misunderstanding theoretical components, as well as difficulties in using high order thinking skills in the learning process. In this context, with the aim of providing more effective science teaching and learning environments, visual materials should be used. However, a case study conducted by Sadera *et al.* (2020) analyzed the relation between students' cognitive learning strategies and conceptions of learning biology. The two scales, "Cognitive Learning Strategies" and "Conceptions of Learning Biology", were revised and adapted to biology in order to measure the students" learning strategies and conceptions of learning. First of all, it was found that students preferred higher-level conceptions of learning such as increasing knowledge seeing in a new way and understanding to lower-level conceptions such as memorizing, preparing for exams, and calculating and practicing. According to the results of regression analysis, it was seen that memorizing and application" was common among the

high school students while predicting the cognitive learning strategies. Moreover, the students who had higher-level conceptions of learning had a tendency to use strategies such as "organization," "elaboration," and "critical thinking." The students who adopted "memorizing" as a lower-level conception of learning preferred "rehearsal" learning strategy.

Biology students' achievement encompasses a broad range of students learning outcomes and attainments within the field of biology. Biology student achievement refer to their results from tests or assessments that measure their proficiency in learnt concepts. Conversational neural language processing can enhance biology students' achievement in various ways. Conversational NLP allows for personalized learning experiences tailored to individual students' needs and preferences. By adapting content delivery, explanations, and feedback to match students' learning styles and paces, NLP systems can enhance students' understanding and achievement in biology. It can provide interactive learning experiences through chatbots or virtual assistants, offering instant feedback, clarifications, and additional explanations. This personalized approach can cater to diverse learning styles and paces, helping students grasp complex biological concepts more effectively. Moreover, NLP-powered tools can analyze students' responses, identify misconceptions, and adapt teaching strategies accordingly, fostering deeper understanding and retention of biological knowledge. Hence, integrating NLP into biology education can promote engagement, comprehension, and ultimately higher academic achievement in students.

Benefit of Conversational Neural language Processing Model on Students Retention

Conversational NLP can positively influence biology students' retention by providing personalized and interactive learning experiences. Conversational NLP tools, such as chatbots or virtual assistants, can engage students in active learning through conversational interactions. This engagement helps maintain students' attention and focus, which is crucial for retention. With the use of conversational NLP, learning content are delivered in a conversational manner, allowing for repeated exposure to key concepts and reinforcement of learning. Students can ask questions, receive instant feedback, and review materials as needed, which can enhances retention. The use of NLP also enhances interactive simulations and learning experiences. The interactive and personalized nature of conversational NLP enhances students' engagement, comprehension, and memory encoding, leading to improved retention of biology concepts among students. By providing interactive and conversational learning experiences, NLP models can stimulate students' active involvement in biology and foster a positive learning environment.

Conversational NLP models offer accessibility and flexibility, allowing students to access learning materials and support resources anytime, anywhere. This accessibility promotes continuous learning and provides opportunities for students to review content, and engage with biology concepts leading to improved retention of learnt concepts. These models can significantly impact biology students' retention by enhancing their learning experiences through personalized, interactive, and engaging interactions. By simulating neural conversation, these models can engage biology students in interactive dialogues where they can ask questions, seek clarification, and participate actively in the learning process, leading to deeper understanding and retention of acquired knowledge (Graesser *et al.*, 2020). Similarly, Enebechi (2021) study revealed that conversational NLP is more effective than the conventional approach in enhancing students' retention in Biology.

Conclusion

The Conversational Neural Language Processing Model will enable learners to get access to innovative learning environment, boost their motivation, increase their performance. Hence need for further researches on the development of Conversational Neural Language Processing Model in local language for teaching different subject and levels of education. Government organisations, agencies should fund more researches in AI for teaching and learning in schools school Authorities and management should provide enabling environment for teachers and students to develop Conversational AI model for self-directed learning. More Conferences, Seminars and workshops should be organized for Nigerian educational stakeholder to keep them abreast with the global emerging technologies.

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A REVIEW PAPER ON STAFF COMPETENCIES AND THE ROLE OF EMERGING TECHNOLOGIES IN LIBRARY DISASTER MANAGEMENT

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Abstract
Libraries, as repositories of knowledge and cultural heritage, hold critical roles in preserving and providing access to vast knowledge resources and face various disaster threats such as fires, floods, earthquakes, and digital (cyber-attacks, data breaches) that could result in significant loss and disruption. The increasing complexity of library disaster management necessitates not only the integration of emerging technologies but also a reevaluation of staff competencies. As emerging technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Blockchain and Cloud Computing reshape the landscape of disaster preparedness and recovery, library staff must possess new technical skills and competencies to manage these technologies effectively. This paper examines the critical role of staff competencies in implementing emerging technologies for library disaster management. Through a comprehensive review of recent literature (2015–2024), case studies, and real-world applications, this paper explores the interplay between staff competencies and technology, offering insights into how libraries can enhance their disaster management capabilities.

Keywords: Libraries, Disaster, Disaster management, Emerging technologies, Staff Competencies.

Introduction
The library sorts, collects, organizes, preserves, and provides an approach to knowledge and information and this makes it an indispensable unit in any institution as the case may be; It is an information center and the powerhouse of research in an institution which should be shielded from disasters (Aboyade *et al*. 2021). Libraries, being custodians of knowledge and culture, battle various disaster threats ranging from natural disasters (earthquakes, floods, cyclones) to cyber-attacks and infrastructure failures. Gajanan (2023) confirmed that disaster has a wide scope which encompasses natural and man-made which are unleashed by man either intentionally or accidentally. Ansari *et al.* (2024) affirm that disasters pose a significant threat to libraries, endangering human safety, and library assets have disorganized libraries and hinder them from providing their services. Traditionally, library disaster management has focused on physical precautions and manual interventions. However, with the advent of emerging technologies such as Artificial Intelligence, the Internet of Things, Cloud Computing, and Blockchain there is an increasing shift toward automated systems that offer advanced capabilities for the monitor, detecting, predicting risks, and responding to crisis potential disasters, but the successful application of these tools is highly dependent on the competencies of library staff. These technologies' profits cannot be maximized because it is sophisticated, therefore the role of the human factor remains crucial. Staff must be equipped with the necessary skills to handle, and interpret data, make informed decisions, and manage these technologies effectively.

Library and Academic library

Todorinova and Wilkinson (2020) define the library as a community hub for knowledge, its role not just as a repository of books but as a place for learning, collaboration, and community engagement. They looked at how libraries have evolved to include digital services, maker spaces, and event hosting to meet the needs of diverse user groups. Johnson & Colby (2021) are of the concept that an academic library is a learning and research center that meets and serves the needs of the university community. They express its transition from print-based collections to digital resources, and how academic libraries support teaching and research through access to e-resources, research consultations, and information literacy programs.

Concept Disaster

Disaster is an unforeseen happening caused by man's action, inaction, or nature that results in destruction, damage, catastrophe, and even loss of life or property (Aboyade *et al*. 2021). Disaster has been established as any sudden event that disrupts the normal functioning of an institution or community, causing widespread damage and distress. Smith (2020) affirmed that disasters can be natural, like floods and earthquakes, or man-made, such as fires, terrorism, or cyber-attacks on libraries, disasters threaten collections, digital records, facilities, and user services. Disasters threaten the preservation of physical and digital collections and disrupt the accessibility of library services (Alshammari *et al*., 2022). Buchanan & Ahmed (2021) examine the impact of natural disasters on library collections, focusing on floods and hurricanes. They note that climate change has exacerbated the frequency and severity of these events, requiring libraries to adopt proactive measures, such as environmental monitoring systems and disaster recovery plans.

Disaster management is various coordinated processes in which disaster is being prepared for, responded to, mitigated, and recovered from which aim at reducing the risks associated with disasters and minimizing their impact when they occur. In libraries, this involves strategies for minimizing risks, ensuring the safety of personnel and collections, and restoring operations after a disaster. **Alexander (2020)** in his own opinion said that disaster management is a comprehensive process that entails **preparedness, response, recovery,** and **mitigation** activities designed to reduce the impact of natural and man-made disasters.

Emerging technologies

Emerging technologies are various advanced tools and systems that are in the early stages of usage but have significant potential to transform various industries. Artificial Intelligence (AI), Internet of Things (IoT), Blockchain (BC) and Cloud Computing (CC) are emerging technologies that offer innovative ways to detect risks, respond to incidents, and recover from damage. Despite constraints like severe operating conditions and the cost of maintenance and deployment, IoT, integrated with Web technologies and clubbed with emerging techniques like AI, machine learning, and big data analytics, provides solutions for real-time monitoring of potential disaster scenarios (Zafar *et al.,* 2019).

Rotolo *et al.* (2020) in their view states see emerging technologies as those technologies in the early stages of development but have the potential to impact society and industries significantly. They highlight the features of these technologies, such as novelty, rapid growth, and potential to disrupt established technologies and industries. Liu and Zhao (2023) affirm that these technologies are being increasingly integrated into library disaster management systems.

Staff Competencies

Staff competency includes all the library-related knowledge, skills, and abilities that a library staff acquired to enhance their effective discharge of duties and to ensure the safety of the library and its holdings. Marrelli *et al*. (2020) affirmed that staff competencies are the combination of skills, knowledge, and behaviors that employees must possess to perform their job roles effectively. They highlight the importance of competency with organizational growth and productivity, of which Kyndt *et al*. (2022) said that digital competencies are an essential component of modern staff competencies, especially in the era of digital transformation and technology. They emphasize how digital literacy, problem-solving abilities, and adaptability have become key components of competencies for employees in a technology-driven age. This can be achieved through training and retraining of library staff.

Technology proficiency is a core competency of staff in emerging technologies in library disaster management.

Kedia *et al*. (2020) in their technological point of view carried out a systematic review to identify technologies (such as Close circuit cameras- CCTV, earthquake early warning systems, smart grids, satellite imaging, drones, the internet of things, etc.) that improve situational awareness and assist decision-making across US government and domestic and international agencies during disaster-response operations of which library is not left out. Islam & Ryan (2023) highlight the importance of technological integration in disaster management. They focus on the use of artificial intelligence (AI), big data analytics, and geospatial technologies in disaster prediction, early detection, and response. They argue that technology enhances the accuracy and efficiency of disaster management efforts. The training of staff members in handling necessary equipment (both manual and those that are technology incline) in case of emergency; activities such as electrical installations, installing single switch control, periodic, termite treatment, drown operation, and digitization of library materials cannot be over-emphasized and these are done strategically to prevent disasters in the library or mitigate its effect during it occurrence (Bansal, 2015).

The introduction of IoT devices in libraries allows real-time environmental monitoring, such as temperature and humidity control, which is vital for preserving physical collections (Chen *et al.,* 2021). However, library staff must be proficient in using these devices, understanding the data generated, and making informed decisions. The ability to interpret IoT-based alerts and take preventive action is now a critical competency for modern librarians. AI can offer predictive insights into risks such as infrastructure failures or cyber threats thereby analyzing vast amounts of data and identifying patterns (Alshammari *et al.,* 2022) but library staff must possess the decision-making skills to act on these predictions because competency in using AI tools and understanding the data provided by these systems enhances the ability to prevent potential disasters.

Cloud computing technology plays of crucial role in ensuring the continuity of services after a disaster, management of cloud storage and access to backup files remotely, can enable quick recovery of digital collections (Liu & Zhao, 2023). Cloud technology management is essential to minimize downtime and ensure the accessibility of library resources even after a crisis.

Hughes (2020) stated that libraries that used blockchain-based systems were able to recover their digital records without losing any data, providing a robust solution to data security challenges. Because of the effectiveness of blockchain in preserving the integrity of digital collections following cyber-attacks. Rathore (2016) looked at emerging technologies (ETs) impact on improving performance in disaster management (DM) processes and its impact on

the performance according to the different phases of the DM cycle (preparedness, response, recovery, and mitigation) through a systematic review of the literature. Scopus, ProQuest, EBSCO, and Web of Science were used as data sources, and an initial sample of 373 scientific articles was collected, of which 69 publications were analyzed using VOSviewer software for text mining and cluster visualization. The results show that ETs foster the preparedness and resilience of specific systems when dealing with different phases of the DM cycle. Simulation and disaster risk reduction are the fields of major relevance in the application of ETs to DM, thus represent a starting point for scholars to develop future research on the topic.

Ishiwatari (2024) examined the role of drones in disaster management by analyzing various applications of drones in response to the Noto Peninsula earthquake in January 2024. Drones were used on the ground in a variety of new ways, including the transport of emergency supplies, restoration of cellphone communications, and inspection of damaged facilities. He identified several issues, such as the need to incorporate drone capabilities into disaster management plans, develop appropriate laws and regulations, establish public-private coordination mechanisms, address technological limitations due to advances in technology, and implement training programs specifically for drone operators. Collaboration among government agencies, private organizations, and industry associations in disaster. His response highlighted the importance of fostering partnerships and mobilizing collective expertise in disaster management and conclusively stated that there is an important role emerging technology (drones) can play in enhancing emergency response efforts and mitigating the impact of future disasters.

Khan *et al.,* (2020) looked at how emerging technology especially Unmanned Aerial Vehicles (UAVs) has gained significant interest in recent years, due to its wide range of applications, such as disaster management, rescue operations, military, civil, and so forth. UAVs are versatile in design and can cover larger areas, contrary to the Tethered Balloon and Loon Balloon systems. In any natural or human-made disaster, there is a high potential risk of damage to resources such as buildings, transport systems, communication systems, and basic services. UAVs prove to offer a better solution to provide fast, cost-effective, easy-to-deploy, and secure wireless communication to the victims. UAVs can be integrated with different technologies, such as the Internet of Things, Wireless Sensor Networks, Heterogeneous Networks, and Cloud computing. UAVs are most often used to fulfill both user services and requirements such as wireless communication facilities to end-users, as a relay node to extend the coverage of the core network.

Summary

Libraries face a wide range of disaster risks that threaten their collections, but emerging technologies offer powerful tools for disaster management. IoT sensors enable real-time monitoring, AI improves disaster prediction, blockchain secures digital records and cloud computing facilitates rapid recovery. To fully leverage these technologies, libraries must invest in continuous staff training to bridge competency gaps in areas like AI, IoT, and cloud computing. A holistic approach, combining emerging technologies with traditional strategies, is essential for building disaster resilience, protecting collections, and ensuring service continuity in an increasingly complex risk environment.

Conclusion

Emerging technologies are revolutionizing library disaster management, emphasizing the need for enhanced staff competencies. By utilizing AI, IoT, blockchain, and cloud computing, libraries can better prevent, mitigate, and recover from disasters, ensuring the protection of

valuable collections for future generations. To achieve this, staff must be proficient in using these technologies for tasks such as environmental monitoring, risk prediction, data security, and disaster recovery. The success of disaster management in libraries depends on a balance between adopting new technologies and continuously developing staff skills, ensuring service continuity even during crises.

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A REVIEW ON THREE MODES OF INQUIRY-BASED INSTRUCTIONS ON SENIOR SECONDARY SCHOOLS MATHEMATICS STUDENTS' LEARNING OUTCOMES IN MINNA METROPOLIS, NIGER STATE, NIGERIA

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Abstract
This paper presents a review on enhancement of secondary school students' learning outcomes in mathematics using video-based package and electronic slide board model in North Central, Nigeria. Video-Based learning is learning that is facilitated by videos. Videos offers a multisensory learning. It involves integrate camera footage, text, graphics, animation, and voice so that it can become a rich audio-visual learning materials and on the other hand electronic slide board are technological tool that uses software and electronics flex which allows presenting interactive class lectures with flex slide support. One can present a content, including motion flex, PowerPoint slides with on-screen annotations and write or erase content from the board using your hands, pen and various objects This review summarises significant research on the meaning Video-Based Package and Electronic Slide Board Model; Interactivity, Explainer videos, Instructional videos and animation and key factors that contributed to enhance achievement of students in Video-Based Package and Electronic Slide Board Model instruction were also recognised in the study. The study concluded that the use of Video-Based Package and Electronic Slide Board Model will aid students' better achievement in Mathematics. It will bring about responsiveness for Mathematics Students about how the Video-Based Package and Electronic Slide Board Model would help to enhance achievement and also support teachers to adapt and adopt it in other topics in Mathematics and use it for classroom teaching in order to avoid passive teaching and encourage active involvement of students and also reduce the stress of teachers. Hence, Government, organizations, agencies and non-governmental organisations (NGOs) should organise seminar, workshops to train teachers on different Video-Based Package and Electronic Slide Board Model Senior Secondary Schools in North Central.

Keywords: Video-Based Package, Electronic Slide Board Model, Achievement, Mathematics

Introduction
Technology occupies the largest position in the modern society in the 21st century, the individualities of societies development in this modern time is determined by the productive advancement in technology. Wolff (2021) opined that apart from the hastening of man's average standard of living, technology has simplified the development of the nations to improve upon their wants and the desire to play a part in the industrialized nations in all spheres of development such as Agriculture, Medicine, Engineering, Architecture, Biology, Chemistry, Physics and Mathematics. Technology can be seen as a process of solving educational problems, which might include motivation, discipline, drop-out rate, school violence, basic skills and a whole lot of educational concerns (Chengliang *etal.*, 2024).

They further stated that technology in education has become an interesting achievement whereby computers are not only used in research work or used as a tool to collect and analyze data but has become a very important and pervasive tool toward effective teaching and learning of subjects especially sciences.

In view of these, the revolution in technology has brought innovations into classroom teaching and learning. Technology usage in schools today has influenced the way educators plan, design instruction, and assess their students. Similarly, innovations in educational technology have changed systems of communication, learning resources, lesson ideas and professional development and facilitate creativity and learning productivity (Chengliang *etal.,* 2024). .

In addition, Jaber *et al.,* (2018) revealed that with the increasing usage of modern technologies, students are becoming better and faster at using innovations. Therefore, the recent attention received by educational technology has turned educators, practitioners, and researchers' focus towards the effects that technological tools may have on students' performance, both academically and behaviourally Jaber *et al.,* (2018).

Over view of Electronic Slide Board

An electronic slide board for teaching typically refers to a technological tool or device used in educational settings to enhance the teaching and learning experience. It combines both the concept of a traditional chalkboard or whiteboard with electronic and digital capabilities (Alokluk 2018). Instead of a physical board and markers, an electronic slide board consists of a digital screen or interactive display. This screen can vary in size, from small tablets to large interactive whiteboards.

The electronic slide board allows for interactivity. Teachers and students can use touch screens, styluses, or digital pens to write, draw, and interact with the content displayed on the board. It can display various types of digital content, flex such as text, images, videos, and interactive applications or software. This versatility allows for dynamic and engaging lessons (Alokluk 2018).

Many electronics slide board's support remote teaching and learning. This is especially valuable for distance education or when students and teachers cannot be physically present in the same location.

Teachers can annotate and highlight content on the board, and students can participate by writing, drawing, or interacting with the material. This promotes active learning and collaboration in the classroom. Most electronic slide boards allow teachers to save and share their lesson materials digitally or manually. This makes it easy to distribute notes, presentations, and assignments to students. The boards often include accessibility features, such as screen readers and magnification, to accommodate students with diverse needs. The models offer the ability to record lessons or presentations, which can be valuable for reviewing content or sharing with absent students. Teachers can customize the background, templates, and tools on the electronic slide board to suit their teaching style and subject matter. Some electronic slide boards support instant feedback and assessment features, allowing teachers to quiz students, collect responses, and gauge comprehension in real-time.

Electronic slide boards have become increasingly popular in educational settings, as they offer a dynamic and interactive way to deliver lessons and engage students. They can be particularly useful in modern classrooms that aim to integrate technology into the learning process.

Video-based interactive teaching strategies are a video which presents educational material on a topic which is to be learned. Such teaching strategies are a key part of flip teaching in which the initial work of communicating the essentials of the topic is done by the video lesson. Video-based is an educational approach to motivate students to learn by using video for the purpose of promoting motivation and engagement in learning (Chen, Y. 2017). The school work on the recorded lessons' videos adopted by teachers on all the topics in any subject. The students will need to watch the video online or offline at home in the absence of the teacher. Then do the home work (assignments) in the class in the presence of the teacher who will render assistance in the area of difficulties and monitor the learning progress in the class. Therefore, Video instructional packages are the educational resources used to improve students' knowledge, abilities, and skills, to monitor their assimilation of information, and to contribute to their overall development and upbringing.

Applications and Advantages Of Electronics Slide Board Models in Education

Fostering Active Learning and Practical Skill Development in the realm of education, electronics slide board models shine through their diverse applications. They serve as catalysts for active learning by allowing students to physically assemble circuits, make connections, and observe how electronic components behave. This immersive experience fosters a deeper grasp of theoretical concepts. Moreover, these models support a wide spectrum of experiments, ranging from fundamental resistor-capacitor (RC) circuits to advanced microcontroller-based projects. By facilitating circuit analysis, troubleshooting, and design, they become invaluable tools in the pedagogical arsenal. Furthermore, their incorporation of safety features, such as overload protection and short-circuit prevention, ensures that learning occurs in a secure environment. The customizability of these models empowers educators to tailor experiments to specific learning objectives, while visual aids like LED indicators and labelled components aid in concept visualization.

Advantages: As a versatile educational tool, electronics slide board models offer several advantages. They actively engage learners, encouraging them to interact with electronic theory. Secondly, by providing a controlled environment that tolerates errors, they nurture problem-solving skills.

Thirdly, these models promote interdisciplinary learning by accommodating integration with fields like robotics, mechatronics, and computer science. Additionally, the practical skills acquired are directly transferable to real-world engineering scenarios, enhancing students' employability**.**

Advantages of Video-based Instructional Package

The followings are some advantages of video instructional package in teaching and learning

i. A good instructional video package can supplement spoken or written words;
ii. It can bring teaching to life in a way that word cannot express;
iii. Words can describe people, places and objects but a picture immediately brings reality;
iv. A teaching aid can simplify and clarify what is complex and difficult to express in words;
v. Instructional video package has motivational value to develop the interest of the students;
vi. They save time, and energy what you will explain in ten minutes, will be possible in less time with the use of instructional video package.

Other benefits of video to students according to (Chen, Y. 2017), includes the following;

Videos create a more engaging sensory experience than using only print materials. Students truly get to see and hear the concept being taught, and with this they can process it in the same way they process their everyday interactions.

They provide a go-to resource that can be watched from anywhere with an internet connection or without internet videos can easily accessible on a multitude of devices including laptops, tablets, and smartphones and televisions using CD plates. This allows for viewing at the student's convenience and from wherever they are.

Videos increase knowledge retention, since they can be stopped and replayed as many times as needed. They can also be reviewed long after the initial lesson taught hence, increases students retention on concept taught. Assist greatly in the learning of all subjects, but particularly those topics that are abstract and complex in nature, such as step-by-step procedures, problem-solving, or science and math formulas and increases proficiency in digital literacy and communication, which are important 21st-century skills.

Students' achievement in Mathematics

Achievement is one of the variables in this study; Achievement is a notable change in the students' performance as a result of their exposure to the specific programme of instruction such as the use of video-based strategy in teaching and learning process. Achievement is also defined as task that one has succeeded in doing, especially after a lot of effort. There has been a reported case of poor achievement of students in Mathematics as reported by a study carried out by Nelson, N. *et al.,* (2017) which shows that students taught set theory with computer assisted instruction program CAIP did better than the control group. In a related longitudinal study on gender difference among the graduating pre-service teachers over three years in Nigeria by Mak, W. F (2016). on which data of the study were drawn from students consisting of 126 males and 127 females final year result from the college of education in Nigeria, revealed that there was no gender difference on achievement among the sampled data. Hence, this finding was appreciated as a source of hope since the findings contradict the general Nigerian stereotype belief about males and females achievement.

Additionally, a study undertaken by Russell, D. (2014) on gender difference in mathematics achievement among 428 senior secondary one (SS I) students, 261 male students and 167 taught using problem-based learning method of instruction of which multistage sampling technique was used from 10 grant-aided and government schools in Nigeria. The design for the study was pre–posttest quasi-experimental and Geometry Achievement Test (GAT), as the instrument for data collection. The finding revealed that there was no significant difference between achievement scores of male and female students taught Geometry using PBL.

Conclusion

Electronics slide board models serve as educational tools that actively facilitate learning in electronics. Their historical evolution, constituent components, and rich array of applications contribute to their significance in education. Educators and institutions must consider these advantages and limitations while contemplating the implementation of these tools to maximize their impact on student learning and skill development. As technology continues to advance, electronics slide board models are poised to remain at the forefront of enhancing electronics education, equipping future engineers and enthusiasts with valuable knowledge and skills.

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ASSESSING COMPUTER SCIENCE LEARNING OUTCOMES USING TALENT AND CANVA INSTRUCTIONAL PLATFORM AMONG SENIOR SECONDARY SCHOOL STUDENTS IN MINNA METROPOLIS

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Abstract
This paper presents a review on Assessing Computer Science Leaning Outcomes Using Talent and Canva Instructional Platforms Amongst Senior Secondary Schools Students' in Minna Metropolis Niger State, Nigeria. Talent and Canva is a computer or online based environment that consists of Augmented Reality (AR) and Virtual Reality (VR) technologies used to create immersive learning experiences in computer science education. Tools such as Unity and Unreal Engine allow students to develop and explore virtual environments, providing practical experience in game design, simulations, and 3D modelling AR and VR can enhance understanding of complex concepts by providing interactive and engaging visualizations packaged Images, Designs, Infographics and videos that enable students to perform experiment virtually and has the components to support and enhance face-to-face or traditional-practical based learning. This review summarises relevant research on the meaning of Talent and Canva organizations face to face and online learning growing challenge of effectively managing and developing their workforce's skills. To meet this demand, a skills-based approach has emerged as a powerful strategy to align employee capabilities with organizational goals. At the heart of this approach lies the skills-based canvas and talent, a structured framework designed to support skills management and drive talent and Canva development. Hence, Government organizations agencies should provide assistance to senior secondary schools by training teachers on assessing computer science using talent and Canva purchasing the packages in order to promote effective and efficient learning of practical in senior secondary schools.

Keywords: Canva, Talent, and Computer

Introduction
The growing integration of technology in education has significantly reshaped teaching and learning processes, especially in fields like computer science. Technology is not only transforming how students access information but also how they engage with learning materials. Various instructional platforms are being adopted globally to enhance the quality of education, including platforms such as Talent and Canva, which have gained prominence in recent years. As classrooms move beyond traditional methods of teaching, technology is emerging as a critical tool in improving students' Studies have demonstrated that digital platforms, when used effectively, can lead to improved academic performance by making learning more interactive and accessible (Al-Samarraie, 2019). The adoption of these tools has paved way for a more personalized and adaptive learning environment, tailored to individual student needs and learning styles.

Overview of Talent and Canva
is a versatile online graphic design tool that has gained popularity in various sectors, including education. It allows users to create a wide range of visual content, from presentations and infographics to social media graphics and posters. Its user-friendly interface and extensive

library of templates, images, and design elements make it accessible for individuals with varying levels of design expertise.

The graphic design platform that allows users to create visuals and instructional tool to enhance learning and engagement in computer science education and digital educational platform designed to deliver interactive lessons and assessments used in this study to facilitate computer science learning among secondary school students. The conceptual model for assessing computer science learning outcomes using Talent and Canva instructional platforms integrates several components into a cohesive framework, it begins with Inputs, which include the Instructional Platforms of Talent (LMS) and Canva (Design Tool), the Educational Context focusing on senior secondary school students and the computer science curriculum, and the Theoretical Framework grounded in Constructivist Learning Theory. The Processes section encompasses Platform Utilization, where Talent is used for course management and interaction, while Canva facilitates content creation and engagement. This leads to Teaching Strategies involving the integration of both platforms and interactive learning approaches. Outputs include Learning Outcomes such as achievement, measured by test scores and project grades, and retention, assessed through long-term understanding and practical application. Student engagement is evaluated through metrics like platform use and participation. The Outcomes involve an enhanced learning experience characterized by improved understanding and increased motivation, alongside performance metrics reflecting The Feedback Loop ensures ongoing Evaluation and Improvement, involving data collection, effectiveness analysis, and adjustments to strategies the platform use and a feedback loop that informs continuous improvement. a comprehensive Learning Management System (LMS) designed to streamline and enhance the educational process in various learning environments, including corporate training and academic settings. It provides a robust platform for managing and delivering educational content, tracking learner progress, and facilitating communication between instructors and students. is known for its flexible and scalable features, making it suitable for diverse educational needs.

Applications and Use Cases of Talent and Canva:

a) Templates and Design Elements**:** Canva offers a vast array of customizable templates for different types of educational materials, such as lesson plans, reports, and visual aids. Users can choose from pre-designed layouts or create their own from scratch, using a wide range of design elements, including images, icons, and fonts.
b) Drag-and-Drop Interface**:** The platform's drag-and-drop functionality simplifies the design process, allowing users to easily add and arrange elements within their projects. This intuitive design approach makes Canva suitable for both beginners and advanced users.
c) Collaboration Tools: Canva supports real-time collaboration, enabling multiple users to work on the same design simultaneously. This feature is particularly useful for group projects or team-based tasks, as it facilitates seamless communication and coordination.
a) Course Management: Talent allows educators to create, organize, and manage courses with ease. Instructors can design courses using a range of multimedia elements, including text, videos, quizzes, and interactive activities. The platform supports various content formats and integrates with other educational tools to provide a seamless learning experience.
b) Learning Pathways: The platform offers tools for creating personalized learning pathways, allowing educators to tailor the learning experience based on individual learner needs and progress. This feature helps in addressing different learning styles and paces, ensuring that students receive relevant and effective instruction.
c) Assessment and Evaluation: Talent includes comprehensive assessment tools for evaluating learner performance. Educators can create and administer quizzes, tests,

and assignments, and use built-in analytics to monitor student progress. The platform provides

b) Active Learning with Technology: Constructivism aligns with the use of interactive coding environments, simulations, and visualization tools, as these technologies provide students with opportunities to experiment, reflect, and build on their understanding of complex concepts in computer science.
c) Collaborative Tools: The use of collaborative tools like GitHub and Google Colab also supports constructivist principles by allowing students to work together, share knowledge, and learn from each other.
d) Personalized Learning: AI and machine learning technologies that offer personalized learning experiences align with constructivist approaches by adapting to individual learning needs and providing tailored support.

Advantages of Talent and Canva compared to traditional.

Technology has fundamentally transformed educational practices, providing new tools and methodologies to enhance teaching and learning. In recent years, the integration of technology in education has evolved beyond traditional methods to include various digital tools and platforms. Technology offers a diverse range of resources, from digital textbooks to interactive software, aimed at improving student engagement and the effective integration of technology can lead to significant improvements in educational practices by enabling personalized learning experiences and fostering greater interaction between students and educational content. digital design tool, has been shown to impact learning outcomes positively by enabling students to create and present visual content The platform allows students to express their understanding of concepts creatively, which can enhance both achievement and retention. the visual representations of information can improve comprehension and memory, making tools like Canva valuable for supporting learning in various subjects, including computer science. an educational platform designed for personalized learning, offers features that can significantly influence learning outcomes by providing tailored learning experiences and skill development opportunities compare to traditional. platforms like Talent can address individual learning needs and preferences, resulting in improved academic performance and a better understanding of complex concepts.

Students' achievement in computer science

Achievement is one of the variables of this study; student achievement in computer science education is a key indicator of educational success and holds great significance in fostering scientific understanding and interest among students. typically assessed through various forms of testing and evaluation, measuring students' grasp of the subject matter (Marzano, 2020). Research has demonstrated that incorporating technology into instruction can positively impact student achievement by offering interactive and engaging learning experiences (Cavanaugh et al., 2019). For example, digital platforms like Canva and Talent can facilitate active learning and provide immediate feedback, which are essential for improving academic performance and achieving educational objectives.

Students' retention in computer science

Student retention, refers to the ability to keep students enrolled in a course or program until completion, is a crucial factor in ensuring educational success. Retention rates in computer science education have been a subject of concern due to the rigorous nature of the subject and the potential for students to face difficulties. Computer science practical plays a critical role in secondary school education as they enhance students' understanding of scientific concepts and foster the development of important skills.it also involves the ability of students to retain and

recall learned information over time (Glover & Brown, 2021). Effective educational tools and practices play a crucial role in enhancing retention by reinforcing learning through repeated exposure and practice. Studies have shown that technology-enhanced learning environments can improve retention by providing engaging content and interactive experiences that support long-term memory (Brusilovsky & Millán, 2019). Platforms like Canva and Talent offer opportunities for students to revisit and apply learned concepts, which can contribute to better retention.

Factors influencing students' retention in computer science practical.

Secondary school students' retention in computer science practical is influenced by various factors, which includes;

Game-based learning platforms: Game-based learning platforms such as CodeCombat and Scratch, use gamification leads to retention in teaching programming concepts and problem-solving skills. These platforms engage students through interactive challenges and rewards, making learning more enjoyable and motivating (Papadakis & Kalogiannakis, 2020). Game-based learning has been shown to improve students' retention in coding skills and foster a deeper understanding of computer science principles (Gee, 2019). Artificial intelligence (AI) and machine learning (ML) technologies are increasingly used to personalize learning experiences in computer science education. Tools like IBM Watson and Google AI provide adaptive learning in retention systems that tailor content and feedback based on individual student performance (García-Sánchez et al., 2021). AI-driven tools can help identify learning gaps and offer customized support, enhancing students' learning outcomes and engagement (Zou et al., 2020). Collaborative tools like GitHub, Google Colab, and Slack facilitate teamwork and communication among students working on group projects. These tools enable version control, code sharing, and real-time collaboration, which are essential skills in the software development industry (Wang & Liu, 2021). By using collaborative platforms, students' retention can learn best practices in software development and improve their ability to work effectively in team settings (Jiang et al., 2021). Online learning platforms, such as Coursera, edX, and Udacity, offer a range of computer science courses and specializations. These platforms provide access to high-quality content from leading institutions and industry experts, allowing students to retain and learn at their own pace and according to their interests (Koller et al., 2019). Online courses often include interactive elements, such as quizzes and peer-reviewed assignments, which enhance the learning experience (Hollands & Tirthali, 2020). By addressing these factors, educators can create an environment that promotes active learning, engagement, and long-term knowledge retention.

Key factors that contribute to enhanced retention and engagement of students in Canva and Talent

Virtual Reality offer unique advantages that contribute to improved retention rates among secondary school students in computer science practical. The following are key factors that contribute to enhanced retention and engagement;

Virtual labs and remote access tools allow students to conduct experiments and access resources without being physically present in a computer lab. Platforms such as Labster and Cisco's Packet Tracer provide virtual environments where students can practice network configurations and experiment with software applications Dunn et al. (2021). This flexibility enables students to engage with course material at their own pace and access advanced resources that may not be available locally Beck et al, (2020).

Online coding competitions and hackathons: such as Codeforces and HackerRank, offer students opportunities to apply their programming skills in real-world scenarios. These events

encourage problem-solving, creativity, and collaboration Pereira et al. (2020). Participation in coding competitions helps students develop practical skills, gain exposure to industry challenges, and build a portfolio of accomplishments Miller et al. (2021). Data science and big data tools, including R and Hadoop, are integrated into computer science curricula to teach data analysis and visualization techniques. These tools enable students to work with large datasets, perform statistical analyses, and derive insights from data Loukides (2019). Integrating data science tools into education helps students develop skills essential for careers in data analytics and related fields Kitchin. (2021). E-portfolios are digital collections of students' work and achievements that can be used for assessment and reflection. Platforms like Mahara and Google Sites allow students to showcase their projects, coding assignments, and other work Barrett. (2020). E-portfolios facilitate self-assessment and provide a comprehensive view of students' progress and skills over time Jafari & Tehrani. (2019). Cloud computing platforms, such as Amazon Web Services (AWS) and Microsoft Azure, provide students with access to scalable computing resources and tools. These platforms allow students to deploy and manage applications, work with large datasets, and explore various cloud-based technologies Marston et al. (2020). Cloud computing experiences prepare students for industry practices and offer practical skills relevant to modern software development Zhang et al. (2021). Online learning platforms, such as Coursera, edX, and Udacity, offer a range of computer science courses and specializations. These platforms provide access to high-quality content from leading institutions and industry experts, allowing students to learn at their own pace and according to their interests Koller et al. (2019). Online courses often include interactive elements, such as quizzes and peer-reviewed assignments, which enhance the learning experience A study by Hollands & Tirthali. (2020).

Conclusion

The use of Virtual Reality in computer science practical will enable the learners to actively engage their selves in learning and building their own knowledge structures by investigating, inquiring and discovering more skills in learning practical through virtual Reality. students centred will also aid students' better performance in computer science practical that will create awareness to computer science teachers about how the innovation would help to enhance their job performance, this will enable them to adapt it and facilitate the use of it in classroom instruction to promote teaching learning and also enhance active involvement of students and reduce stress of limited and unavailability of laboratory facilities. Hence, school authorities and managements should provide conducive environment for students and teachers to effectively use virtual Reality for their teaching and learning processes.

Government organizations, agencies and non-governmental should provide assistance to senior secondary schools by training teachers on Assessing of computer science packages and purchasing the packages in order to promote effective and efficient learning of practical in senior secondary schools.

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THE ROLE OF THREE MODES OF INQUIRY-BASED INSTRUCTIONS ON SENIOR SECONDARY SCHOOLS BIOLOGY STUDENTS' LEARNING OUTCOMES IN MINNA METROPOLIS, NIGER STATE, NIGERIA

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Abstract
This paper presents A Review on Three Modes of Inquiry-Based Instructions on Senior Secondary Schools Biology Students' Learning Outcomes in Minna Metropolis, Niger State, Nigeria. Inquiry-based instruction is a systematic, peer-mediated teaching strategy under the guidance of the teacher. It involves students learning from and with each other in modes which are symbiotically beneficial and involves exchange of ideas, knowledge, experience and skills among participants. This review summarises significant research on the meaning of Inquiry-Based Instruction that includes; Guided Inquiry-based instruction (GIBI), Structured Inquiry-Based Instruction (SIBI), Open of Inquiry-Based Instruction (OIBI), and key factors that contributed to enhance achievement of students in Inquiry-based instruction were also identified in the study. The study concluded that the use of Inquiry-based instruction will aid students' better achievement in Biology. It will bring about responsiveness for Biology teachers about how the Inquiry-based instruction would help to enhance their job delivery, this will support them to adapt and adopt it in other concepts in Biology and use it for classroom instruction in order to avoid passive instruction and encourage active involvement of students and also reduce the stress of teachers. Hence, Government, organizations, agencies and non-governmental organisations (NGOs) should organise seminar, workshops to train teachers on different Inquiry-Based Instruction in senior secondary schools.

Keywords: Inquiry-Based Instructions, Achievement, Biology

Introduction

Science and Technology embrace the main key to the progress and development of each nation and this is to enable the nation's social- economic growth to improve in all phases of life that has to do with healthcare, nurturing, clothing, as well as housing. Abdul (2024) opined that technology provides a means through which societies can achieve commendable sustainable development and it is a contributory factor to promoting the well-being of human as well as the planet. The use of technology in daily lives has transformed the way people communicate, work and live. However, for any country to attain technological growth, there is need for such country to create an enabling environment both locally and internationally where human skills can be developed by creating positive changes that help people to investigate the world around them like inquiry-based instruction (IBI).

This study investigates the discrete effects of inquiry-based instructional practices that described the PISA 2015 construct 'inquiry-based instruction' and how each practice, and the frequency of each practice, is related to science achievement across 69 countries. The data for this study were drawn from the PISA 2015 database and analysed using hierarchical linear modelling (HLM). HLMs were estimated to test the contribution of each item to students' science achievement scores. Some inquiry practices demonstrated a significant, linear, positive relationship to science achievement (particularly items involving contextualising science

learning). Two of the negatively associated items (explaining their ideas and doing experiments) were found to have a curvilinear relationship to science achievement. All nine items were dummy coded by the reported frequency of use and an optimum frequency was determined using the categorical model and by calculating the inflection point of the curvilinear associations in the previous model e.g. students that carry out experiments in the lab *in some lessons* have higher achievement scores than students who perform experiments *in all lessons*. These findings, accompanied by detailed analyses of the items and their relationships to science outcomes, give stakeholders clear guidance regarding the effective use of inquiry-based approaches in the classroom.

Overview of Inquiry-Based Instruction

Inquiry-based Instruction is a student-centered teaching method that encourages students to ask questions and investigate real-world problems (Splash, 2024). In this type of learning environment, students are actively engaged in the learning process and are given the opportunity to explore their natural curiosities. This type of learning is often hands-on and allows students to connect what they learn in the classroom and the real world. Inquiry-based learning has been shown to improve critical thinking skills, problem-solving skills, and creativity. The responsibility of inquiry-based instruction lies on the teachers and the students and it is only the teachers that is availed with the opportunity to rethink how teaching and learning can be significantly improved by using different instructional approaches (Jayasundara 2014). As far as education chain is concerned, teachers serve as an important link through which the needs of the 21st Century can be met in the educational system. Danner (2013) stated that teachers are at the fore front in leveraging instructional approaches to be used in order to improve teaching and learning process.

Benefits Inquiry-Based Instruction

There are so many benefits of inquiry-based instruction which includes;

1. **Improves communication skills**
   It also helps students improve their communication skills. When working on a problem, they often have to explain their thoughts and ideas to others. This helps them learn how to communicate effectively with others.
2. **Helps students understand complex topics**
   Inquiry-based learning can also help students understand complex topics. When they are allowed to explore these topics in a hands-on environment, they can learn about them more meaningfully.
3. **Encourages critical thinking**
   Inquiry-based learning encourages students to think critically about the information they are presented with. They are asked to question the information and develop their own solutions. This type of learning helps students develop problem-solving skills and critical-thinking skills.
4. **Improves problem-solving skills**
   Inquiry-based learning helps students develop problem-solving skills. When they are given the opportunity to explore real-world problems, they are forced to think outside the box and come up with their own solutions. This is an important skill that will help them in their future careers.
5. **Encourages creativity**
   This concept of learning encourages creativity. When students are given the opportunity to explore a problem independently, they often come up with creative solutions. This is due to the fact that any particular way of thinking does not restrict them.

6. **Connects learning to the real world**
   Inquiry-based learning helps connect learning to the real world. When students are allowed to explore problems that exist in the real world, they can see how what they are learning in the classroom is relevant. This also helps them develop a better understanding of the material.
7. **Encourages engaged learning**
   Finally, this type of learning encourages engaged learning. When students are actively involved in the learning process, they are more likely to retain the information. This is due to the fact that they are invested in what they are doing.

Strategies and Tips For Implementing Inquiry-Based Learning

For Inquiry-Based Learning to be effective, the following are the Strategies and Tips to be Implemented;

1. **Start with a Question**
   The best way to start an inquiry-based lesson is by asking a question. This will get students thinking about the topic and will encourage them to ask their own questions.
2. **Allow for Exploration**
   Once you have asked a question, allow students to explore the topic on their own. This will help them to understand the material better.
3. **Encourage Discussion**
   Encourage students to discuss their ideas with each other. This will help them to develop a better understanding of the material.
4. **Provide Resources**
   Be sure to provide students with resources that they can use to explore the topic. This will help them develop a better understanding. Teachers can also give access to online learning platforms like SplashLearn, which further help enhance the knowledge of the concepts.
5. **Summarize What Was Learned**
   At the end of the lesson, be sure to summarize what was learned. This will help students to remember the information.

Students' achievement in Biology

Achievement is one of the variables in this study; Achievement can be defined as something that has been done or achieved through effort, as a result of hard work. Also, according to Carrier (2015) it is the act of achieving something; the state or condition of having achieved or accomplished something Britannica, (2024). Student achievement in biology is a key pointer of didactic success and holds abundant importance in adopting scientific understanding and interest among students. Several research studies have investigated students' academic performance in biology and revealed interesting insights. A study carried out by Cairns (2019), on investigating the relationship between instructional practices and science achievement in an inquiry-based learning environment. The data for the study were drawn from the PISA 2015 database and analysed using hierarchical linear modelling (HLM). HLMs were estimated to test the contribution of each item to students' science achievement scores. Some inquiry practices demonstrated a significant, linear, positive relationship to science achievement (particularly items involving contextualising science learning). Two of the negatively associated items (explaining their ideas and doing experiments) were found to have a curvilinear relationship to science achievement. All nine items were dummy coded by the reported frequency of use and an optimum frequency was determined using the categorical model and by calculating the inflection point of the curvilinear associations in the previous model for example, students that carry out experiments in the lab in some lessons have higher

achievement scores than students who perform experiments in all lessons. These findings, accompanied by detailed analyses of the items and their relationships to science outcomes, give stakeholders clear guidance regarding the effective use of inquiry-based approaches in the classroom.

Additionally, a study by John et al. (2022) on The relationship between inquiry-based teaching and students' achievement. New evidence from a longitudinal PISA study in England.

The study revealed that the frequency of inquiry-based instruction is positively associated with teenagers' performance in science examinations. This finding is robust to the use of different measures of inquiry, different measures of attainment, across classrooms with varying levels of disciplinary standards and across gender and prior attainment subgroups.

Conclusion

Inquiry-Based Instruction (IBI) have been found to be a rewarding instructional process capable of helping students to learn and develop their skills and improve their performance more than conventional teaching method. additionally, IBI offers high degree of independence needed as students are required to learn how to communicate effectively and help their fellow students to comprehend abstract concepts through the regulatory role of their teachers. Thus, IBI is considered to be an effective teaching and learning strategy to improve student's performance in secondary schools and should be embraced by computer science teacher in Nigerian secondary schools.

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RELATIONSHIP BETWEEN PARENT'S SOCIO-ECONOMIC STATUS AND ACADEMIC PERFORMANCE AMONG SENIOR SECONDARY SCHOOL BIOLOGY STUDENTS IN MINNA MERTOPOLIS OF NIGER STATE

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Abstract
This study investigated the relationship between parent's socio-economic status and academic performance of senior secondary school students in Biology in Minna metropolis of Niger state. Descriptive research design survey was used. The sample consisted of 271 students from selected secondary schools randomly selected for the study. The instruments used for the study was a self-designed questionnaire and inventory to collect students' results. Validity of the instrument was ascertained through face and content validity. Reliability co-efficient of 0.80 was obtained. Three research questions and one null research hypotheses were formulated and tested at 0.05 level of significance. The data were analyzed using multiple regression statistical tools. Conclusions drawn from the analysis indicates that parents' socio-economic status influenced the academic performance in Biology of public senior secondary school students in Minna Metropolis of Niger State. It is therefore recommended that parents without proper educational background should endeavor to send their children to extra lessons after school hours/days, by weekends and during holidays to improve their academic performance. Also, Government should embark on programs or formulate policies that can bridge the gaps between children of the rich and the poor in their academic pursuit. More so, parents with high socio-economic status should assist schools in area of educational developments, setting up of laboratories and libraries in schools.

Keywords: Academic Performance, Social economic Status

Introduction
Parent's socio-economic status (PSES) is a major contributing factor, which affects the academic achievement of students. In every society, there exists a sort of social grading of what is termed 'social stratifications' which means the division of people into different social classes (Brown et al., 2016). Parental socio-economic status (SES) encompasses various factors such as income, education, and occupation, which collectively influence the opportunities and resources available to children within a household (Havighurst, 2021). It is commonly conceptualized as the social status or class of an individual or group. Ahmad (2016) refers to socio-economic status (SES) as a combined measure of an individual or family's economic and social position in relation to others based on income, educational qualifications and occupation. In Nigeria system of social classes, some groups of parents belong to the upper, middle and lower classes. These groups are divided according to various factors which also include their respective educational level (educational qualification), wealth, income, language, and style of living among others. The upper class are those who occupy the most prestigious positions, the middle-class people are those who are between the upper class and the lower class in terms of social status while the lower-class people are those whose income and occupational status are very low in the society (Brown et al., 2016).

Academic performance refers to students' achievements in their academic endeavors, including grades, test scores, and overall mastery of subject content (Sirin & Rogers-Sirin, 2019). In the

context of Biology, academic performance is assessed based on students' understanding of biological concepts, their ability to apply knowledge in problem-solving tasks, and their performance in examinations and assessments (Reeve et al., 2020).

Research has consistently shown a strong relationship between parental socio-economic status (SES) and academic performance among students. The relationship between parental SES and academic performance is complex and multifaceted, influenced by various factors operating at individual, family, and societal levels. The poor performance in standardized examinations conducted by the West African Examinations Council (WAEC) and National Examinations Council (NECO) has continued to be a major concern to the government and other education stakeholders in Nigeria (chief Examiners report, 2023). These were the main reasons that prompted the researcher to carry out research on parent's socio-economic status (SES) to further verify if it is a significant factor bedeviling the performance of students in senior secondary school examinations (SSCE).

Aim and Objectives of the Study

The aim of this study is to determine the relationship between parent's socio-economic status and academic performance of senior secondary school Biology students in Minna Metropolis of Niger state. The study seeks to achieve the following objectives:

2.0 To determine the relationship between parent's educational level and academic performance of students in Biology.

3.0 To find out the relationship between parent's income level and academic performance of students in Biology.

4.0 To determine the relationship between parent's occupational status and academic performance of students in Biology.

Research Questions

The following research questions were developed to guide the study:

1. What is the relationship between parent's educational level and students' academic performance in Biology?
2. What is the relationship between parent's income level and students' academic performance in Biology?
3. What is the relationship between parent's occupational status and students' academic performance in Biology?

Research Hypotheses

HO_1: There is no significant relationship between male and female student's academic performance in Biology based on their parent's SES.

Methodology

Descriptive survey design was adopted for the study. The sample of the study consist of 271 secondary school Biology students (SS II) sampled out of forty-one thousand one hundred and eighty-three science students' (41,183) population in Minna Metropolis. simple random sampling technique was used to select the sample from two government schools in Minna metropolis.

The instrument for data collection was a self-designed questionnaire titled parent's socio-economic status questionnaire (PSESQ). The PSESQ is divided into four (4) sections – A, B, C and D. Section A aimed to gather demographic information from the respondents, Section B-D covers parent's educational level, parent's occupational status and parent's income level

respectively having eight (8) items on each construct. A pilot test was conducted on 10 Biology students of Bosso secondary school Minna, Niger state which is part of the population but not part of the sampled schools. The data obtained was analyzed using Cronbach alpha which yielded 0.8 and was considered reliable. The data collected was analyzed with mean and standard deviation while the hypotheses was tested using ANOVA and Multiple regression with alpha level set at 0.05 for test of significance using statistical package for social sciences (SPSS Version 20.0).

Results and Discussion

Research Question One:

What is the relationship between parent's educational level and students' academic performance in Biology?

In order to answer research question 1, mean and standard deviation of respondents was calculated and presented in table 1

Table 1: Mean and Standard Deviation of parent educational level and Performance in Biology in Minna Metropolis of Niger State

	No. of Sample	Mean (X)	Standard Deviation SD	Mean Difference MD
Parent Education level	271	55.74	11.49	
Academic Performance	271	42.86	13.28	12.88

Table 1 showed the mean and standard deviation of the responses of the respondents on parent's educational level and academic performance. The result revealed that the mean and standard deviation of the responses of respondents on parent's educational level were $\bar{X}$= 55.74 and SD = 11.49 respectively. The mean and standard deviation of the respondent's academic performance were $\bar{X}$ = 42.86 and SD = 13.28 respectively.

Research Question Two:

What is the relationship between parent's income level and students' academic performance in Biology?

In order to answer research question 2, mean and standard deviation of respondents was calculated and presented in table 2

Table 2: Mean and Standard Deviation of parent income level and academic Performance in Biology in Minna metropolis of Niger State

	No. of Sample	Mean (X)	Standard Deviation SD	Mean Difference MD
Parent income level	271	63.30	14.33	
Academic Performance	271	45.12	11.54	18.18

Table 2 showed the mean and standard deviation of the responses of the respondents on parent's income level and academic performance. The result revealed the mean and standard deviation of the responses of respondents on parent's income level were $\bar{X}$= 63.30 and SD = 14.33 respectively. The mean and standard deviation of the respondent's academic performance were $\bar{X}$ = 45.12 and SD = 11.54 respectively

Research Question Three:
What is the relationship between parent's occupational status and students' academic performance in Biology?
In order to answer research question 3, mean and standard deviation of respondents was calculated and presented in table 3

Table 3: Mean and Standard Deviation of parents' occupational status and academic Performance in Biology in Chanchaga Local Government

	No. of Sample	Mean (X)	Standard Deviation SD	Mean Difference MD
Parent Occupational status	271	61.24	12.69	
Academic Performance	271	46.87	11.38	14.37

Table 3 showed the mean and standard deviation of the responses of the respondents on parent's occupational status and academic performance. The result revealed the mean and standard deviation of the responses of respondents on parental occupational status were $\bar{X}$= 61.24 and SD = 12.69 respectively. The mean and standard deviation of the respondent's academic performance were $\bar{X}$ = 46.87 and SD = 11. 38 respectively.

Testing Research Hypotheses
HO1: There is no significant relationship between male and female student's academic performance in Biology based on their parent's SES
To test this hypothesis, Multiple Regression was used and the analysis is presented in table 4a, 4b and 4c

Table: Multiple Regression Result on relationship between Male and Female Biology Students' Socio-Economic Status and Performance in Chanchaga, Niger State.
4a Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.081[a]	.007	.004	15.25051

- Predictors: (Constant), Gender, student's SES in Biology

ANOVA analysis between Male and Female Biology Students' Socio-Economic Status and Academic Performance in Chanchaga Local Government of Niger State.

Model		Sum of Squares	Df	Mean Square	Fcal	P-valu Remark
1	Regression	871.888	2	435.944	1.341	0.134 Sig.
	Residual	53882.472	268	201.054		
	Total	54754.360	270			

a. Dependent Variable: Students' Performance

- Predictors: (Constant), Gender, Socio-Economic Status in Biology

The findings show that there is no significant difference between the predictor (gender and socio-economic status) and the students' performance F (2,268) = 1.341, P = (0.134) > 0.05. This indicate that the model is not a good predictor of the relationship between gender, socio-economic status and student's academic performance in biology. The results of the Regression coefficient Is presented in Table 4c

Multiple Regression Co-efficient between the Predictor Variable and Dependent Variable Coefficients

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	tcal	P-value	Remark
1	(Constant)	52.833	3.370		10.711	.000	Sig
	Socio-economic status in Biology	-.086	.054	-.082	-1.681	.054	
	Gender	-.320	1.724	-.016	-.180	.760	

a. Dependent Variable: Students' Performance

Tables4 a b and c presented multiple regression result on the relationship between male and female Biology students' socio-economic and academic performance in Chanchaga Local Government of Niger State. In the multiple regressions analysis students' academic performance was used as dependent variable, while socio-economic and gender were independent variables. The results indicated that socio-economic status is not a significant predictor of students' academic performance in Biology (B = -.086, t = -1.681, p (.054) > 0.05). Similarly, gender is not a significant predictor of students' academic performance in Biology (B = -.320, t = -.180, p (.760) > 0.05). This implies that an increase in student's socio-economic status will not impact student's academic performance when we control for gender.

Discussion of Findings

Finding of the result revealed that the mean and standard deviation of the responses of respondents on parent's educational level were $\bar{X}$= 55.74 and SD = 11.49 respectively. The mean and standard deviation of the respondents' academic performance were $\bar{X}$ = 42.86 and SD = 13.28 respectively. This means that some educated parents do not have enough time for their children education due to their busy schedules.

The finding in research question revealed the mean and standard deviation of the responses of respondents on parents' income level were $\bar{X}$= 63.30 and SD = 14.33 respectively. The mean and standard deviation of the respondents' academic performance were $\bar{X}$ = 45.12 and SD = 11.54 respectively. From the result displayed, this implies that students' academic achievement in Biology has a very low correlation to parents' income level.

Findings in research question three showed the relationship between parents' occupation on students' academic performance in Biology. From the result displayed, implies that students' academic achievement in Biology has a very low correlation to parents' occupation.

The findings on hypothesis one on the academic performance of male and female student's performance in Biology compared to socio-economic status, socio-economic status proved that there was no significant relationship in performance of male and female student's performance in Biology and socio-economic status. On this basis, the hypothesis one is not rejected. There is no significant relationship between male and female Biology student's socio-economic status and performances.

Conclusion and Recommendations

The study concludes that there was no significant relationship between parents' educational background on students' academic performance in Biology but Parents' occupation has a significant relationship with students' academic achievement in Biology. The study recommended that Parents with high incomes should do more by funding their children's education and providing them with the necessary reading materials, favorable learning

environment and equipment to enhance their academic pursuits while those with lower incomes should strive to help their children's education to compete with their counterparts from higher-income parents.

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UTILISATION OF INSTITUTIONAL REPOSITORIES FOR RESEARCH ACTIVITIES AMONG FACULTY MEMBERS IN FEDERAL UNIVERSITIES IN NORTH-CENTRAL, NIGERIA

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Abstract
This paper examined utilisation of institutional repositories for research activities among faculty members in federal universities in North-Central, Nigeria. The study was guided by two objectives. The population of the study was 133 Library and Information Science Educators in federal universities in North-central, Nigeria. Total enumeration or census was carried out because the population is manageable. Out of the 133 copies of questionnaire administered, 111 copies were returned representing 83% response rate. The findings of the study revealed that the extent of use of institutional repositories for research activities among faculty members is moderately high. The faculty members revealed that the extent of use of institutional repositories were high in writing of theses/dissertations, conference proceedings, seminar papers and journal article. The study concluded that while faculty members in federal universities in North-central, Nigeria recognise the importance of institutional repositories, the utilisation of these repositories for research activities are limited. The study recommended among others that federal universities in North-central, Nigeria should develop collaborative workspaces for research projects, share research outputs, prepare and share lecture notes. By utilising institutional repositories for these purposes, faculty members can enhance their research activities, improve collaboration and knowledge sharing and support institutional goals.

Keywords: Faculty members, Institutional repositories, Research activities, Utilisation.

Introduction

Research plays a key role in modern day civilisation in that it is done with the motive for societal development and propelled by high level curiosity which translates or builds up to further investigation (Salami *et al.*, 2020). In the academia, the concept of research is taken seriously since the promotion of lecturers is majorly dependent on the number of publications they have. This requirement makes it mandatory for faculty members to be productive scholars. Research activity of faculty members is key for the advancement of societies and career growth of the faculty members in higher educational institutions. According to the Organisation of Economic Corporation and Development (2017), research involves any creative systematic activity undertaken in order to increase the stock of knowledge and the use of this knowledge to develop new applications for modern living. Research can also be seen as a systematic analysis to uncover new facts with the intention of gaining knowledge to resolve or address a problem.

Okonedo *et al.* (2015) defined research activity as the whole of researches conducted by academics in universities in their vocation over a predetermined period. This period can be a period of 3 years which rest largely on the quality and quantity of scholarly publications such as documents published through a peer-review process and acknowledged as recorded sources

such as books, book chapters, journal articles, conference papers and proceedings, creative works and visual arts among others (Tsafe *et al.*, 2016).

Research activity is viewed as the measure of an academic's achievement in terms of quantity or quality of publications over a given period of time. One of the fundamental goals of research is to create new knowledge that can be applied. Hence, it is important to state that research activity is a robust measure of academic achievement and recognition as well as the totality of research activities performed by lecturers over a given period of time (Basiru, 2018). Research activity is crucial to faculty members, researchers' and learned members especially in the tertiary institutions and central to the teaching capability of faculty members or academic staff. This is because the academic mandate of any faculty member is to teach, conduct research and participate in community service. This makes it crucial for faculty members or academic staff to engage in research and become productive.

According to Gunawan *et al.* (2018), the measurement of the quantity of research activity of faculty members is viewed in terms of the numbers of publications in learned, globally accepted indexed databases, number of patents produced, number of chapters in books or books published locally or internationally which are believed to be accepted by high impact journals. Others, includes number of publications in proceedings of conferences/workshop, research-oriented books, staff bulletins, subject books, technical reports, articles in journals, pamphlets and monographs and this measure varies from one institution to another. Research activity is conducted in a variety of formats, including journal articles, books that have been published, book chapters, technical reports, conference papers, seminar papers, edited works, workshop papers, theses, and other sorts of publications (Basiru, 2018). In order for faculty members to be significantly or intellectually productive, they must have access to trustworthy data such as the institutional repository.

Institutional repository is a place meant for collection and making accessible to users, information generated in the institution and which may be in form of books, thesis, dissertations, articles, conference papers, research works grey literature or those electronic formats, and is always under the administration of the institutional library. In the present technological era, it is always administered and presented in digital formats. In view of Alumona (2019), institutional repository is a digital archive of the intellectual product created by faculty, research staff and students of an institution and accessible to end users both within and outside the institution. Institutional repository is a collection of services that tertiary institutions offer to its community, intended for the management, organisation and diffusion of digital works produced by these members.

The Association of College and Research Libraries (2018) argued that the purposes of institutional repositories include opening up the outputs of the university to the world, maximizing the visibility and impact of the outputs, showcasing the university to interested constituencies like prospective staff, prospective students and other stakeholders. Others based on the College and Research Libraries include: collecting and curating digital outputs, managing and measuring research and teaching activities, provision of a workspace for work-in-progress and for collaborative or large-scale projects. Institutional repositories therefore enable and encourage interdisciplinary approaches to research, facilitate the development and sharing of digital teaching materials and aids in addition to supporting students by providing access to thesis and dissertations.

It should be noted that institutional Repository utilisation is the act of using repositories either by depositing research outputs or by retrieving information from the repository (Akingbade, 2022). From this assertion, IR utilisation could be understood as the manner or way faculty members use repositories through the deposition of their works and the way the end- users also use the repositories by accessing and retrieving the deposited works. Consequently, Alumona (2019) suggested that a key criterion that is used to measure the quality of a university was the quality and quantity of its research outputs. A situation where the institutional repositories of universities are not used by their faculty members due to lack of accessibility, truncates the essence of establishing the repositories thereby leading to loss in funds, prestige and ranking products of the institutions. Similarly, a situation where the faculty members can access but are not using the institutional repositories for research activity also translates to unquantifiable loss to both institutions and faculty members in terms of quality. This study, therefore, investigated the accessibility and utilisation of institutional repositories for research activity among faculty members in federal universities in North-Central, Nigeria.

Statement of the Research Problem

Due to the recent method or way of scholarly communications are used, there has been an increase in negative statements on the research activity of faculty members in educational institutions in Nigeria, particularly universities in recent times. Olayina *et al.* (2022) argued that the subscription fees for many e-books and journals have risen to the point where even universities with strong financial standing can no longer afford access to volumes of materials required by her academic community for academic productivity in teaching and research. As a result, faculty members in federal universities in Nigeria struggle to achieve high levels of research activity. It could be observed that critiques of faculty members' research activity in federal universities are on the rise. This could be linked to poor Institutional Repository (IR) growth and development as a result of faculty members lack of access and attitude towards the use of available information resources platforms such as IR in their institutions, which results to poor or low academic productivity among faculty members in federal universities under study, defeating the goal for which IR is been established.

Similarly, the goal of institutional repositories is to make research findings particularly peer-reviewed academic articles openly accessible for usage over the Internet in order to improve research activities. However, it could be observed that most faculty members with IRs in their federal universities do not appear to be in this situation. In other words, despite the phenomenal rise of institutional repositories, there is still low level of research activity among faculty members. It is against this backdrop that this study investigated the d utilisation of institutional repositories for research activity among faculty members in federal universities in North-Central, Nigeria.

Objectives of the Study

The following objectives guided the study.

1. examine the extent of use of institutional repositories for research activities among faculty members in the studied areas;
2. evaluate the purpose(s) for which institutional repositories are used among faculty members for their research activities in federal university in North-Central, Nigeria.

Literature Review

Concept of Institutional Repository

Institutional repository is a receptacle where a large volume of information is stored. It represents a place of location where potentially rich resources of information, data, images and

other valuable research results are accessed and used. There are many definitions of Institutional Repositories (IRS). Institutional repository is a place where information generated in an institution by members of an academic community of that institution through their various academic efforts are digitised and kept for use by users within or outside the institution. Association of College and Research Libraries (2018) defined institutional repository as online archives for collecting, preserving and providing open access to an institutions intellectual output and other digital assets, with emphasis on research and scholarly works. According to New World Encyclopedia (2018), institutional repository is an online locus for collecting, preserving and disseminating in digital form, the intellectual output of an institution, particularly a research institution. Ridwan (2015) defined institutional repository as contemporary services which academic research institutions render its community members in form of managing and disseminating their intellectual works through a digital medium.

According to Abdelrahman (2017), institutional repositories is described as a web based database (repository) of scholarly materials which is institutionally defined (as opposed to subject based repository), cumulative and perpetual (a collective of record); open and interoperable (e.g. using (Open Access Journal) OAJ-complaint software); and thus, collects, stores, and disseminates (is part of the process of scholarly communications). Institutional repository sprung up as an answer to the problem of high cost of journals which is a critical tool in research. The situation was also compounded by dividing budgets for libraries which could not guarantee the purchase of the costly journals which contain research output of many academics.

Aneneme *et al*. (2017) stated that institutional repository has benefits for both the university and users as follows: increased visibility, prestige, ranking and public value of both researchers and the universities. To contributors, it also increases impact of their research output, creates further research approaches and creates opportunity for self-archiving of work. It also offers increased citation of published work and more so, researchers enjoy access to articles without hindrance and charges. It also exposes contributors to wider audience.

Anenene *et al.* (2017) outlined contents of institutional repository such as theses and dissertations, datasets, projects, course notes, seminar papers, conference proceedings, administrative documents, learning objects and other forms of grey literature. In similar vein Okoroma and Abioye (2017) affirmed availability of pre-prints and post-prints of journal articles, conference papers, research reports, audios, teaching and e-learning materials, e-theses, primary research data and datasets. Other contents are videos, audios, teaching and e-learning materials, e- theses, electronic records, multimedia or image materials, working papers and grey literature which are by nature usually very difficult to access and other scholarly item (Okoroma and Abioye, 2017).

Concept of research activity

As a mandate to conduct research in federal universities by faculty members, during these processes, digital contents such as seminar papers, conference papers, technical reports, datasets, theses and dissertations and journal articles to mention but a few are produced. Faculty members determine the development of tertiary institutions of learning by developing curriculum, controlling the academic rules and creating a better method for students' teaching (Gunawan *et al.*, 2018). Faculty members enhance their research activity by carrying out investigations on identified problem(s), presentation of findings of such investigations in conferences/seminars and publishing the findings in journals and/or text books.

The principal criterion for measuring faculty members' research activity is the research output or productivity of publications in referred national and international journals and textbooks. According to Okonedo (2015), research activity in universities often serves as a major role in attaining upward mobility in the academic environment as it is related to promotion, tenure and salary of academic staff. Research in tertiary institutions of learning serves as a good platform for faculty members to become accomplished scholars and plays an eminent role in facilitating the prosperity of a nation and ultimately the well-being of the citizenry.

According to Andrew (2018), most research activity measure in universities is to assess publications that are submitted or accepted (in press), or published which could be journal articles (refereed and non-refereed), books (including edited books and textbooks), book chapters, monographs, conference papers, and research proposals written to receive external and internal grants. In the academia, the concept of research activity is regarded as an indication of the success of lecturers which influences promotions, rank, levels, honorariums and faculty members' benefits, (Sahardi *et al.*, 2018). In this assertion, emphasis is laid on quantitative rank of related journals, qualitative measures of total and average research activity of faculty members and quantitative measures of total and average research activity. It has been reported that the benefit of research is the advancement of knowledge being created and communicated in an academic environment through scholarly seminars, conferences and publications.

Okendo (2018) stated that research activity refers to the work that has been researched upon and published in journals, book chapters, monographs, articles, technical reports, bulletin, conference papers, working papers, short communication papers, patents and standards. Studies, such as Simisaye (2017) had revealed that faculty members research activity is influenced by individual factors (self-efficacy, affiliation, motivation, commitment, orientation skills, research skills, achievement motivation, community contribution, sense of responsibility, scientific pursuit, autonomy and flexibility, satisfying interest and curiosity). Faculty members in federal universities engage in research activities to transfer knowledge and to keep abreast with current trends as they teach.

The total volume of research production from the faculty members on an individual level determines how productive they are. The idea behind the productivity of researchers is that it is directed towards knowing and measuring the quality of teaching in the institution. Furthermore, research is an important criterion in determining the career growth of a lecture in tertiary institutions published in notable databases. In a more recent study by Kyvik and Reymer (2017), the scholars were of the view that the use of channel of publication is crucial in determining the productivity of faculty members with great emphasis on visibility of the lecturers. It is commonly accepted that the measure of research activity is by number of publications in terms of volume by researchers.

Methodology

This study adopted survey research design. This is because survey research design encompasses a systematic and comprehensive collection of information about the opinions, attitudes, feelings, beliefs and behaviours of people. The population of the study was 133. This consisted of Library and Information Science Educators in federal universities in North-Central, Nigeria. Total enumeration or census was carried out because the population size is manageable. Questionnaire was the instrument used for data collection. Descriptive statistical tool involving frequency counts and percentages, mean and standard deviation were used to analyse the data.

Results and Discussion

Table 1: Purpose(s) Institutional Repository are Used among Faculty Members for their Research Activities

%	Statements	SA	A	D	SD	n	FX	$\bar{x}$	STD	Decision
		4	3	2	1	111				
1	To access the electronic theses and dissertations (ETDs) for teaching and research	54	27	20	10	111	347	3.13	0.63	Agreed
2	To access the e-books collection for teaching and research	51	36	14	10	111	350	3.15	0.65	Agreed
3	To access e-journal articles for teaching and research	49	38	14	10	111	348	3.14	0.64	Agreed
4	To access materials for seminar presentations	36	38	24	13	111	319	2.87	0.37	Agreed
5	Depositing scholarly works for safekeeping	40	39	22	10	111	331	2.98	0.48	Agreed
6	To develop collaborative workspace/ information sharing space	14	27	40	30	111	247	2.23	0.27	Disagreed
7	To increase my visibility as an author and researcher	42	38	22	9	111	335	3.02	0.52	Agreed
8	Access scholarly work to prepare lecture notes	28	32	26	25	111	285	2.57	0.07	Disagreed
9	To participate in the scholarly communication process	40	35	25	11	111	326	2.94	0.44	Agreed
	Weighted mean							2.87		

Key: Strongly Agreed (SA), Agreed (A), Disagreed (D) and Strongly Disagreed (SD), n = Number of Retrieved Copies of Questionnaire, $\bar{X}$=Mean and (Weighted mean = 2.87)

Table 1 showed the purpose(s) for which institutional repositories are used among faculty members for their research activities. Out of the nine items listed, seven items listed produced high mean scores which were above the weighted mean of 2.87. These items include item 2: To access the e-books collection for teaching and research (x□=3.15; SD=0.65), item 3: To access e-journal articles for teaching and research (x□=3.14; SD=0.64), item 1: To access the

electronic theses and dissertations (ETDs) for teaching and research (x□=3.13; SD=0.63), item 7: To increase my visibility as an author and researcher (x□=3.02; SD=0.52), item 5: Depositing scholarly works for safekeeping (x□=2.98; SD=0.48), item 9: To participate in the scholarly communication process (x□=2.94; SD=0.44) and item 4: To access materials for seminar presentations (x□=2.87; SD=0.37). On the other hand, two items produced low mean scores which were below the weighted mean of 2.72. These items include item 8: Access scholarly work to prepare lecture notes (x□=2.57; SD=0.07) and item 6: To develop collaborative workspace/ information sharing space (x□=2.23; SD=0.27). The decision mean of 2.87 and above is considered as the purpose(s) for which institutional repositories are used among faculty members for their research activities, while below 2.87 are not considered as purpose(s) for which institutional repositories are used among faculty members for their research activities. From the analysis, the study revealed that items 1, 2, 3, 5, 7, 4 and 9 were strongly agreed by the respondents as the purpose(s) for which they utilised institutional repositories for their research activities, while item 6 and 8 were disagreed among the respondents as the purpose(s) for which they utilised institutional repositories for their research activities.

Research Question 5: What is the extent of use of institutional repositories for research activities among faculty members in the studied areas?

Table 2 showed the extent of use of institutional repositories for research activities among faculty members in the studied areas.

Table 4.9: Extent of Use of Institutional Repositories for Research Activities among Faculty Members

S/N	Statements	VHE	HE	LE	VLE	n	FX	$\bar{x}$	STD	Decision
		4	3	2	1	111				
1	I use institutional repositories in writing of theses/dissertations	45	41	15	10	111	343	3.09	0.59	High
2	I use institutional repositories in writing conference proceedings	33	46	24	8	111	326	2.94	0.44	High
3	I use institutional repositories in writing seminar papers	43	22	33	13	111	317	2.86	0.36	High
4	I use institutional repositories in writing workshop papers	43	41	19	8	111	341	3.07	0.57	High
5	I use institutional repositories in writing manuals	21	24	39	27	111	261	2.35	0.15	Low
6	I use institutional repositories in writing administrative documents	13	25	42	31	111	242	2.18	0.32	Low
7	I use institutional repositories in writing technical reports	21	27	41	22	11.1	269	2.42	0.07	Low

8	I use institutional repositories in writing journal articles	37	56	11	7	111	345	3.11	0.61	High
9	I use institutional repositories in writing research reports	43	16	19	33	111	291	2.62	0.12	Low
	Weighted mean							2.74		

Key: Very High Extent (VH), High Extent (HE), Low Extent (LE) and Very Low Extent (SD), n = Number of Retrieved Copies of Questionnaire, $\bar{X}$=Mean and (Weighted mean = 2.74)

Table 2 showed the extent of use of institutional repositories for research activities among faculty members. Out of the nine items listed, five items listed produced high mean scores which were above the weighted mean of 2.74. These items include item 8: I use institutional repositories in writing journal articles (x□=3.11; SD=0.61), item 1: I use institutional repositories in writing of theses/dissertations (x□=3.09; SD=0.59), item 4: I use institutional repositories in writing workshop papers (x□=3.07; SD=0.57), item 2: I use institutional repositories in writing conference proceedings (x□=2.94; SD=0.44) and item 3: I use institutional repositories in writing seminar papers (x□=2.86; SD=0.36). On the other hand, four items produced low mean scores which were below the weighted mean of 2.74. These items include item 9: I use institutional repositories in writing research reports (x□=2.62; SD=0.12), item 7: I use institutional repositories in writing technical reports (x□=2.42; SD=0.07), item 5: I use institutional repositories in writing manuals (x□=2.35; SD=0.15) and item 6: I use institutional repositories in writing administrative documents (x□=2.18; SD=0.32). The decision mean of 2.74 and above is considered as the extent faculty members utilise institutional repositories for their research activities, while below 2.74 are considered as the extent faculty members do not utilise institutional repositories for their research activities. From the analysis, the study revealed that items 1, 2, 3 and 8 were strongly agreed by the respondents as the extent of use of institutional repositories for their research activities, while item 4, 5, 6, 7 and 9 were disagreed among the respondents as the extent of use of institutional repositories for their research activities.

Discussion

In line with the findings of research question 1, it is revealed that the purpose(s) for which institutional repositories were used among faculty members for their research activities were strongly agreed. Faculty members revealed that the purpose(s) for which they use institutional repositories for their research activities is to access the electronic theses and dissertations (ETDs), e-books collection, e-journal articles for teaching and research, depositing scholarly works for safekeeping, increase visibility as an author and researcher and participate in the scholarly communication process. This could be because IR expands the research and scholarship of lecturers and increase their visibility and public value. This is in line with the findings of Okoro and Okogwu (2017) who opined that Institutional Repository (IR) provides compelling response to two strategic issues facing academic institutions. First, it expands access to research and scholarship by the academy, increases competition and reduces the monopoly power of journals and brings economic and heightened relevance to the institutions and libraries that supports them. Secondly, it serves as a tangible indicator of a university's quality and to demonstrate the scientific, societal, and economic relevance of its research activities, thus, increasing the institution's visibility, status and public value

However, faculty members indicated that accessing materials for seminar presentations, developing collaborative workspace/ information sharing space and accessing scholarly work to prepare lecture notes were disagreed as part of the purposes(s) for which they utilise institutional repositories for their research activities.

In response to research question 2, the study showed that the extent of use of institutional repositories for research activities among faculty members is moderately high. The faculty members revealed that the extent of use of institutional repositories were high in writing of theses/dissertations, conference proceedings, seminar papers and journal articles.

However, faculty members revealed that the extent of use of institutional repositories in writing workshop papers, manuals, administrative documents, technical reports and research reports were to a very low extent.

Conclusion

In conclusion, the study revealed that while faculty members in federal universities in North-central, Nigeria recognise the importance of institutional repositories, the utilisation of these repositories for research activities are limited. There is a need for training, technical support and incentives to encourage faculty members to use institutional repositories. Institutional repositories have the potential to enhance research activities and visibility of faculty members but their full potential is not being realised. As such, federal universities need to address the challenges and limitations to ensure that institutional repositories are fully utilised and effective in supporting research activities of faculty members

Recommendation

1. The management of federal universities in North-central, Nigeria should develop collaborative workspaces for research projects, share research outputs, prepare and share lecture notes. By utilising institutional repositories for these purposes, faculty members can enhance their research activities, improve collaboration and knowledge sharing and support institutional goals.
2. The management of federal universities in North-central, Nigeria should provide training and support that will encourage faculty members' engagement especially in the writing of research reports, technical reports, manuals and administrative documents.

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PERCEIVED EMPLOYABILITY SKILLS ACQUISITION OF BIOLOGY PRE-SERVICE TEACHERS IN UNIVERSITIES IN MINNA METROPOLIS, NIGER STATE, NIGERIA

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Abstract
The research aimed to the appraise of employability skills possessed by undergraduate Biology students in Minna Metropolis. With the rapidly evolving job market, it is crucial to identify and assess the skills that are valued by employers in the field of Biology. Three universities in Minna metropolis were randomly selected; Federal University of Technology (FUT) Minna, Ahmadu Bello University, Zaria and Usman Danfodio University, Sokoto (Affiliated programs in COE, Minna). Thirty (30) students were selected in each university making total of ninety (90) students. The instruments use for data collection was a questionnaire design by the researcher for Biology students. The instruments use for this study was vetted by the supervisor in department of Science Education, School of Science and Technology Education. Two research questions guided the study; while data collected were analyzed using summated scale. The major findings of the study revealed that majority of university undergraduates in Minna Metropolis perceived themselves to have high knowledge of employability, yet further finding revealed that majority of the respondents perceived themselves to have high need of Life-long Learning Skill and Team-work Skills. This implies that the respondents have low level of Life-long Learning and Team-work Skills. As such, it was recommended that University Management should improve standard by making Employability Skills a development priority area for its undergraduates before their graduation. Both instruction and assessment of undergraduates should challenge and develop students' Life-long learning skill, Team-work skills and other relevant skills before their graduation. University Management should encourage her students to develop and demonstrate employability skills like Life-long learning skill, Team-work skills, information and communication technology knowledge, numeracy skill, communication skill, creativity and problem-solving skills

Keywords: Employability skill, Life –long learning, Team work, problem-solving skills, Team-work skills, Creative thinking skills, Communication Skills

Introduction
The teaching profession plays a critical role in the socio-economic development of any nation by shaping the future workforce. In Nigeria, biology pre-service teachers—students currently undergoing teacher education programs—are pivotal in the country's educational system, particularly in STEM (Science, Technology, Engineering, and Mathematics) education. However, employability remains a pressing issue for graduates, particularly in education fields. Employability skills are referred to as those skills, knowledge and attitudes required to succeed in modern workforce (World Economic Forum, 2024). For biology pre-service teachers, these skills go beyond technical knowledge, encompassing a range of soft skills, pedagogical competencies, and the ability to adapt to the rapidly changing demands of the education sector. In the Nigerian educational system, pre-service teacher training focuses on preparing students for the complexities of teaching. This training includes theoretical and practical components, such as classroom management, curriculum development, and subject-specific content. However, several reports suggest that graduates, including those in the teaching profession,

face challenges related to employability. These challenges may arise from mismatches between the skills acquired during training and the skills demanded by employers in the labor market Adebisi and Adewale (2016).

The 21st century has introduced a dynamic shift in the labour market, characterized by technological advancements, global competition, and the need for innovation in various sectors, including education. As such, it is no longer sufficient for pre-service teachers to rely solely on their knowledge of biology as a subject. They must also possess critical employability skills, such as communication, problem-solving, teamwork, digital literacy, time management and organization, adaptability and integrity Harper, (2024).

Perceived employability refers to an individual's self-assessed abilities, skills, and qualities that are valued by employers and enhance their likelihood of gaining employment and advancing in one's career Rothwell, (2024). of their ability to gain and maintain employment based on their skills, knowledge, and attributes. For biology pre-service teachers in Minna, their perception of their employability skills is critical, as it can influence their ability to navigate the job market successfully.

Several challenges, however, may undermine the development of these skills, including inadequate resources, insufficient exposure to practical teaching experiences, and outdated curricula that may not align with current educational demands Owolabi and Oginni (2018). Furthermore, limited opportunities for professional development and mentorship in the Nigerian educational system may hinder pre-service teachers from fully realizing their potential employability's. Understanding the perceived employability of these individuals provides insights into how well universities prepare their students for the labour market. Addressing the gaps in skills acquisition and fostering the development of key competencies will not only improve employability outcomes but also enhance the quality of biology education in Nigeria.

Statement of the Problem

In spite of the laudable philosophy of Science Education programme in Nigeria recent studies have shown that graduates of Biology face discrimination in the labour market in field such as; administration, banking and finance, financial institution in the country. Meanwhile, as emphasized by the philosophy of Science Education programme in Nigeria, the curriculum of science education is geared towards equipping students with broader requisite knowledge and skill attributes, such as; digital nature, team-work, communication leadership, thinking and problem-solving skills for graduates' employability. All these attributes are expected in every graduate of a university in order to be productive in the national workforce which in turn, impact the achievement of national development. Several related studies were conducted in many places in Nigeria, but Ezeamagu, Mary (2021) worked on appraisal of employability skills of university undergraduates: The 21st Century Key to Functional Education in north west Nigeria to the best knowledge of the researchers, none was reported from Minna, Niger State. Therefore, this study was set to examine the employability skills among biology preservice teachers in Niger State.

Aim and Objectives of the Study

The aim of this study was to appraise the employability skills among Biology preservice teachers in university of Minna metropolis. Specifically, the study set to achieve the following objectives:

i. Examine the extent of acquisition of employability skills among the university Biology pre-service teachers in Minna, Niger State.

ii. Determine gender difference in acquisition of employability skills among the university Biology pre-service teachers in Minna, Niger State

Research Questions of the Study

In other to achieve desired objectives, the following research questions are position to guide the study:

i. What is the extent of acquisition of employability skills among the university Biology pre-service teachers in Minna, Niger State.
ii. Is there gender difference in the perceived acquired employability skills among the university Biology pre-service teachers in Minna, Niger State

Hypotheses of the Study

$H_0$1: There is no significant difference extent of acquisition of employability skills among the university Biology pre-service teachers in Minna, Niger State.

Methodology

The study used survey research design. This design involves the collection of information from a sample of individuals through their responses to pre-determined questions. Survey design was chosen for this study as it is most appropriate for gathering information "as it is" on student employability skills. The survey design was considered suitable since the study sought information from a sample that was drawn from a population using questionnaires.

Population of the study

The population for the study comprised all preservice Biology teachers in the universities in Minna, Niger State. There were three universities in the Metropolis; which are; Federal University of Technology, Minna; Ahmadu Bello University Zaria and Usman Danfodio University Sokoto affiliated.

Sample and Sampling Technique

Stratified sampling was used to select thirty (30) students in the state of the university selected. There are three (3) universities in Minna metropolis, in each university, thirty (30) graduating Biology pre-service teachers were randomly selected which give the total of ninety (90) Biology pre-service teachers.

Research Instrument

The researcher used employability skills questionnaire (ESQ) as the instrument for data collection. The questionnaire was tagged, which was made up of questions arranged systematically based on the contents of employability skills. The employability skills questionnaire contained fifteen (15) items covering life-long skills, team-work skills. The instruments consist of two (2) Section; Section 'A'; Bio Date and Section 'B' Main item. Section 'B' consists of items that elicit information on participants' communication, leadership, problem-solving, creative thinking, teamwork and life-long learning skills.

Validity of the Research Instrument

To ascertain the validity of the instruments, the questionnaire was giving to two (2) experts from the Department of Science Education, Federal University of Technology Minna. After which the researcher modified the items in line with expert's comments and advice. The researcher adjusted the instrument according their advice. The experts adjudged the instrument as a valid instrument for the intended purpose in the study

Reliability of the Research Instrument

The researcher conducted pilot study on four hundred level of Ibrahim Badamasi Babangida University Lapai. The data obtained was analyzed using Cronbach Alpha which yielded 0.78 coefficient, indicating that the instrument was reliable.

Method of Data Collection

The researcher visited the selected universities to seek for permission and cooperation to use the Universities. Each of the three sampled universities were visited and cooperation of staff and students irrespective of department were sought and they were informed about the objectives of the study. There will be orientation for the lecturers in the department, a period of two weeks was given to each sampled school to administer and fill the questionnaire and the researcher will go back to collect the filled instrument

Method of Data Analysis

Data collected for this study was organized and analyzed using descriptive statistics. Specifically, mean and standard deviation were used to answer the stated research questions. The decision on the research question was based on the resulting mean score, of which mean score of 3.0 was considered a criterion for the agreement with item. Statistical Package for Social Sciences (SPSS version 23.0) was used to carry out the data analysis and the hypotheses were tested at 0.05 level of significance.

Results

Research question one: What is the extent of acquisition of employability skills among the university Biology pre-service teachers in Minna, Niger State?

The responses of pre-service Biology teachers in university Minna, Niger State on possession of employability skills

Table 1 indicates that pre-service Biology teachers possess employability skills. Their average responses across all items related to employability skills, range from2.84 to **3**.38, above the scale midpoint of 2.50 The overall mean (grand mean) of 3. I9 further supports this finding. Moreover, the high standard deviation of 0.87 suggests a consistent possession of employability skills among these pre-service teachers

Table 1: Mean and Standard Deviation of Pre- Service Biology Teachers on Employability Skills n Minna, Niger State.

S/N	ITEMS	Mean	SD	Remarks
	I work/co-operate well with other students and team leader	3.18	0.65	Possessed
	I can lead a team-work at school	3.11	0.91	Possessed
	I place much value on respect for others	3.27	0.80	Possessed
	When doing a task, I often diverse new ways to do it faster and better	3.23	0.8I	Possessed
	I like trying out things myself	3.28	0.86	Possessed
	I usually come up with creative and innovative ideas during group work	3.27	0.75	Possessed
	I can speak and write clearly so that others can understand	3.34	0.77	Possessed
	I can read and understand information in words, graphs, diagrams or charts	3.09	0.85	Possessed

I listen and ask questions in order to understand instructions and other people point of view	3.09	I.00	Possessed
I can assess situation, identify problem and evaluate solutions	3.18	0.94	Possessed
I recognize many dimension of a problem and can determine a route cause	3.36	0.89	Possessed
I am not afraid to be creative when solving problems	2.84	1.08	Possessed
I like to learn new things	3.10	0.95	Possessed
I learn from my mistakes and accept feedback	3.38	0.89	Possessed
I can identify and access learning opportunity	3.12	0.92	Possessed
Grand Total	3.19	0.87	Possessed

Research Question Two: Is there gender difference in the perceived acquired employability skills among the university Biology pre-service teachers in Minna, Niger State?
The responses of male and female pre-service Biology teachers on possession of employability skills In University in Minna is presented in Table 2.

Table 2: Mean and Standard of Male and Female Pre-Service Teacher on Possession of Employability Skills in University in Minna

.S/N	ITEMS	MALE	MEAN	STD	Female	Mean	STD
	I work/co-operate well with other students and team leader		3.15	0.76		3.23	0.42
	I can lead a team-work at school		3.15	0.93		3.05	0.90
	I place much value on respect for others		3.24	0.86		3.31	0.72
	When doing a task, I often diverse new ways to do it faster and better		3.20	0.87		3.29	0.71
	I like trying out things myself		3.24	0.86		3.34	0.87
	I usually come up with creative and innovative ideas during group work		3.22	0.79		3.34	0.68
	I can speak and write clearly so that others can understand		3.22	0.79		3.35	0.68
	I can read and understand information in words, graphs, diagrams or charts		3.24	0.86		3.51	0.56
	I listen and ask questions in order to understand instructions and other people point of view		3.00	0.96		3.24	0.77
	I can assess situation, identify problem and proffer solutions		3.07	1.09		3.11	0.83
	I recognize many dimension of a problem and can determine a route cause		3.04	0.94		3.40	0.91
	I am not afraid to be creative when solving problems		3.37	0.70		3.36	0.70
	I like to learn new things		3.34	1.03		2.75	1.09
	I learn from my mistakes and accept feedback		3.00	1.06		3.10	1.03
	I can identify and access learning opportunity		3.11	1.03		3.09	0.82
	Grand Total		3.17	0.90			

Table 2 indicates that both male and female pre-service Biology teachers possess employability skills. Their average responses across all items related to employability skills, range from 3.00 to **3**.36, above the scale midpoint of 2.50 The overall mean (grand mean) of 3. I9 of and 3. 28 further supports this finding. Moreover, the high standard deviation of 0.87 for male and 0.89 for female suggests a consistent possession of employability skills among these pre-service teachers. The finding shows that both male and female pre-service biology teachers possessed employability skill

Hypothesis One (H_{01}): There is no significant difference in possession of male and female pre-service biology teachers in Niger State

Table 3: T-test of Male and Female Pre-service Biology Teachers on Possession of Employability Skills in Minna, Niger State

Variables	N	Mean	SD	Df	t-value	P-value	Remark
Male	43	I4.69	5.I9	88	I.563	0.768	Not sig
Female	47	I5.73	**3. 35**				

Not significant at 0.05 Alpha levels

Table 3 shows that female pre-service Biology teacher obtained marginally high mean score on the possession of employability skills (mean = I5.73 SD= 3. 35) than their male counterparts (I4.69, SD = 5. I9). However, T-test indicated there is no significant difference (t= I.563, df =88 p>0.05). The null hypothesis which states that there is no significant difference between male and female pre-service Biology teachers is upheld**.**

Discussion of Results

The findings from this study provide valuable insights into the employability skills of pre-service Biology teachers in University in Minna, Niger State. The results have important implications for improving the quality of Biology education in the region.

The findings of the study indicated that pre-service Biology teachers in Minna possess employability skills Their mean responses across various employability skills, including cooperation with other, team work, respect for others, ability to study the situation, identification of problem and provision of the solution to the problem identified, collaborate with other to solve problem when necessary, ability to learn from past mistakes, were all above 2.50 midpoint of the4 -point scale. This finding is consistent with existing research on the employability skills on pre-service Biology teachers in Nigeria. For example, a study by Owolabi and Oginni (20I8) found that many pre-service teachers in the country employability skills necessary for employment. Similarly, Nigerian pre-service teachers possessed employability skills needed for employment Research has shown that pre-service teachers' employability is very paramount to be gainfully employed by employers in Nigeria at large.

Moreover, the findings showed that there was no significant difference in possession of employability skills between male and female pre-service Biology teachers in university in Minna Niger State. This finding is in agreement with work of Adebisi and Adewale (20I6) who found that there was no significant difference in the male and female possession of employability skill in Oyo state Nigeria. The finding is in contrast to the finding of Owolabi and Oginni (20I8) who found that gender had influence on the possession of employability skills of preservice teachers in Kwara State, Nigeria. Also the finding is in contrast to the finding of Ezeamaga, Mary Ugochukwu and Owolabi, O. Henry (2021) who found that majority of university undergraduates in North West in Nigeria perceived themselves to have high knowledge of employability.

Conclusion

The concept of perceived employability skills of Biology pre-service teachers has increasingly become the concern of stakeholders in education and indeed employers of labour. The researchers concluded that the university preservice teachers in Minna perceived themselves to have acquired employability skills necessary for labour force in Nigeria. In addition, gender has influence on the pre-service teachers' perception of the employability skills acquisition as males' preservice teachers perceived to have more employability skills than the female preservice teachers.

Recommendations

In light of above discussion on Perceived Employability Skills among Pre-service teachers in universities in Minna metropolis. Employability skills should be included in the school curriculum for the benefit of all citizen and Nigeria as a whole, the following recommendations were made;

1. School should create environment that enhance students acquisition and development of job-or-employment-related skills.
2. Opportunities should be created in school for student to participate more in industrial attachment/placement, part-time work experience, taking courses on employability, interaction with job/work placement agency, visit to industries and other infrequent but vital employability promoting activities.
3. Practicing and trainee teachers of science subjects should be trained and re-trained on employability skills development strategies to ensure their sense of efficacy and practice in fostering students competencies in employability skills especially; ICT, numeracy, time-management and independent study skills.

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EFFECT OF CHALLENGE-BASED AND ACTIVITY-BASED INSTRUCTIONAL TECHNIQUES ON MOTOR VEHICLE MECHANICS STUDENTS LEARNING OUTCOMES IN TECHNICAL COLLEGES IN KANO STATE, NIGERIA

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Abstract
The study investigated the effect of challenge-based and activity-based instructional techniques on motor vehicle mechanics students learning outcomes in technical colleges in Kano State. Two research question and two null hypotheses guided the study. A Quasi experimental research design was adopted for the study. The study was conducted on motor vehicle mechanics students from two technical colleges (Government Technical College, Kano and Government Technical College, Ungogo) in Kano State. Purposive sampling technique and simple random sampling technique was adopted for this study. A purposive sampling technique was used to select two technical colleges that offer MVM trade from the six technical colleges. A simple balloting technique also used to assign a school to the experimental group (Challenged-based teaching strategy) and the other school to control group (Activity-based teaching strategy). The total of 65 TC II students from the two technical colleges chooses. The instruments that were used for data collection are Motor Vehicle Mechanics Works Achievement Test (MVMWAT), and MVMW Psychomotor Skills Achievement Test (MVMWPSAT) validated by three experts from Department of Industrial and Technology Education, Federal University of Technology, Minna Niger State. The reliability coefficient of the instrument was determined to be 0.88 through Cronbach Alpha Statistics. Descriptive and inferential statistics was used to analyse the data. The null hypotheses were tested using Analysis of Covariance (ANCOVA) at .05 level of significance. The findings among others revealed that Students taught MVMW with activity-based instructional technique have higher cognitive achievement in mean gain with 26.31 than the challenge-based instructional techniques with mean gain of 22.95, Students taught MVMW with activity-based instructional technique have higher psychomotor skills achievement mean gain with 1.55 than the challenge-based instructional techniques with mean gain of 1.15. Based on the finding it was recommended that the ministry of Education should review the curriculum for MVMW with a view to incorporate activity-based instructional techniques into the teaching and learning of MVMW to improve the cognitive and psychomotor achievement of the students. Technical college teachers should be sensitized on the efficacy of activity-based instructional techniques through conference, seminars and workshops.

Keywords: Technical Colleges, Motor Vehicle Mechanical Works (MVMW), Challenge-Based Instructional Technique, Activity-Based Instructional Technique, Learning Outcomes, Cognitive Achievement and Psychomotor Achievement

Introduction
Technical colleges are post-basic schools that specialize on providing practical hand-on training and education to prepare students for specific careers in industries and other sectors of economy. According to Ubanwa *et. al.* (2022), technical colleges are institutions where students are trained to acquire relevant skills and knowledge in different trade areas in order to become self-reliant or take-up paid jobs as craftsmen and master craftsmen in the world of work. The trade programmes offered in the attainment of these goals in technical colleges

according to FRN (2013) includes; painting and decorating, electrical installation work, blocklaying, bricklaying and concreting, air conditioning and refrigeration, carpentry and joinery, furniture making and upholstery, plumbing work, fabrication and welding craft practice as well as motor vehicle mechanic trades.

Motor Vehicle Mechanic Work (MVMW) is one of the trades offered at technical college level in Nigeria. The trade is designed to equip the learners with employable and profitable skills required to work as professional motor vehicle mechanics in automotive industry. The trade involves hands-on experience with repairing, maintaining, and diagnosing issues in various types of vehicles such as cars, trucks, motorcycles, and other motorized vehicles. The goal of MVMW as contained in the National Board for Technical Education (NBTE, 2001) is to produce skilled craftsmen with quality knowledge of the working principles of motor vehicles, the techniques and safety practices involved in the maintenance and repairs of vehicles. However, the reverse is the case as most auto-mechanic craftsmen produced from Nigerian technical colleges are unable to service and repair faults on motor vehicles (Adamu *et al.,* 2022). Nwolu-Elechi (2013) attributed this poor skill performance among MVMW graduates to the instructional techniques deployed by MVMW teachers to inculcate knowledge and skills to the learners. Some of the commended techniques which MVMW teachers are expected to adopt in order to bring about effective skills acquisition and improve the academic performance of MVMW students include problem-based instructional techniques such as activity-based and challenge-based instructional technique.

Challenge-based instructional technique is one of the innovative pedagogies in the field of education that actively engages students in relevant real-world problem that occur in their environment and that require a remedy. According to Badde *et al.* (2023) challenge-based instructional technique is an immersive, multidisciplinary approach to teaching and learning that allows students to use the technologies they use to solve real-world challenges in their everyday lives. Challenge-based instructional technique in the context of this study is a collaborative learning experience in which MVMW teachers and students work together to learn about compelling issues, propose solutions to real problems relating to motor vehicles, and take action. Another problem based instructional techniques which can solve real-world problem in MVMW trade is activity-based instructional technique.

Activity-based instructional technique is the process of learning by performing tasks. It involves the use of hands-on, experiential activities to facilitate learning. According to Albadi and David (2019), activity-based instructional technique can be regarded as a fruitful learning approach that helps student to grasp the required outcomes defined by the teacher himself. Activity-based instructional techniques in the context of this study is an instructional approach that emphasizes on MVMW students' active learning through various activities to develop the three domains of learning (cognitive, affective, and psychomotor) equally in motor vehicle mechanics trade. The ultimate aim of any instructional approach is for the students to achieve the desired learning outcomes.

Learning outcomes are measurable statements that articulate value as a result of taking a course or completing a programme. According to Badde *et al*. (2023) learning outcomes are behaviors that students can perform after the learning has taken place. Learning outcomes in the context of this study measure the potential applications of knowledge and skills acquired by students in MVMW. Hence, one of the learning outcomes to be covered in this study are students psychomotor and cognitive achievement.

Cognitive achievements refer to the intellectual accomplishments and milestones reached by individuals through the development and application of cognitive abilities such perception, memory, reasoning, problem-solving and decision making. Nwosu *et al*. (2022) explained that cognitive achievement involves the ability of students to apply critical thinking, analytical reasoning and problem-solving strategies to solve complex problems across different subject areas and real-world contexts. Hence students in technical colleges are encouraged to acquire intellectual growth and development beyond the technical aspects of their chosen fields which focuses on psychomotor achievement.

Psychomotor achievement can be regarded as development of organized patterns of muscular activities guided by signals from the environment. Ogbuanya *et al.,* (2021) explained that psychomotor achievement refers to achievement of students in practical task which is usually represented by a score or mark obtained in a performance test. Psychomotor achievement in the context of this study is the coordination of a sensory or ideational (cognitive) process and a motor activity of MVM students in technical colleges. However, there are other studies that showed a significant difference on the effect of challenged-based teaching technique on students' cognitive and psychomotor in woodwork and metalwork technology of education (Badde, *et al.*, 2023; Hassan & Abdullahi, 2020). Based on the variations in the findings by various researchers, the researcher aims to determine the effect of challenge-based and activity-based instructional techniques on motor vehicle mechanics students learning outcomes in technical colleges in Kano State.

Statement of the Research Problem

The motor vehicle craftsmen and master craftsmen are neither employed by relevant industries nor be self-reliant, because of the limited skills acquired which may be as a result of wrong teaching methods used by their teachers and resources provided for the school for teaching. Therefore, there is need for a change of method and technique in the teaching of motor vehicle mechanic works, so as to enable the students of technical college acquire adequate knowledge and skills for the world of work, hence the problem of the study is to find out the effect of challenge-based and activity-based instructional techniques on motor vehicle mechanics students learning outcomes in technical colleges in Kano State.

Objectives of the Study

The objectives of the study are to determine the effect of:

1. Challenge-based and activity-based instructional techniques on students' cognitive achievement in MVMW in technical colleges in Kano State.
2. Challenge-based and activity-based instructional techniques on students' psychomotor skills achievement in MVMW in technical colleges in Kano State.

Research Questions

The following research questions will guide the study

1. What is the effect of challenge-based and activity-based instructional techniques on students' cognitive achievement in MVMW in technical colleges in Kano State?
2. What is the effect of challenge-based and activity-based instructional techniques on students' psychomotor achievement in MVMW in technical colleges in Kano State?

Hypotheses

The following null hypotheses were formulated to guide the study and will be test at 0.05 level of significance.

Ho_1: There is no significant difference in the mean cognitive achievement scores of students taught MVMW using challenge-based and activity-based instructional techniques in technical colleges in Kano State.

Ho_2: There is no significant difference in mean psychomotor skills achievement scores of students taught MVMW using challenge-based and activity-based instructional techniques in technical colleges in Kano State.

Methodology

This study adopted a quasi-experimental design. Specifically, the pre-test-post-test non-equivalent control group design. The pre-test post-test non-equivalent group design is a specific type of quasi-experimental design used in research to compare the effects of an intervention or treatment on two or more naturally occurring groups (Smith, 2020). The study was conducted on motor vehicle mechanics students from two technical colleges (Government Technical College, Kano and Government Technical College, Ungogo) in Kano State. Purposive sampling technique and simple random sampling technique was adopted for this study. A purposive sampling technique was used to select two technical colleges that offer MVM trade from the six technical colleges. A simple balloting technique also used to assign a school to the experimental group (Challenged-based teaching strategy) and the other school to control group (Activity-based teaching strategy). The total of 65 TC II students from the two technical colleges chooses. The instruments that were used for data collection are Motor Vehicle Mechanics Works Achievement and Retention Test (MVMWART), MVMW Psychomotor Skills Achievement Test (MVMWPSAT) and Motor Vehicle Mechanics Works Interest Inventory (MVMWII) validated by three experts from Department of Industrial and Technology Education, Federal University of Technology, Minna Niger State. The reliability coefficient of the instrument was determined to be 0.88 through Cronbach Alpha Statistics. Descriptive and inferential statistics was used to analyse the data. The null hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. If the significant of F calculated is less than 0.05, the null hypotheses was rejected and if the significance of F calculated is greater than 0.05, the null hypotheses was accepted.

Results

Research Question One

What is the effect of challenge-based and activity-based instructional techniques on students' cognitive achievement in MVMW in technical colleges in Kano State?
The data for answering Research Question 1 is presented in table 1

Table 1: Mean of Pre-test and Post-test Cognitive Achievement Scores of Students taught MVMW using Challenge-Based and Activity-Based Instructional techniques.

		Pre-test		Post-test		
Groups	N	Mean	SD	Mean	SD	Mean Gain
Challenge-Based Instructional Technique	23	15.96	6.15	38.91	6.73	22.95
Activity-Based Instructional Technique	42	11.69	5.37	38.00	8.91	26.31

Table 1 shows that, the experimental group I taught with challenge-based instructional techniques had pre-test mean achievement score of 15.96 with standard deviation of 6.15 and post-test score of 38.91 with standard deviation of 6.73. The mean gained between the pre-test and post-test of the experimental group I was 22.95. The experimental group II taught with activity-based instructional techniques had pre-test mean achievement score of 11.69 with

standard deviation of 5.37 and post-test score of 38.00 with standard deviation of 8.91. The mean gained between the pre-test and post-test of the experimental group II was 26.31. The experimental group II had higher mean gained than experimental group I.

Research Question Two

What is the effect of challenge-based and activity-based instructional techniques on students' psychomotor achievement in MVMW in technical colleges in Kano State?

Data collected for research question two is presented in Table 2.

Table 2: Mean and Standard Deviation of Challenge-Based and Activity-Based Instructional Techniques on Students' Psychomotor Achievement in MVMW

		Pre-test		Post-test		
Groups	N	Mean	SD	Mean	SD	Mean Gain
Challenge-Based Instructional Technique	23	1.78	0.10	2.93	0.16	1.15
Activity-Based Instructional Technique	42	2.22	0.07	3.77	0.23	1.55

Table 2 shows the mean and standard deviation of psychomotor skills achievement pre-test and post-test score of students taught using challenge and activity-based instructional techniques. From the results, it can be deduced that mean and SD scores of the pretest and posttest scores of challenge and activity-based instructional techniques are X=1.78, SD=0.10, X=2.93, SD =0.16 and X=2.22, SD=0.07, X=3.77, SD= 0.23 respectively. The Mean gains were 1.15 and 1.55 respectively. The post-test score shows that activity-based instructional techniques have higher mean score of 1.55 than challenge-based instructional techniques with mean score of 1.15. The analysis of this result shows that the activity-based instructional techniques for psychomotor skills achievement test score is higher than the psychomotor skills achievement score of challenge-based teaching approach. Therefore activity-based instructional technique is more effective than the challenge-based instructional techniques in enhancing students psychomotor skills achievement in MVM.

Hypothesis One

There is no significant difference in the mean cognitive achievement scores of students taught MVMW using challenge-based and activity-based instructional techniques in technical colleges in Kano State.

To test this formulated hypothesis, Analysis of Covariance (ANCOVA) was employed, and the result was presented in Table 3.

Table 3: Analysis of Covariance (ANCOVA) of students on challenge-based and activity-based instructional techniques on cognitive achievement in MVMW

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	99.856[a]	2	49.928	.742	.480
Intercept	11340.527	1	11340.527	168.598	.000
Pretest	87.467	1	87.467	1.300	.259
Instructional Techniques	.008	1	.008	.000	.991
Error	4170.359	62	67.264		
Total	99733.000	65			

Corrected Total	4270.215	64

Dependent Variable: posttest a. R Squared = .023 (Adjusted R Squared = -.008)

Table 3 show the F-calculated value for testing the significance difference between the cognitive achievement scores of students taught MVMW using challenge-based instructional techniques and those taught with activity-based instructional techniques. The F calculated value of 0.000 was obtained with associated exact probability value of .991. Since the associated probability of 0.991 was greater than 0.05 at a level of significance, the null hypothesis which stated that there is no significant difference in the mean cognitive achievement scores of students taught MVMW using challenge-based and activity-based instructional techniques was accepted. Hence, there was no significance difference between the mean achievement scores of students taught MVMW using challenge-based and those taught with activity-based instructional techniques. This result revealed that students taught MVMW with challenge-based instructional techniques have lower cognitive achievement than those taught with activity-based instructional techniques.

Hypothesis Two

There is no significant difference in mean psychomotor skills achievement scores of students taught MVMW using challenge-based and activity-based instructional techniques in technical colleges in Kano State.

To test this formulated hypothesis, Analysis of Covariance (ANCOVA) was employed, and the result was presented in Table 4.

Table 4: Analysis of Covariance (ANCOVA)of students on challenge-based and activity-based instructional techniques on psychomotor skills achievement in MVM

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	11.493[a]	2	5.746	213.835	.000
Intercept	.002	1	.002	.069	.794
MEANPRETEST	1.077	1	1.077	40.070	.000
INSTRUCTIONALTECHNIQUES	.030	1	.030	1.135	.291
Error	1.666	62	.027		
Total	798.719	65			
Corrected Total	13.159	64			

Dependent Variable: MEANPOSTTEST a. R Squared = .873 (Adjusted R Squared = .869)

Table 4 revealed the ANCOVA result of students on challenge-based and activity-based instructional techniques on psychomotor skills achievement in MVMW. The result indicates that F-ratio= 1.135 with p=0.291 respectively. The p value is greater than α value. Therefore, there was no significant difference between the mean psychomotor skills achievement scores of students taught using challenge-based and activity-based instructional techniques on psychomotor achievement in MVMW. The null hypothesis was accepted. This result revealed that students taught MVMW with activity-based instructional techniques have better psychomotor skills achievement than those taught with challenge-based instructional techniques

Discussion of Findings

The findings on research question one on the effects of challenge-based and activity-based instructional techniques on students' cognitive achievement in MVMW revealed that students taught MVMW with activity-based instructional technique have higher cognitive achievement test score than the challenge-based instructional technique. Therefore activity-based instructional technique is more effective than the challenge-based instructional technique in enhancing students' cognitive achievement in MVMW. The findings contrast with Badde *et al.* (2023) who studied effects of challenge-based and activity-based approaches on students learning outcomes in fabrication and welding craft practices in technical colleges in Kaduna State. The study revealed that challenge-based teaching approach is more effective than the activity-based teaching approach in enhancing student's achievement in welding and fabrication. The finding of the study is incongruity to Ogbuanya, *et al.* (2021) who studied effects of challenge-based and activity-based learning approaches on technical college students' achievement, interest and retention in woodwork technology. The study revealed that students taught woodwork using the challenge-based learning instructional approach had a higher mean score than students taught using the activity-based learning teaching method in cognitive achievement tests.

The findings on hypothesis one, there is no significant difference in the mean cognitive achievement scores of students taught MVMW using challenge-based and activity-based instructional techniques. There was no significance difference between the mean cognitive achievement scores of students taught MVMW using challenge-based and those taught with activity-based instructional techniques. The null hypothesis was accepted. The finding is also in support of Khan *et al.* (2017) conducted a research work on the impact of activity-based teaching on students' achievement in Physics at secondary level. The study revealed that there was a positive impact of activity-based teaching in developing cognitive skills in the students of physics at secondary level. Consequently, the research recommended that the National Board for Technical Education (NBTE) should consider a review of MVMW work curriculum for Technical Colleges with a view to incorporating the activity-based instructional techniques into the teaching of MVMW.

The findings on research question two on the effects of challenge-based and activity-based instructional techniques on students' psychomotor skills achievement in MVMW revealed that the students taught MVMW with activity-based instructional technique have higher psychomotor skills achievement test score than the challenge-based instructional techniques. Therefore activity-based instructional technique is more effective than the challenge-based instructional technique in enhancing students' psychomotor achievement in MVMW. The findings incongruity with Badde *et al.* (2023) who studied effects of challenge-based and activity-based approaches on students learning outcomes in fabrication and welding craft practices in technical colleges in Kaduna State. The study revealed that students taught welding and fabrication with challenge-based teaching approach have higher psychomotor achievement test score than the activity-based teaching approach. Therefore, challenge-based teaching approach is more effective than the activity-based teaching approach in enhancing student's psychomotor achievement in welding and fabrication. The finding is discrepancy with Hassan & Abdullahi (2020) who carried out research on effect of activity-based and challenge-based learning approaches on technical colleges students' psychomotor achievement in furniture craft technology in Zamfara and Katsina State and found out that the challenge-based learning approach is more successful in enhancing the students' psychomotor achievement in furniture craft technology than the activity-based learning approach. Consequently, the research recommended that the National Board for Technical Education (NBTE) should consider a

review of MVMW work curriculum for Technical Colleges with a view to incorporating student-centered instructional techniques into the teaching of MVMW.

The findings on hypothesis two, there is no significant difference in mean psychomotor skills achievement scores of students taught MVMW using challenge-based and activity-based instructional techniques. It revealed that there was no significance difference between the mean psychomotor achievement scores of students taught MVMW using challenge-based and those taught with activity-based instructional techniques. The findings of the study dissension with Badde *et al.* (2023) who revealed that there was a significant difference between the mean psychomotor achievement scores of students taught using challenge-based approach and those taught using activity-based learning approach in welding and fabrication. Consequently, the research recommended that the Government and private technical colleges should employ teachers who know the MVMW content and have the pedagogical skills to apply student-centered teaching methods like the activity-based instructional technique.

Conclusion

The study identified the effect of challenge-based and activity-based instructional techniques on motor vehicle mechanics students learning outcomes in technical colleges in Kano State. The study revealed that activity-based instructional technique is more effective than the challenge-based instructional technique in enhancing students' cognitive and psychomotor achievement in MVMW. The use of activity-based instructional technique is fruitful learning approach that helps student to grasp the required outcomes defined by the teacher himself.

Recommendations

Based on the findings of this study, the following recommendations were made:

1. The ministry of Education should review the curriculum for MVMW with a view to incorporate activity-based instructional techniques into the teaching and learning of MVMW to improve the cognitive and psychomotor achievement of the students.
2. Technical college teachers should be sensitized on the efficacy of activity-based instructional techniques through conference, seminars and workshops.

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EMERGING TECHNOLOGIES AND INNOVATIVE PEDAGOGY IN TECHNICAL EDUCATION FOR ECONOMIC DEVELOPMENT.

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Abstract
Emerging technologies and innovative pedagogy play a crucial role in technical education, which is essential for economic development. The integration of innovative pedagogical technologies in the education system can lead to improved learning outcomes, increased student engagement, and better preparation for the workforce.

This study explores into the dynamic landscape of vocational education, spotlighting the pivotal role played by emerging technologies in shaping pedagogy and skill development. The swiftly changing world of work demands educational adaptability, and emerging technologies offer innovative avenues to meet this imperative. Examining cutting-edge innovations such as Virtual Reality (VR), Augmented Reality (AR), Artificial Intelligence (AI), Machine Learning (ML), Internet of Things (IoT), Robotics, Automation, Big Data, Analytics, Blockchain, 3D printing, and Gamification, this research explores their application in vocational education. Drawing on a comprehensive literature review and diverse global case studies, the paper explores the transformative potential of these technologies and associated challenges. Despite cost and training concerns, the study suggests solutions like affordable access, educator training programs, and equitable technology distribution. It concludes by underscoring the necessity for strategic investments in professional development, technology accessibility, and inclusive educational programs to ensure responsible integration of emerging technologies, positioning vocational education as a catalyst for societal and economic advancement.

Keywords: Emerging Technologies, Innovative Pedagogy, Technical Education and Training, economic development

Introduction
Emerging technologies are new or evolving technologies that are poised to have a significant impact on society (Bailey, 2022). These technologies are often characterized by their potential to disrupt existing industries, create new markets, and solve complex problems. Some of the most promising emerging technologies include Virtual Reality (VR), Augmented Reality (AR), Artificial Intelligence (AI), Machine Learning (ML), Internet of Things (IoT), Robotics and Automation, Big data and analytics, Blockchain and distributed ledger technology, 3D printing and additive manufacturing. These technologies have the potential to revolutionize fields such as healthcare, education, transportation, and manufacturing. While emerging technologies offer great promise, they also present challenges. These challenges include ethical concerns, privacy issues, and the potential for job displacement. It is important to carefully consider these issues before deploying emerging technologies on a large scale. Emerging technologies are a powerful force for change. These technologies have the potential to improve our lives in many ways, but it is important to use them wisely and responsibly (Srinivasan, 2008; Bergey, 2014).

Benefits of Emerging Technologies in Vocational Education
Emerging Technology is increasingly used in vocational education to enhance learning experiences. It has shown its capacity to foster an enabling environment along with institutional-wide engagement (Bozalek et al., 2013). A growing body of research is exploring

the use of emerging technologies in vocational education. For example, a study has found that using virtual reality (VR) to train students for welding tasks resulted in significant improvements in performance and confidence (Price et al., 2019). Another study found that using augmented reality (AR) to train students for plumbing tasks resulted in reduced errors and increased completion rates (Kwiatek et al., 2019). The impact of emerging technologies on society, business, economy, and humanity is only going to increase in the coming decades (Siau, 2017).

Virtual Reality (VR) and Augmented Reality (AR) Applications

Virtual Reality (VR) and Augmented Reality (AR) have revolutionized the learning experience by providing immersive and interactive training environments. In vocational education, students can utilize VR to simulate complex tasks in a risk-free setting, enhancing their understanding of intricate concepts. Research has shown that with VR simulation learning can be personalised to suit individual learning needs and provide adaptive learning experience (tom Dieck et al., 2021). AR, on the other hand, overlays digital information onto the real world, enabling students to visualize and manipulate objects, making learning more engaging and tangible.

Artificial Intelligence (AI) and Machine Learning (ML) in Skill Enhancement

AI and ML technologies empower personalized learning experiences. AI algorithms analyze student behaviour, adapting the learning materials and pace to match individual needs. AI-driven tutors provide real-time feedback, identifying strengths and weaknesses, guiding students to mastery. AI-powered learning platforms can adapt to the individual needs of each student, providing them with the right level of challenge and support. This can help students to learn more effectively and efficiently (Maghsudi et al., 2021). However, Machine Learning algorithms, when applied to vocational tasks, help students refine their skills by analyzing patterns, thereby enhancing their expertise (Nafea, 2018).

Internet of Things (IoT) in Vocational Training

The integration of IoT devices in vocational training connects students to real-world applications. For instance, in automotive repair training, IoT sensors can monitor engine performance, allowing students to diagnose issues and apply solutions in a controlled environment. This practical, hands-on experience is invaluable, preparing students for the challenges of the modern workplace (Borgia, 2014).

Gamification and Interactive Learning Tools

Gamification techniques leverage game design elements to engage and motivate learners. Interactive learning tools, coupled with gamified approaches, enhance student participation and enthusiasm. Gamification has significantly demonstrated to boost active learning and motivation in online classes, resulting in increased engagement and reduced anxiety among students (Rincon- Flores & Santos-Guevara, 2021). By incorporating game-like scenarios, students can tackle challenges, earn rewards, and collaborate with peers, fostering a competitive yet supportive learning environment.

Robotics and automation.

The increasing prevalence of robotics and automation in the 21st-century industrial landscape is transforming not only the world of work but also the realm of education. Robotics and automation are the demand of 21st century industrial needs. They are replacing manual jobs and eventually revolutionalising every nation's economy (Zhao & Siau, 2017). This technological shift is not only enhancing efficiency and precision among learners but also

fostering heightened collaboration and communication, while simultaneously facilitating personalized learning experiences (Madaev et al., 2023). Studies have shown Robotics Laboratory and Automation provide a wholesome experience to learners to draw on their basics and conduct advanced experiments at different stages of their learning process. Hence, Robotics and Automation are going to fundamentally change the mode of pedagogy and reform the way we learn (Siau, 2017).

Big data and analytics

The influence of a data-driven learning environment extends to teaching and assessment, offering a continuous monitoring mechanism. With the advent of virtual learning spaces, the role of Data and analytics has permeated the boundaries of education with constant data collection, continuous algorithmic assessment, and record retention. This has in turn dictated the desired learning outcomes, content creation, and assessment methods, shifting decision-making away from educators and diminishing the involvement of parents and students in the decision-making process (Zeide, 2017). It provides opportunities for dynamic information exchanges, which is essential for staying up to date in the field of vocational education.

Blockchain and distributed ledger technology

Blockchain and distributed ledger technology (DLT) are gaining recognition for their transformative potential in various sectors like Healthcare, Banking providing services like safe & secure transactions, transaction settlement, digital currency banks, and supply chain applications. With the incorporation of Blockchain along with Distributed ledger technology, it has paved a way to improve information management making it accessible and securing data privacy. It has proven to provide practical and safe technological ways for conducting digital certification, recording and so on (Yuliana & Agustina. 2022).

3D printing and additive manufacturing

The use of 3D printing and additive manufacturing in vocational education is a growing area of interest, with potential applications in design, manufacturing, and materials processing (Keaveney & Dowling, 2018). This technology can enhance learning experiences, particularly in mechanical engineering, by providing a hands-on approach to design and fabrication. However, its full potential is yet to be realized, and further research is needed to explore its use in instructional media (Ramdhani & Mulyanti, 2020). The current implementation of 3D printing in education is varied, with applications ranging from teaching and learning about 3D printing to creating assistive technologies (Ford & Minshall, 2019). Despite its potential, the use of 3D printing in vocational education is still in its early stages, and more research is needed to fully understand its impact and potential.

Challenges and Limitations of Emerging technologies in Vocational Education

While the benefits of integrating emerging technologies in vocational education are evident, it is not without challenges and limitations. One of the primary challenges is the initial cost of acquiring the necessary equipment and software (Schwendimann et al., 2018). It also requires Technical expertise for its maintenance for organisations with a limited Human Resource and Funds availability (Papathanassiou et al., 2013). Such training, and equity persist. Cost - effective solutions are emerging as technology becomes more accessible. Training programs for educators are essential, ensuring they can harness the full potential of these tools. Addressing equity concerns involves providing access to technology both in schools and at home, promoting digital literacy among all students.

Innovative Pedagogy in Technical Education

Innovative pedagogy in technical education involves the use of new and innovative teaching methods, such as project-based learning, problem-based learning, and flipped classrooms. These methods can help students develop critical thinking, problem-solving, and collaboration skills, which are essential for success in the workforce. Innovative pedagogy implies the application of existing teaching and learning methods which involve radical changes, but often they result only in incremental adaptations of well-known practices. It is the best mix of teaching methods that may be taken together that would meet the needs of the learner in an informal or formal learning environment. This can be equated with any new action that aims to improve student learning. Innovation is needed to transform TVET and meet the needs of learners and employers. Innovative pedagogy applied in this study are Facilitated peer tutoring and Industry based method. Facilitated Peer Tutoring refers to the use of facilitating and learning strategies in which the learners learn with and from each other with an immediate intervention of the facilitator. FPT encourages active engagement of the learners and promotes mastery, accuracy and fluency in content learning. Industry based method is a method whereby the subject teachers creates opportunities for their students to be linked to related industry, to gain practical skills from experts in the industry related to the topic of study. It is one of the learning approaches that has been practiced all over the world for decades now (Wilson, 1997).

Innovative Pedagogy (IP) for TVET Teachers

Innovative pedagogy in this guide focuses on the combination of three teaching approaches namely:

A. Facilitated peer-tutoring method;
B. Industry based approach;
C. Discussion method/demonstration method (conventional method)

This was chosen based on literature reviewed, task analysis performed on the content of the subjects selected for the study, primary data collected and interactions with the TVET teachers.

Facilitated Peer-Tutoring Method (FPT). In this innovative method, the facilitator is involved with the role of assigning students into smaller groups using the high achieving students who are more knowledgeable in the given task to act as tutor to help to teach the low achieving students here referred to as 'tutees' in the selected topic or task, having received prior guidance from the teacher. This method can be used in an innovative way to facilitate knowledge, skills at the secondary level education. This approach is used in combination with the discussion and demonstration methods. However, this step is carried out after the discussion/demonstration method.

Steps in Planning and Implementation of Facilitated Peer-Tutoring

The first thing done by the facilitator was to clarify the specific objectives of the tutoring program. The steps are highlighted in Figure 1.

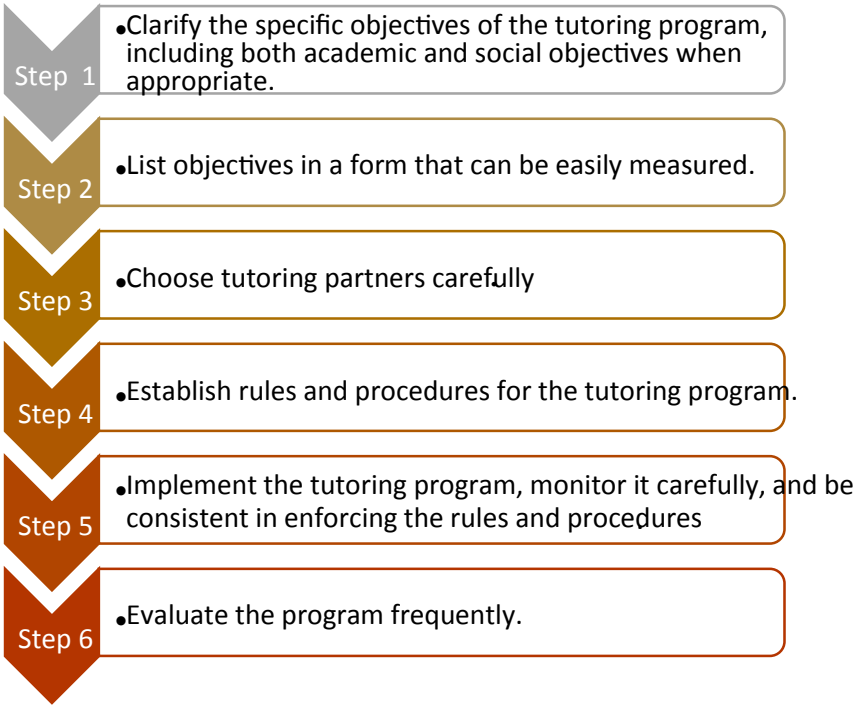

Figure 1: Steps followed in implementing facilitated peer-tutoring teaching method

Industry-Based Method - In using this innovative approach, the facilitator first scheduled a working visit at the industry nearest to the school and established an understanding on the need for such collaboration. The learners with the help of the classroom teacher are taken to the industry for practical experience on the selected topic of interest as contained in the scheme of work. Once this was done, the industry-based facilitator guided the learners through practical demonstration during the scheduled days and time while giving the students opportunities to practice such drills using the right tools and materials, using the learning objectives (LO). This industry-based method is used for a particular topic, and due to time constraints a day was dedicated for this. The facilitator developed a guide for running the lesson at the industry and which includes the goal, how the goal will be reached and ways of measuring how well the goal has been reached during the industry work visits. The use of industry-based learning approach helps to bring about an effective learning of practical concepts or subjects where knowledge, skills and attitude (KSA) will be achieved. The learners understands the theories mainly through their classroom facilitators and move to the industrybased to further learn and practice practical drills particularly in institutions where the training facilities are lacking under the guidance of the facilitators and the industry-based trainers. Figure 2 highlights the steps taken by the TVET facilitator in adopting industry-based approach.

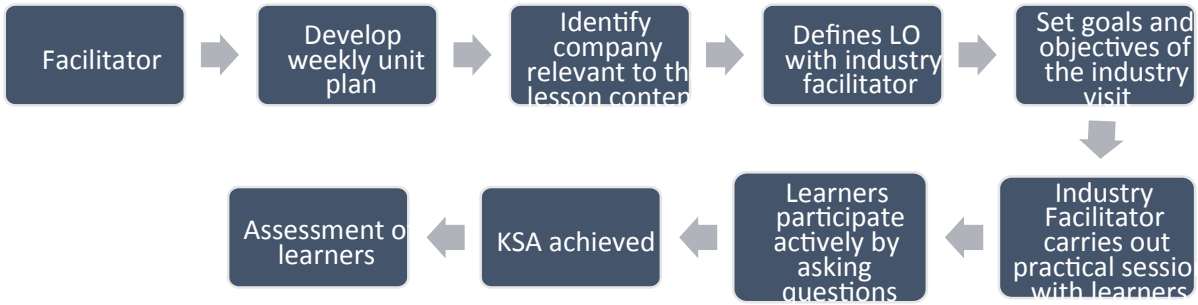

Figure 2: Steps taken by facilitator in adopting the industry-based approach.

Discussion /demonstration Teaching Method- Learners were actively involved in talking and listening to each other.To use this method, the teacher gave suitable foundation for the discussion by posing thought provoking questions, and then stimulates the trainees or learners to discuss the basic questions, and finally guide the discussion to a logical conclusion. The demonstration session involved the learning process of the skill in a step-by-step process by explanation.

Guide designed for utilizing Innovative Pedagogy

The following steps formed a guide for the TVET teachers in implementing innovative teaching methods in their classroom teaching and learning practices. This is a modified version of Bill Lucas, (2012) framework

Step 1 - identified and set learning outcomes to be achieved by the learner. From the defined objectives, developed the lesson plan to facilitate the achievement of the days' objectives.

Step 2 - identified the nature of the 'subject matter' i.e. the theoretical knowledge, practical skills and underpinning behavior attitude needed to become competent on the stated LO. Industries with the required learning facilities to engage the learners was identified and session time/period for the industry/student session was defined.

Step 3 - performed contextual analysis of the overall learning context by determining the nature and profile of learners. Instructional facilitation method to use was determined.

Step 4 - defined the scope of desired outcomes and the set competencies the learner is expected to develop in the subject area was listed by the facilitator.

Step 5 - defined the range of learning methods and how best to blend them in the training process based on the LOs. Facilitated Peer-tutoring + Conventional Method, Industry-Based Method + Conventional Method. **Step 6 -** carried out performance evaluation analysis

Economic Development

Technical education is essential for economic development, as it provides students with the skills and knowledge needed to succeed in the workforce. The integration of emerging technologies and innovative pedagogy in technical education can help prepare students for the jobs of the future and drive economic growth.

Economic Development is the creation of wealth from which community benefits are realized. It is more than a jobs program, it's an investment in growing your economy and enhancing the prosperity and quality of life for all residents.

Economic development means different things to different people. On a broad scale, anything a community does to foster and create a healthy economy can fall under the auspice of economic development. Today's economic development professionals are trying harder than ever to define their field in terms that are more concrete and salient to policymakers, the public, and other professionals. There are probably as many definitions for economic development as there are people who practice it. Below is CALED's definition as published in the Economic Development Handbook:

From a public perspective, local economic development involves the allocation of limited resources – land, labor, capitol and entrepreneurship in a way that has a positive effect on the level of business activity, employment, income distribution patterns, and fiscal solvency.

It is a process of deliberate intervention in the normal economic growth by making it easier or more attractive. Today, communities in California are giving attention to what they can do to promote fiscal stability and greater economic development.

Economic development is a concerted effort on the part of the responsible governing body in a city or county to influence the direction of private sector investment toward opportunities that can lead to sustained economic growth. Sustained economic growth can provide sufficient incomes for the local labor force, profitable business opportunities for employers and tax revenues for maintaining an infrastructure to support this continued growth. There is no alternative to private sector investment as the engine for economic growth, but there are many initiatives that you can support to encourage investments where the community feels they are needed the most.

Technical Education and Economic Development

Economic development and technical education are closely linked, with technical education playing a crucial role in driving economic growth and development. Technical education provides individuals with the skills and knowledge needed to succeed in the workforce, leading to increased productivity, innovation, and job creation.

The relationship between economic development and technical education is a strong and positive one. Technical education plays a crucial role in economic development by providing individuals with the skills and knowledge needed to succeed in the workforce. This, in turn, leads to increased productivity, innovation, and economic growth.

Benefits of Technical Education to Economic Development

Some of the benefits of technical education to economic development are:

- **Increased Productivity**: Technical education provides individuals with the skills and knowledge needed to perform tasks more efficiently, leading to increased productivity and economic growth (Vu, T. B., Hammes, D. L., & Im, E. I., 2012).
- **Innovation**: Technical education fosters innovation by providing individuals with the skills and knowledge needed to develop new products, services, and processes (Liu, L., 2021).
- **Job Creation**: Technical education leads to job creation by providing individuals with the skills and knowledge needed to fill in-demand jobs (Lee, H. S., Har, W. M., & Lee, S. Y., 2020).
- **Economic Growth**: Technical education leads to economic growth by increasing productivity, innovation, and job creation (Ma, X., 2022).

Examples of Successful Technical Education Programs

- **Career and Technical Education (CTE) Programs**: CTE programs provide individuals with the skills and knowledge needed to succeed in in-demand careers such as healthcare, technology, and manufacturing (Ifeanacho, & Chinwe, C., 2018).
- **Apprenticeships**: Apprenticeships provide individuals with hands-on training and experience in a specific trade or skill (Pilz, M. & Regel, Ju., 2021).
- **Vocational Training**: Vocational training provides individuals with the skills and knowledge needed to succeed in a specific trade or skill (Chunzhu, Yu., & Jing, L., 2015).

Challenges Facing Technical Education

- **Funding**: Technical education programs often face funding challenges, making it difficult to provide individuals with the resources and support needed to succeed. Financial support for technical education is inconsistent. This affects the maintenance of facilities, procurement of modern equipment, and overall educational quality. (Aldoosry, R. Z., Aldahmash, A. H., Alfaifi, M. S., Almutairi, A. M., Aldossari, A. S., Alshuaibi, A. A., & Alabbad, A. H., 2020).
- **Accessibility**: Technical education programs may not be accessible to all individuals, particularly those in rural or disadvantaged areas (Asadullah, M. A., & Ullah, A. Z., 2018).

Perception and Stigma: Technical education is often perceived as being inferior to traditional academic education, making it difficult to attract individuals to technical education programs. This leads to a stigma against pursuing technical careers. This perception limits enrolment and societal support. (Mgabhi, G., & Mohammed, M., 2018).

- **Infrastructure Deficiency:** Many technical institutions in Nigeria suffer from inadequate infrastructure such as outdated workshops and laboratories. This shortfall limits practical training opportunities for students.
- **Shortage of Qualified Staff:** A significant challenge is the shortage of qualified instructors. The demand for skilled personnel often exceeds the availability, leading to compromised learning experiences.
- Relevance of Curriculum: The curriculum in many technical institutions requires updating to meet current industry demands. Outdated courses do not equip graduates with the skills needed in today's job market.

Solutions to the Challenges

To improve the state of technical education in Nigeria, several strategies can be considered:

- **Increased Funding Allocation:** Government and private sector partnerships can enhance funding for infrastructure development and staff training.
- **Curriculum Review and Industry Collaboration:** Regular review of curricula in consultation with industries ensures graduates are equipped with relevant skills.
- **Enhanced Staff Recruitment and Training:** Initiatives to attract and retain qualified instructors through competitive salaries and continuous professional development.
- **Public Awareness Campaigns:** Promoting the importance of technical education in economic development can shift societal perceptions and increase enrolment.

Conclusion

In conclusion, emerging technologies and innovative pedagogy play a vital role in technical education, which is essential for economic development. The integration of innovative pedagogical technologies in the education system can lead to improved learning outcomes, increased student engagement, and better preparation for the workforce. Technical education, in turn, provides individuals with the skills and knowledge needed to succeed in the workforce, leading to increased productivity, innovation, and job creation.

As the world continues to evolve and technological advancements accelerate, it is crucial that technical education keeps pace. By embracing emerging technologies and innovative pedagogy, technical education can provide students with the skills and knowledge needed to drive economic growth and development.

Recommendations

- Governments, educational institutions, and industries should invest in emerging technologies and innovative pedagogy to enhance technical education.
- Technical education programs should be designed to provide students with hands-on experience and training in emerging technologies.
- Educators should be trained to effectively integrate emerging technologies and innovative pedagogy into their teaching practices.
- Continuous assessment and evaluation of technical education programs should be conducted to ensure they remain relevant and effective in preparing students for the workforce.
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By working together to integrate emerging technologies and innovative pedagogy into technical education, we can create a more skilled and adaptable workforce, drive economic growth and development, and build a brighter future for generations to come

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INFLUENCE OF VIRTUAL FIELD TRIPS ON STUDENT ENGAGEMENT AND SPATIAL THINKING SKILLS AMONG GEOGRAPHY STUDENTS IN SECONDARY SCHOOLS IN MINNA, NIGER STATE

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Abstract
This review explores the influence of Virtual Field Trips (VFTs) on student engagement and spatial thinking skills among geography students in secondary schools in Minna, Niger State. VFTs, defined as interactive online experiences that allow students to explore geographical locations and concepts remotely, have gained prominence in education due to advancements in technology and the increasing need for engaging learning modalities. This review highlights the critical importance of student engagement and spatial thinking in geography education, emphasizing how these elements contribute to enhanced learning outcomes. Tracing the historical development of VFTs, the review outlines their evolution from simple online tours to immersive experiences facilitated by tools such as Geographic Information Systems (GIS), Google Earth, and Virtual Reality (VR). Theoretical frameworks, including self-determination theory and constructivism, are examined to explain how virtual learning environments can foster engagement. Synthesized research findings indicate that VFTs significantly enhance student engagement by promoting interactivity, immersion, and real-world relevance. The review also delves into the definition of spatial thinking and its pivotal role in geography education, alongside the cognitive and technological tools that support its development. It identifies key studies evaluating the relationship between VFTs and spatial thinking skills, noting both common themes and discrepancies in the literature. Furthermore, challenges and limitations in implementing VFTs are addressed, focusing on technological barriers, teacher training, and pedagogical alignment with curricular objectives. In conclusion, the review synthesizes the significant findings on VFTs' impact on engagement and spatial thinking while identifying gaps in the literature, particularly the need for longitudinal studies and research on diverse student populations. Recommendations for geography educators and future research directions emphasize the necessity for improved technology integration and innovative pedagogical approaches in geography education.

Keywords: Virtual Field Trips, Student Engagement, Spatial Thinking, Geography Education, Technological Advancements, Secondary Schools, Niger State.

Introduction
The digital age has brought about significant transformations in the way education is delivered, with technology providing new, innovative methods to enrich student learning. One such method is the Virtual Field Trip (VFT), which allows students to explore environments and geographical locations virtually, often through immersive experiences. Unlike traditional field trips, which are often limited by geographical, financial, or logistical constraints, VFTs offer flexibility and accessibility, enabling students to visit and interact with various locations across the globe from the comfort of their classrooms or homes (Usman *et al.,* 2023). In the context of geography education, where the ability to visualize and engage with spatial environments is crucial, VFTs have become an increasingly valuable tool.

Virtual field trips are designed to simulate real-world experiences using multimedia elements such as video, audio, and interactive maps. Through platforms like Google Earth, 3D virtual environments, and augmented reality applications, students can explore natural landmarks, urban landscapes, and various geographical features without the need for physical travel (Usman, 2021). This mode of learning has gained popularity as it offers a cost-effective, safe, and scalable alternative to traditional field trips, especially in schools where resources are limited. Moreover, VFTs can expose students to a wider range of environments, from remote ecosystems to urban centers, fostering a deeper understanding of geography's global scope. This evolution in the educational experience is not only about convenience but also about expanding the horizons of students' learning, making previously inaccessible locations accessible for study.

One of the primary advantages of VFTs in geography education is their potential to significantly enhance student engagement. Engagement, defined as the degree of attention, curiosity, and interest students exhibit during the learning process, is crucial for effective learning outcomes (Filgona & Sababa, 2023). When students are actively engaged, they are more likely to retain information, apply critical thinking, and demonstrate higher levels of achievement. In geography, where abstract concepts such as spatial relationships, environmental processes, and global interconnections are critical, maintaining engagement is often a challenge, particularly when relying solely on traditional teaching methods like lectures or textbook readings. Virtual field trips provide an interactive and immersive learning environment that can capture students' imaginations, fostering a more active and participatory approach to learning. Through visual and sensory stimulation, VFTs create a dynamic learning space that can sustain attention and enhance understanding.

In addition to engagement, spatial thinking skills are another critical component of geography education. Spatial thinking involves the ability to understand and manipulate the spatial relationships between objects, locations, and environments, and is fundamental to problem-solving and critical thinking in fields such as urban planning, environmental science, and geospatial technologies (Nmadu, 2022). Geography, by nature, demands a high level of spatial cognition, as students must be able to visualize geographic patterns, navigate spatial data, and interpret the spatial dimensions of human-environment interactions. VFTs offer a unique platform to cultivate these skills by allowing students to interact with virtual spaces, engage in map-based exploration, and experience geographical phenomena in a three-dimensional context. Through such experiences, students develop a deeper understanding of both physical and human geography, enhancing their ability to think spatially and apply this knowledge to real-world situations.

Despite the growing interest in the use of VFTs, there is still much to learn about their impact on student engagement and spatial thinking skills. While several studies have suggested that VFTs enhance motivation and engagement, fewer have delved into how these virtual experiences influence spatial cognition and long-term understanding of geographical concepts. This review aims to explore and synthesize existing research on the topic, examining the various ways in which VFTs are integrated into geography curricula and their effectiveness in promoting both engagement and spatial thinking. In doing so, the review will identify key gaps in the literature and provide recommendations for future research and educational practice.
The purpose of this review is to consolidate the available evidence on the influence of VFTs on student engagement and spatial thinking skills, particularly in secondary geography education. A thorough understanding of these effects is crucial for educators seeking to implement VFTs effectively in the classroom. By examining the existing research, this review

will offer insights into best practices for using VFTs, highlighting the conditions under which they are most effective and the specific aspects of geography education they are best suited to enhance. Additionally, the review will explore the pedagogical strategies that can be employed to maximize the benefits of VFTs, such as integrating them with inquiry-based learning or combining them with physical fieldwork experiences.

Historical Context and Evolution of Virtual Field Trips

The concept of Virtual Field Trips (VFTs) has evolved significantly over the past few decades, reflecting broader technological advancements and changes in educational methodologies. Initially, VFTs began as simple online tours, often comprising static images and brief descriptions of geographic locations. These early iterations lacked interactivity and engagement, primarily serving as supplemental resources rather than integral components of the educational experience. However, as technology progressed, so too did the nature and scope of VFTs, leading to more immersive and interactive experiences that can simulate real-world explorations (Ibrahim, 2023).

One of the key milestones in the development of VFTs was the advent of the internet in the 1990s, which allowed educators to access a vast array of digital resources. Websites offering virtual tours of museums, historical sites, and natural wonders began to emerge, enabling students to "visit" places that may be geographically distant or otherwise inaccessible. These tours, however, were primarily one-dimensional, offering limited engagement and interaction. The introduction of multimedia elements—such as audio narration, video clips, and interactive maps—marked a significant shift, enhancing the educational value of VFTs (MOGBO, 2023). The rise of Geographic Information Systems (GIS) and digital mapping technologies in the early 2000s further revolutionized the field of geography education. GIS allowed educators and students to visualize complex spatial data and analyze geographical relationships, thereby enriching their understanding of spatial concepts. This technological advancement paved the way for more sophisticated VFTs, where students could engage with real-time data, manipulate geographic information, and explore scenarios that reflect the dynamic nature of geographic systems (usman, 2021).

The integration of Google Earth in education during the late 2000s marked another significant advancement in the evolution of VFTs. Google Earth provided a user-friendly platform for exploring the world through satellite imagery and 3D visualization, making geography more accessible and engaging for students. Educators began to leverage this tool to create VFTs that allowed students to "fly" over landscapes, examine features up close, and even analyze environmental changes over time. This level of interactivity contributed to a deeper understanding of spatial thinking skills, enabling students to better grasp concepts like scale, distance, and geographic relationships (Usman *et al*., 2023).

In recent years, the emergence of Virtual Reality (VR) technologies has taken VFTs to new heights. VR enables users to experience immersive environments that mimic real-world settings, fostering a sense of presence that traditional VFTs cannot achieve. In geography education, VR has been employed to simulate field experiences, allowing students to explore ecosystems, urban environments, and historical landmarks in a fully interactive manner. This immersive experience has proven particularly beneficial in enhancing student engagement and spatial thinking, as students can manipulate their virtual surroundings and engage in problem-solving activities that reflect real-world geographic challenges (Filgona and Sababa, 2023).

The evolution of VFTs has also been accompanied by a shift in educational paradigms, emphasizing constructivist learning approaches. These approaches encourage active learning and engagement, aligning perfectly with the capabilities of modern VFTs. Research indicates that when students participate in interactive learning experiences, such as VFTs, their engagement levels increase, and they develop critical thinking and spatial skills more effectively (Ogah *et al.,* 2023). This alignment between technology and pedagogy highlights the importance of integrating VFTs into geography curricula to foster a deeper understanding of geographic concepts.

Student Engagement in Virtual Learning Environments

Student engagement is a critical aspect of educational success, particularly in virtual learning environments (VLEs), where traditional methods of instruction are often transformed by technology. Several theoretical frameworks provide insight into how VLEs can enhance student engagement. One such framework is Self-Determination Theory (SDT), which posits that individuals are more engaged in activities when they feel autonomous, competent, and connected to others (Isaac, 2021). In the context of VLEs, the opportunities for self-directed learning and collaborative activities can foster a sense of agency among students, thereby increasing their intrinsic motivation to participate actively in their educational experiences. Constructivism, another influential theory, suggests that learners construct knowledge through interactions with their environment and peers (Opara, 2021). VLEs, particularly those incorporating virtual field trips (VFTs), provide rich, interactive contexts where students can explore content, engage in problem-solving tasks, and collaborate with classmates, facilitating deeper learning and sustained engagement.

Research has shown that the design of VLEs significantly impacts student engagement levels. Studies focusing on VFTs highlight how interactivity, immersion, and real-world relevance contribute to enhancing engagement. For instance, interactivity, which includes features like quizzes, simulations, and opportunities for feedback, allows students to actively participate in their learning process. This active participation has been linked to higher engagement levels, as students feel more involved and invested in their learning outcomes (Isaac, 2021). Additionally, the immersive nature of VFTs—often facilitated by multimedia elements and 3D visualizations—can create an engaging learning experience that captures students' attention and motivates them to explore further. For example, a study by Nuhu (2023) demonstrated that students who engaged with immersive VFTs reported higher levels of engagement compared to those who participated in traditional learning methods, highlighting the potential of immersive technology in enhancing educational experiences.

Real-world relevance is another critical factor influencing engagement in VFTs. By connecting educational content to real-world contexts, VFTs can make learning more meaningful for students. This relevance not only enhances student interest but also promotes a deeper understanding of complex concepts, particularly in subjects like geography. Research indicates that when students can see the application of what they are learning in real-life scenarios, they are more likely to engage with the material (Usman *et al.,* 2023). For instance, VFTs that allow students to explore geographical phenomena—such as climate change, urban development, or cultural diversity—can spark curiosity and encourage students to take ownership of their learning journey.

Moreover, the collaborative aspect of VFTs can further enhance engagement levels. Many VFTs facilitate group interactions, allowing students to work together on tasks, share insights, and build a sense of community, even in a virtual setting. This collaborative environment can

lead to enhanced motivation and engagement, as students feel a sense of belonging and support from their peers (Ibrahim, 2023). In essence, the combination of interactive features, immersive experiences, real-world relevance, and collaborative opportunities creates a multifaceted approach to learning that significantly boosts student engagement in VLEs.

3Virtual Field Trips and Spatial Thinking Skills

Spatial thinking refers to the cognitive processes involved in understanding, reasoning about, and manipulating spatial relationships among objects and concepts (Ogah, 2023). This skill encompasses various abilities, including mental rotation, spatial visualization, and the comprehension of maps and diagrams. In the field of geography, spatial thinking is particularly critical as it enables students to analyze geographical data, interpret spatial patterns, and engage in problem-solving related to real-world phenomena. As geography education increasingly emphasizes the importance of spatial analysis in a variety of contexts—from urban planning to environmental management—developing students' spatial thinking skills has become a central focus for educators (Mogbo, 2023). Virtual field trips (VFTs) provide a unique platform to enhance these skills, allowing students to experience geography in an immersive and interactive manner.

Digital tools play a crucial role in fostering spatial thinking by providing students with cognitive scaffolding that enhances their ability to visualize and manipulate spatial information. Tools such as virtual maps, Geographic Information Systems (GIS), and 3D models allow learners to explore geographical concepts in depth and from different perspectives. For instance, VFTs often incorporate interactive maps and multimedia elements that facilitate experiential learning and active engagement. Research has shown that using these digital tools can significantly improve students' spatial thinking abilities by providing them with opportunities to practice and apply their skills in a contextualized setting (Filgona & 2023). Moreover, these tools help bridge the gap between abstract concepts and tangible experiences, making spatial relationships more comprehensible and relatable to students.

Challenges and Limitations in Implementing VFTs

The implementation of Virtual Field Trips (VFTs) in educational settings presents several technological barriers that can hinder their effectiveness and accessibility. One significant challenge is the disparity in technology access among students and schools. In many regions, particularly in developing countries or rural areas, limited internet connectivity and inadequate access to necessary devices such as computers or tablets can prevent students from fully engaging in VFT experiences (Mogbo, 2023). This digital divide not only restricts students' exposure to VFTs but also exacerbates existing inequalities in educational opportunities, as those without access to technology are left behind. Furthermore, schools may struggle to maintain the infrastructure needed to support VFTs, including reliable internet connections and sufficient bandwidth, which are essential for streaming content and participating in interactive experiences (Mogbo, 2023).

In addition to access issues, the lack of comprehensive teacher training poses a significant barrier to the successful implementation of VFTs. Educators often need specific training to effectively integrate technology into their teaching practices, especially when employing innovative tools like VFTs. However, many teachers may not have received adequate professional development in using VFTs or understanding how to leverage them for enhanced student learning (Nmadu, 2022). This gap in knowledge can lead to a limited understanding of the pedagogical strategies required to facilitate meaningful learning experiences. Without

proper training, educators may struggle to utilize VFTs to their full potential, ultimately diminishing their impact on student engagement and learning outcomes.

Conclusion and Future Directions

This review has synthesized existing research on the influence of Virtual Field Trips (VFTs) on student engagement and spatial thinking skills within geography education. The findings indicate that VFTs can significantly enhance student engagement by offering immersive, interactive experiences that connect geographical concepts to real-world contexts. Numerous studies highlight how VFTs foster active participation, motivation, and curiosity among students, resulting in a deeper understanding of geographical content. Furthermore, the use of VFTs has been shown to develop spatial thinking skills, as they encourage students to navigate digital environments, analyze geographical data, and apply critical thinking skills in interpreting spatial relationships. Overall, the integration of VFTs presents a promising avenue for improving student learning outcomes in geography.

Despite the positive findings surrounding VFTs, gaps in the literature indicate a need for further exploration in several areas. One significant gap is the scarcity of longitudinal studies examining the long-term impacts of VFTs on student engagement and spatial thinking skills. Most existing research focuses on immediate outcomes, leaving a lack of understanding regarding how these benefits may persist over time (Ibrahim, 2023). Additionally, there is a need to explore the effects of different types of VFTs—such as guided versus unguided experiences—on diverse student populations. This investigation is crucial to understanding how factors such as age, learning styles, and prior knowledge may influence the effectiveness of VFTs in enhancing engagement and spatial thinking skills.

To address these gaps, future research should prioritize longitudinal studies that assess the sustained impact of VFTs on students' academic achievement and cognitive skills. Such research could involve tracking student performance over extended periods to determine whether initial engagement and spatial thinking improvements translate into long-term academic success. Moreover, comparative studies examining the effectiveness of various VFT formats, such as interactive simulations versus video tours, would provide valuable insights into how different approaches can cater to the diverse needs of students (Nmadu, 2022). This line of inquiry would ultimately contribute to a more comprehensive understanding of the pedagogical value of VFTs in geography education.

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IMPACT OF EDUCREATION AND PIKTOCHART ON ACHIEVEMENT AND RETENTION AMONG GEOGRAPHY STUDENTS IN SECONDARY SCHOOLS IN SHIRORO, NIGER STATE, NIGERIA: A COMPREHENSIVE REVIEW

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Abstract
This review investigates the impact of digital tools Educreation and Piktochart on student achievement and retention among secondary school geography students in Shiroro, Niger State, Nigeria. As education increasingly incorporates technology, visual learning tools have emerged as significant assets in enhancing educational outcomes. Educreation, an interactive learning platform, and Piktochart, a user-friendly infographic creator, both facilitate visual learning, making complex geographical concepts more accessible and engaging for students. This review synthesizes existing research on the effectiveness of these tools, highlighting their roles in improving academic performance and information retention. Research findings indicate that Educreation promotes active engagement through multimedia resources, enhancing students' understanding and retention of geographical knowledge. Similarly, Piktochart aids in the simplification of information through visually appealing infographics, contributing to improved academic achievement. However, challenges remain regarding the integration of these tools into existing curricula and the need for adequate teacher training and technology access. The review emphasizes the importance of further research within the Nigerian context to explore the long-term benefits and challenges of using these digital tools. Practical recommendations for educators and policymakers are provided to enhance the effective implementation of Educreation and Piktochart in geography education, ultimately fostering better learning outcomes for students. By leveraging these innovative tools, educators can create a more dynamic and effective learning environment that supports students' academic success and retention.

Keyword: Educreation, Piktochart, Visual Learning, Geography Education, Student Achievement, and Retention

Introduction
In the rapidly evolving landscape of education, digital tools have emerged as key resources in enhancing student engagement, comprehension, and retention across various subjects. In the field of geography education, where visual representations of spatial data are paramount, tools like Educreation and Piktochart have gained prominence. Educreation is an interactive platform that allows educators to create dynamic lessons incorporating multimedia, audio, and video to explain geographic concepts (Parveen & Husain, 2021). Piktochart, on the other hand, is a visual communication tool that simplifies complex data through infographics, maps, and charts, making it particularly effective in geography where visual data is essential for understanding patterns and trends (Chia *et al*., 2023). Both tools provide innovative ways to transform traditional geography lessons into interactive learning experiences, enabling students to visualize and interact with geographic data in more meaningful ways.

The integration of digital tools like Educreation and Piktochart in secondary school geography education is aligned with modern pedagogical trends that emphasize the importance of active

learning and student-centered approaches. Traditional geography instruction often relies on textbook-based learning and static maps, which can limit students' engagement and understanding of abstract spatial concepts (Latif, 2024). However, by incorporating interactive and visual tools, students are able to see real-time demonstrations of geographic phenomena, engage in self-paced learning, and create their own visual representations of data, thus enhancing their grasp of complex topics such as climate change, population distribution, and landform development.

Academic achievement and retention are critical indicators of student success in any educational context. Achievement refers to the measurable performance outcomes of students, often assessed through standardized tests, quizzes, and class activities (Chia *et al*., 2023). In the context of geography education, achievement can be seen in students' ability to analyze spatial data, apply geographic theories, and demonstrate knowledge of environmental systems.

Retention, on the other hand, refers to a student's ability to retain and recall information over time, which is crucial in subjects like geography where foundational knowledge is built upon cumulatively throughout the curriculum (Davis, 2022). The goal of using digital tools like Educreation and Piktochart is not only to enhance students' short-term achievement but also to improve their long-term retention of geographic concepts by providing them with engaging, interactive, and visually supported learning experiences.

The purpose of this review is to synthesize existing research on the impact of Educreation and Piktochart on students' achievement and retention in secondary school geography classes, with a specific focus on schools in Shiroro, Niger State, Nigeria. Numerous studies have examined the role of technology in education, but there is limited literature that focuses specifically on the impact of visual learning tools in geography education, particularly in resource-constrained settings like Shiroro. By analyzing existing studies, this review aims to provide a comprehensive understanding of how these tools affect geography students' performance and retention, highlighting both the opportunities and challenges associated with their implementation in Nigerian secondary schools (Aungst, 2023).

Theoretical Frameworks Supporting Visual Learning

Cognitive Theory of Multimedia Learning (CTML)

Mayer's **Cognitive Theory of Multimedia Learning (CTML)** provides a foundational understanding of how multimedia, including tools like Educreation and Piktochart, enhances learning outcomes by reducing cognitive load and improving retention. According to Tucker (2023), CTML is built on the premise that people learn more effectively when presented with both verbal and visual materials, as these align with the brain's dual-channel processing system. Mayer posits that humans have separate channels for processing verbal and visual information, and effective learning occurs when these channels are used optimally to avoid cognitive overload. The use of multimedia tools like Educreation supports this theory by integrating audio, text, and imagery to present geographic content in ways that engage both channels, thus maximizing understanding and retention. For instance, a geography lesson using Educreation might incorporate a narrated explanation alongside animated maps or images, helping students visualize abstract concepts such as tectonic plate movement or erosion processes.

Dual-Coding Theory

Complementary to CTML is Paivio's Dual-Coding Theory (DCT), which further supports the idea that learning is enhanced when information is processed through both verbal and visual channels. Paivio argued that the brain stores and processes information in two distinct but

interconnected systems: a verbal system for linguistic information and a non-verbal system for visual information. According to DCT, when learners are exposed to both verbal and visual stimuli simultaneously, the two systems work together to create richer cognitive connections, making it easier to recall and apply the learned information (Ahmad *et al*., 2022). In geography education, tools like Piktochart facilitate dual coding by enabling students to create and interpret infographics, maps, and charts that visually represent geographic data, while also providing verbal explanations of these visuals.

Both CTML and DCT emphasize the importance of managing cognitive load in educational settings, particularly when dealing with complex or abstract concepts. In geography, students are often required to understand multi-dimensional data, such as population distribution, landforms, or climate patterns, which can be cognitively demanding. Tools like Educreation and Piktochart help to reduce cognitive load by presenting information in a structured and visually supported manner, allowing students to process it more easily. Mayer's CTML, in particular, highlights the concept of extraneous cognitive load, which occurs when information is presented in a way that is confusing or overwhelming (Mitayo & Nakanitanon, 2021). By using multimedia tools that streamline information presentation, educators can minimize extraneous load, allowing students to focus more on essential learning processes.

In summary, both Mayer's Cognitive Theory of Multimedia Learning and Paivio's Dual-Coding Theory provide strong theoretical support for the use of digital tools like Educreation and Piktochart in geography education. These frameworks explain how multimedia and visual learning reduce cognitive load, enhance understanding, and improve both achievement and retention.

Impact of Educreation on Geography Learning

Educreation is an interactive digital whiteboard platform designed to enhance learning by integrating multimedia into classroom teaching. The platform allows educators to create visually dynamic lessons using a combination of text, audio, and visuals, which can be accessed by students both during and after class. Educreation is particularly useful in subjects like geography, where spatial understanding and visual representations are crucial for learning complex concepts such as landforms, climate systems, and human-environment interactions. By utilizing Educreation, teachers can create interactive maps, animations, and charts that help students visualize geographic processes in real-time. The platform's recording feature also enables teachers to provide voice-over explanations while they manipulate visual elements, offering students a more immersive learning experience. This feature is particularly effective in reinforcing the link between geographic theories and real-world applications (Bicen & Beheshti, 2021).

The interactive nature of Educreation makes it a valuable tool for promoting student engagement, as it enables learners to actively participate in lessons by interacting with the whiteboard, asking questions, and accessing recorded sessions for review. Geography, being a subject that relies heavily on visualization, benefits significantly from the integration of this platform. It supports the development of students' spatial thinking, as they can manipulate maps and diagrams, helping them better understand spatial relationships and geographic patterns. Moreover, the ability to revisit lessons outside the classroom contributes to greater flexibility in learning, allowing students to engage with the material at their own pace (Roehrich & Grabanski, 2023).

Research on Educreation and Achievement

Several studies have explored the impact of Educreation on student achievement, particularly in geography and related fields. A study by Singh *et al*. (2022) found that students who used Educreation in geography classes performed significantly better in their final exams compared to those taught through traditional methods. The study attributed this improvement to the platform's ability to break down complex information into manageable, visually-supported segments, making it easier for students to understand and apply key concepts. Educreation's integration of visual aids, such as animated maps and graphs, was particularly noted for helping students grasp abstract geographic ideas, such as topographical variations and the movement of tectonic plates.

In a similar study Latif (2024) found that Educreation improved students' understanding of both physical and human geography. The study revealed that students who were taught using Educreation scored higher on assessments that required the interpretation of geographic data, such as population distribution maps and climate charts. The researchers noted that the platform's interactive nature encouraged students to actively engage with the material, resulting in better comprehension and higher academic achievement. This is consistent with the broader literature on multimedia learning, which suggests that digital tools that incorporate both visual and auditory elements can enhance students' cognitive processing and improve their overall academic performance (Parveen & Husain, 2021).

Research on Educreation and Retention

Educreation also plays a significant role in enhancing the long-term retention of information, particularly in subjects like geography that rely heavily on visual learning. According to Paivio's Dual-Coding Theory, information is more likely to be retained when it is presented through both visual and verbal channels, as the brain encodes the material in multiple ways, making it easier to retrieve later. Educreation supports this dual-coding process by allowing teachers to present geographic information using a combination of visual aids and spoken explanations. For instance, a lesson on river systems may include a dynamic visual representation of a river's flow, accompanied by an audio explanation of how erosion and deposition occur. This multi-sensory approach helps students form stronger mental connections, leading to better retention of the material (Davis, 2022).

Research on Educreation's impact on retention supports these theoretical claims. In a study conducted by Pettit *et al*. (2023), students who were taught using Educreation showed significantly higher retention rates compared to those taught through traditional lecture methods. The study found that students who had access to Educreation's recorded lessons were able to revisit complex geographic concepts, such as climate change and land use patterns, which contributed to their ability to recall information during exams. The ability to pause, replay, and review lessons at their own pace was highlighted as a key factor in enhancing long-term retention. This suggests that Educreation not only improves immediate academic performance but also supports sustained learning over time.

Impact of Piktochart on Geography Learning

Piktochart is a web-based tool designed to help users create visually appealing infographics, presentations, and reports. The platform is widely used in educational settings to simplify complex information through the use of visual elements such as charts, maps, icons, and images. In geography education, Piktochart plays a critical role in supporting visual learning by enabling students and teachers to present geographic data and concepts in a clear, concise, and engaging manner. The tool allows students to transform raw data into visually enriched

infographics, making abstract geographic concepts more tangible. This is particularly beneficial in geography, where spatial analysis and the presentation of data through maps and charts are central to understanding topics like population growth, resource distribution, and environmental patterns (Aungst, 2023).

Through its user-friendly interface, Piktochart provides an accessible platform for both educators and students to visualize geographic information effectively. Teachers can use the tool to create infographics that summarize geographic theories, while students can employ it to present project work and assignments in visually captivating formats. The ability to customize graphics according to the lesson's needs ensures that Piktochart remains adaptable to various geographic topics, whether it involves the presentation of demographic data or the illustration of geographic phenomena like erosion or climate change (Chia *et al*., 2023). Thus, Piktochart supports the development of critical thinking and data literacy among geography students, key skills in interpreting and analyzing geographic data.

Comparative Impact of Educreation and Piktochart

Visual Learning Tools in Comparison

Educreation and Piktochart, while both digital tools that enhance visual learning, offer distinct educational benefits. Educreation is primarily an interactive whiteboard application that allows teachers and students to create multimedia presentations and tutorials that integrate drawings, audio, and visual elements. This versatility allows for dynamic lesson delivery and real-time interaction in the classroom, supporting immediate feedback and personalized learning experiences (Ahmad *et al*., 2022). On the other hand, Piktochart is a platform specifically designed for creating infographics, emphasizing the visual presentation of information through charts, icons, and data visualizations. Piktochart excels in organizing complex data into a format that is easy to interpret, making it particularly suitable for summarizing and presenting geographical statistics (Davis, 2022).

In terms of their strengths, Educreation's primary advantage lies in its interactive nature. It enables students to actively engage with the material, making it a suitable tool for collaborative learning and for tasks that require ongoing feedback, such as map drawing and fieldwork annotations (Pettit *et al*., 2023). Conversely, Piktochart is particularly strong in its ability to simplify and visualize abstract concepts, which aids in the presentation and understanding of spatial data, environmental patterns, and demographic distributions in geography (Parveen & Husain, 2021). However, Educreation may require more technological infrastructure, such as interactive whiteboards, to fully utilize its features, while Piktochart's web-based nature makes it more accessible but less interactive.

Effectiveness in Different Learning Scenarios

Educreation and Piktochart serve different functions in learning, with their effectiveness varying depending on the learning scenario and the students' needs. For visual learners, both tools offer substantial benefits, but Piktochart may provide a more focused and polished method for processing information visually, particularly for summarizing large amounts of data. The tool's ability to integrate charts, icons, and geographical maps enables visual learners to understand concepts such as population density, climate zones, and resource distribution at a glance, which significantly enhances retention (Tucker, 2022). Educreation, with its interactive features, supports both visual and kinesthetic learners by allowing them to engage physically with the learning material. This makes it an ideal tool for students who benefit from tactile engagement, such as those involved in drawing maps or performing simulations of geographic phenomena like erosion or river formation.

Studies show that kinesthetic learners, who learn best through hands-on activities, perform better when using interactive tools like Educreation. The ability to manipulate images, add annotations, and engage in real-time feedback loops with teachers helps to reinforce geographic concepts in a way that passive learning methods cannot (Davis, 2022). However, Piktochart's strength in organizing data and presenting it in a visually attractive format makes it particularly effective for projects and assessments that require summarizing information, such as environmental case studies or demographic analysis, catering well to both visual learners and students who excel in structured learning environments.

Conclusion and Future Directions

In summarizing the impact of Educreation and Piktochart on student achievement and retention in geography education, it is evident that both digital tools significantly enhance learning outcomes. Educreation facilitates interactive learning experiences through its multimedia features, allowing students to engage actively with geographical concepts, which promotes better retention of information . Similarly, Piktochart's ability to create visually appealing infographics aids in simplifying complex information, making it more accessible to students, thus fostering improved academic performance (Bada & Olabisi, 2020). Overall, both tools have demonstrated their effectiveness in promoting visual learning, suggesting that their integration into geography curricula can lead to higher achievement and better retention among secondary school students in Niger State, Nigeria.

Despite the promising findings, gaps in the literature remain, particularly concerning the implementation of these tools in various educational contexts. Most existing studies focus on broader educational settings without delving deeply into the specific challenges faced in Nigerian secondary schools. Future research should aim to investigate the long-term effects of Educreation and Piktochart on student outcomes across diverse geographical regions within Nigeria, as well as the potential for comparison with other visual learning tools. Additionally, qualitative studies exploring student and teacher experiences with these digital platforms could provide valuable insights into their practical application and effectiveness in enhancing geography education.

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DIGITAL TECHNOLOGY USE AND EMPLOYEES' PRODUCTIVITY AMONG LIBRARIANS IN PRIVATE UNIVERSITIES IN OSUN STATE

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Abstract
Digital technologies offer various opportunities which can be essential to the achievement of any organization that embraces its use. Similarly, digital technologies such as computers, internet and smart phones have brought great changes to all spheres of human endeavours. The use of digital technology for library and information service delivery has undergone various levels of development. An automated cataloguing, circulation and acquisition systems has led to better management of library operations and improved services. Today, ICT is providing libraries with powerful new tools to meet their patrons' information needs beyond their traditional printed materials. The explosive growth of ICT and use in libraries have had impact on librarians and raise serious questions on how they need to adapt to new tasks and activities in a globally interconnected world. The objectives of the study are, impact of digital technology in employee productivity, challenges facing the digital technology. Descriptive survey research design was adopted for this study. Total enumerative sampling technique was used to select respondents from the population. Findings show that, impacts of digital technology in employee productivity in library are answering users query, cataloguing and classification, referral services, discharging and charging of library materials to the users, challenges faced by librarian in using digital technology in the library are epileptic power supply, slow internet network, inadequate finance, compatibility of hardware and software, library lacks the necessary equipment to implement ICTs in libraries. The study therefore recommends, university management should endeavour to provide stable internet facility in order to improve the use of digital technology by librarians for more effective productivity.

Keywords*:* Digital technology, Impact, Employee, Productivity, Librarian

Background to the Study
Application of modern digital technology in the academic libraries is providing the library professional with new opportunities to improve their sources and services. Information is now published both electronically and by print making it accessible to users according to their demands. It is important to access the digital technology applications in library and information centre in the context of changing user needs. Digital technologies offer various opportunities which can be essential to the achievement of any organization that embraces its use. Similarly, digital technologies such as computers, internet and smart phones have brought great changes to all spheres of human endeavours. For instance, the use of digital technologies enhances speedy communication and feedback process.

Digital technology definition includes all electronic tools, automatic systems, technological devices and resources that generate process or store information. The difference between analogue and digital technology is that in analogue technology, data is converted into electric rhythms of multiple amplitudes, while in digital technology; information is converted into the binary system, i.e. zero or one, where every bit is the symbol of two amplitudes. Every aspect

of library services has been altered by digital technologies. According to the United Nations (2021), digital technologies are technologies for managing, processing or communicating information; which include the Internet, wireless networks, smart phones, computers, software etc. Digital technologies, also known as information and communication technology (ICT) are electronic digital devices that are used for creating, manipulating, storage and retrieval of information. Okon (2015) observes that digital technology development have created a shift from traditional information environment to an e-environment such as CD-ROMs, online services, as well as online database. It has established a new service environment that has pushed traditional boundaries even further, allowing for more effective information work and service delivery (Sani & Musa, 2019). Academic libraries needed to shift their focus from traditional activities like collecting, processing, storing, and accessing information to customer-centred automated information services generated by online/offline databases, e-resources, e-journals, networks, and consortia to survive in this new service environment. Computers and other digital devices are now employed to handle numerous housekeeping activities such as acquisition, cataloguing, circulation, and serials control, as well as to provide various services to library patrons. With these advancements, librarians are required to have a working knowledge of computers and Internet skills, making them digital literates who can efficiently provide information resources to their consumers (Agim & Azolo, 2019).

The use of digital technology for library and information service delivery has undergone various levels of development. An automated cataloguing, circulation and acquisition systems has led to better management of library operations and improved services. Today, ICT is providing libraries with powerful new tools to meet their patrons' information needs beyond their traditional printed materials. With internet connectivity, university libraries can reach beyond their walls to provide patrons with resources available in their libraries. Social media as typified in library 2.0 model are increasingly becoming part of libraries and they are tools for enhancing library services and resources (Tiemo & Edewor, 2011). Many libraries are effectively using twitter to communicate services like opening times, new arrivals etc, while others have developed applications that enable users to search catalogs from within Facebook (Baro & Asaba, 2010). There is no doubt that the application of ICTs have provided one of the best innovations in the history of libraries and it is changing the shape of libraries and role of librarians at an unprecedented shape (Lewis, 2017). As technology evolves fast and continuously, the users' information needs change and have more expectations from librarians. Librarians need to continuously update their technological skills in parallel with the technological changes that occur. Academic libraries need to adjust to the evolution of technology. Librarians need to accept their new roles and duties and be able to respond to these changes by learning how to use the new digital technologies effectively. In order to respond to an environment that changes continuously they need to be educated so as to acquire the adequate technology skills. Academic librarians should have the adequate skills to manage, organize and provide services to the students. Nowadays, librarians have to work with both printed and digital material. Librarians after having learnt and having acquired digital skills are ready to provide their services and assist the library users to meet their goals. Additionally, librarians apart from the technical skills it is important to have other skills such as managerial skills, teaching, consulting and so on. We could say that academic librarians of the 21st century have various roles as they combine the traditional skills with the technology skills. Having worked as academic librarians in the past, we have in our mind that librarians should provide the best services and satisfy users. In order to provide the best digital library services to users, librarians need to be trained to the new technological changes.

Librarians in academic libraries work in an ever changing technological environment. As noted by Al-Qallaf (2016) "today, librarians provide access to eclectic e-collections, create and maintain digital content, support e-learning, provide real time e-reference, negotiate contracts and licensing agreements and struggle with the economics of electronic information". Thus, the explosive growth of ICT and use in libraries have had impact on librarians and raise serious questions on how they need to adapt to new tasks and activities in a globally interconnected world. It is thus paramount for university libraries to address associated issues related to the use of ICT in work processes, operations and services; such as librarians reaction to technological changes; their perceptions, beliefs and opinions regarding the implications of technology in libraries and the ability to cope with new technologies in a healthy manner.

The performance of librarians can impact the growth and success of university libraries. As a result, job performance has become a key indicator in determining an organization's likelihood of success or failure. Job performance simply refers to an employee's capacity to perform effectively in agreement with the job requirements to achieve the organization's goals and objectives. Job performance is defined by Igbinovia & Popoola (2016) as a set of workers' behaviours that can be observed, quantified, and assessed, and the behaviors must align with the organization's goals. Job performance is also influenced by a combination of qualitative traits, such as an individual's abilities, competencies, motivation, and dedication. Personal discipline, communication skills, organizational training, and individual self-development are some of the other abilities required. As a result, digital literacy, or working knowledge of computers and the Internet, is required of 21st century librarians to improve job performance. Digital technologies improve work performance, productivity, accuracy, and space efficiency in library services (Satpathy & Mahanan, 2011; Bilal, 2011).

The importance of digital technology in marketing is that you can simply record and analyse the execution and result of your campaigns. This is because when digital marketers spend their time and money in making effective campaigns, they want to see the successful outcomes of those campaigns. It makes it simple for them to record their campaigns, which enables them to become accustomed and determines improved outcomes.

The impact of digital technology and connectivity, robotics, stabilized production and digital reality: the connection of these hi-tech inventions develops a cyber-physical surrounding that causes in the comprehensive reconsideration of the way that resources and manufacturing methods of work. The impact of digital technologies will be in any industry in the period of the digital revolution and virtual era, capable of creating more quickly, effectively, efficiently, safely, and accurately. The three main impacts of digital technology on the industrial world include the improved performance or productivity and flexibility, huge reorganization of supply chain and mass customization. Within the last few decades, the impacts of digital life have changed significantly. It is barely possible to imagine what daily life would look like without all those used gadgets. A big proportion of people are doing their work mainly on a computer, everyone is checking their mobile phones a lot of times every day. Online activities can affect truth and trust of people, through conversations on Facebook, etc. Moreover, the well-being of individuals can be influenced, physically as well as emotionally. The impact of digital life on society brings exceptional benefits in many different fields. The healthcare industry benefits, whether it comes to the control of a pregnancy or the access to information. Along with such benefits are negative impacts in a different way. Digital life can affect relationships, working environment and studying.

Employee productivity (sometimes referred to as workforce productivity) is an assessment of the efficiency of a worker or group of workers. Productivity may be evaluated in terms of the output of an employee in a specific period of time. The capacity for collaboration has always been important for productivity. In the early days of the corporate network, email and video conferencing provided productivity gains and lowered costs. Newer mobile collaboration tools make it much easier for geographically dispersed employees to work together. Tablets, smart phones and laptops let users connect with colleagues anywhere, at any time.

According to proponents, the BYOD (bring your own device) trend makes employees more productive because employees are working on devices that they own and are used to, they're likely to use them more often. The devices are mobile by definition, so whether an employee is taking notes in a meeting, reviewing documents during a commute or preparing the next day's agenda while watching television, he can accomplish more in a way that doesn't impact his personal time as significantly as it would if he had to work from a desktop computer.

Simultaneously, however, constant connectivity and the rise of social networking have made it easier and more tempting for employees to waste time on the job. To prevent online time-wasting (sometimes called cyber slacking), some organizations monitor employees or limit the sites they can access from the corporate network. Therefore, the study will look into the use of digital technology and employee productivity among the librarians in Adeleke university library, Ede Osun State.

Statement of the Problem

The advent of digital technologies in libraries and information centers was aided by the presence of digital skills. Due to the influx of electronic information resources, the globe has become a global village where the use of various digital technologies has become known. As a result, librarians must be knowledgeable on how to use this technology. It has been recognized that technological advancements can boost income opportunities for everyone, including librarians and users.

However, digital literacy among librarians in Nigerian university libraries is relatively poor. Most librarians lack computer skills, are unable to access their electronic mail, and are unable to acquire the skills required to automate their libraries due to a shortage of manpower. Without ICT skills, library staff will be unable to perform optimally in a changing work environment and may become obsolete in the system (Abbas, 2014). As a result, for effective library service delivery in the twenty-first century, library workers must learn and regularly enhance their digital literacy abilities. As a result, this study looked at the digital technology use and employee productivity among librarians' private Universities in Osun state.

Reviewed Literature

Digital Technologies are used for accessing, processing, gathering, manipulating and presenting or communicating information. The application of modern digital Technology in the academic libraries is providing the library professional with new opportunities to improve their sources and services. Information is now published both electronically and by print making it accessible to users according to their demands. It is important to access the Digital technology applications in library and information centre in the context of changing user needs. Digital technologies offer various opportunities which can be essential to the achievement of any organization that embraces its use. Similarly, digital technologies such as computers, the Internet and smart phones have brought great changes to all spheres of human endeavors. For instance, the use of digital technologies enhances speedy communication and feedback process.

Furthermore, using digital technology for administrative job performance will enhance productivity. This translates that for productivity to be achieved, employees need to work with tools and skills that can optimize their performance.(Maliki. T.O, 2021). Digital technology can be described as combinations of systems and processes that use digital signals. According to the United Nations (2021), digital technologies are technologies for managing, processing or communicating information; which include the Internet, wireless networks, smart phones, computers, software etc. Digital technologies, also known as information and communication technology (ICT) are electronic digital devices that are used for creating, manipulating, storage and retrieval of information.

Okon (2015) observes that digital technology development have created a shift from traditional information environment to an e-environment such as CD-ROMs, online services, as well as online database. Bandwidth, according to Alhasan and Adepoju (2014), is the amount of data that a computer network can transfer in a certain amount of time. Omekwe and Echezona (2016) noted that the north-south digital divide is proportionately skewed against Africa, thereby making information global access faster, broader and diverse in the Europe and America than in Africa. Kamba (2015) discovered the problem of IT especially internet use in Nigeria libraries to include inadequate and poor information infrastructure. Krubu and Osawaru's (2011) findings identified ICT resources and the use of the resources available at John Harris and Benson Idahosa University libraries as search engine, internet, CD-Rom, Online database, and World Wide Web. These resources are used to acquire, store, process, retrieve, and disseminate information. ICT has made it possible for Nigerian academic libraries to use the internet for search engines such as Yahoo, Google, e-mail etc and to access online digital resources such as Amazon, Wikipedia etc. According to Yerkey and Jorgensin (2016), "digital libraries are electronic libraries in which large numbers of geographically distributed users can access the contents of large and diverse repositories of electronic objects-networked texts, images, maps, sounds, videos, catalogues of merchandise, scientific, business and government data sets". As an in thing now, digital technology in libraries poses some challenges to libraries and librarians. With unique characteristics, it ushered in information glut that calls for new skills in information creation and management. This demand by the technology is a very overwhelming task that equally calls for new and critical ways of moving librarians forward. It is a massive task that no one can hope to carry through without the full co-operation and enthusiasm of librarians at all levels, especially in academic libraries, where the rapidity and the quick succession in which new technologies and learning emerged cast.

Use of Digital Technology among Librarians in Academic Environment

Digital technology has greatly enhanced library and information service delivery. That technology has undergone various level of development is an understatement. Today, the library goal of providing information services and access to information resources is greatly improved by the use of information communication technology (ICT) Information Communication Technology (ICT) is a term used to describe the various technologies that are used in the processing of information including coding, creation, storage, retrieval, manipulation, dissemination and transmission (Zulu, 2011). Grace, Kenny and Qiang (2004) described ICT as tools that facilitate the production, transmission and processing of information. In a broader context, ICT encompasses array of networks, hardware and applications of communication and information creation, management, processing, storage and dissemination.

The use of digital technology for library and information service delivery has undergone various levels of development. An automated cataloguing, circulation and acquisition systems

has led to better management of library operations and improved services. Today, ICT is providing libraries with powerful new tools to meet their patrons' information needs beyond their traditional printed materials. With internet connectivity, university libraries can reach beyond their walls to provide patrons with resources available in their libraries. Social media as typified in library 2.0 model are increasingly becoming part of libraries and they are tools for enhancing library services and resources (Tiemo& Edewor, 2011). Many libraries are effectively using twitter to communicate services like opening times, new arrivals etc, while others have developed applications that enable users to search catalogs from within facebook (Baro & Asaba, 2010). There is no doubt that the application of ICTs have provided one of the best innovations in the history of libraries and it is changing the shape of libraries and role of librarians at an unprecedented shape (Lewis, 2017). Librarians in academic libraries work in an ever changing technological environment. As noted by Al-Qallaf (2016) "today, librarians provide access to eclectic e-collections, create and maintain digital content, support e-learning, provide real time e-reference, negotiate contracts and licensing agreements and struggle with the economics of electronic information". Thus, the explosive growth of ICT and use in libraries have had impact on librarians and raise serious questions on how they need to adapt to new tasks and activities in a globally interconnected world. It is thus paramount for university libraries to address associated issues related to the use of ICT in work processes, operations and services; such as librarians reaction to technological changes; their perceptions, beliefs and opinions regarding the implications of technology in libraries and the ability to cope with new technologies in a healthy manner.

Anyaoku (2012), librarianship as a profession should evolve in tandem with advances in information technology in terms of learning ICT skills for excellent job performance. In this digital era, librarians are expected to be adept at using computers, networking, and the Internet in the delivery of library services using digital technologies, according to Ezeama et al. (2014). Academic librarians' capacity to employ digital technology in the twenty-first century is heavily reliant on their ability to have the necessary abilities. However, the digital literacy skills and competencies of librarians in Nigeria in the use of digital technologies in providing library services have been noticed to be very low (Abdurrahman et al., 2018, Agim & Azolo, 2019).

Objectives of the Study

The objective of the research study is to examine the digital technology use and employee productivity among librarians at private Universities in Osun state. The specific objectives are to:

1. To examine the impact of digital technology in employee productivity in private University;
2. To investigate the available digital technology in private University library;
3. To examine the use of digital technology by librarian in private University library;
4. To identify the challenges facing the digital technology in private University library;

Research Questions

The following research questions will help in achieving the objectives of the study,

1. What are the impacts of digital technology in employee productivity in private University library?
2. What are the available digital technologies in private University library?
3. How does librarian make use of digital technology in private University library?
4. What are the challenges faced by digital technology in private university library?

Methodology

Area of the Study

Adeleke University is a private faith-based learning institution located in a serene and nature friendly atmosphere of 520 acres of land in the historic town of Ede, Osun State, South-Western part of Nigeria. The University was founded in 2011 by Dr. Adedeji Adeleke, through the Springtime Development Foundation (SDF), a philanthropic, non- profit making organization established to assist indigent students to benefit from quality higher education.

Descriptive survey research design was adopted for this study. This was appropriate because it made it easier to research a substantial number of the study population.

The population of this study comprises of eight (7) library professionals and (15) Non-professionals of Adeleke University Ede.

Staff Category	Number of Library staff	Percentages
Professional Librarian	7	31.9%
Non-professional	15	68.1%
Total	**22**	**100%**

Source: (Field Survey 2022)

Total enumeration sampling method was used to capture the entire library staff in Adeleke University library due to its small population. This method affords every individual in the population equal opportunity of chance to participate in the study, 22 library staff will be used for this study.

A self-structured questionnaire was used as an instrument in gathering data from respondents. The questionnaire comprised two (2) sections. Section A comprised demographic information of the respondents such as gender, age, status, experience while section B comprised relevant question relating to digital technology use and employee productivity among librarians at Adeleke University library, Ede in Osun State.

Analysis/Findings/Discussion

Research Question 1: What are the impacts of digital technology in employee productivity in Adeleke University library?

Impacts	SA	A	D	SD
Digital technologies assist librarians in answering users query	20(83.3%)	-	2(8.3%)	-
Digital technologies assist librarians in cataloguing and classification	19(79.2%)	-	3(12.5%)	-
Digital technologies assist librarians in referral services	7(29.2%)	14(58.3%)	1(4.2%)	2(8.3%)
Digital technologies assist librarians in discharging and charging of library materials	15(62.5%)	3(12.5%)	6(25%)	-
Digital technologies assist me in using e-resources of the library	8(33.3%)	14(58.3%)	2(8.3%)	-
Digital technologies help me to compete with my other colleagues in the profession	2(8.3%)	17(70.8%)	5(20.8%)	-
It change my attitude towards ICTs phobia	-	4(16.7%)	10(41.7%)	10(41.7%)
It reduce work stress	-	6(25%)	9(37.5%)	9(37.5%)
It avoid duplication errors	1(4.2%)	4(16.7%)	10(41.7%)	9(37.5%)

Sources: Field survey 2023

The table above shows, impacts of digital technology in employee productivity out of 22 respondent, 20 respondents representing 91.6% agree that digital technologies assist librarians in answering users query, 2 respondents representing 8.3% not agree that digital technologies assist librarians in answering users query, 20 respondents representing 87.5% agree that digital technologies assist librarians in cataloguing and classification, 3 respondents representing 12.5% not agree that digital technologies assist librarians in cataloguing and classification, 20 respondents representing 87.5% agree that digital technologies assist librarians in referral services, 3 respondents representing 12.5% not agree that digital technologies assist librarians in referral services, 19 respondents representing 87.5% agree that digital technologies assist librarians in discharging and charging of library materials, 3 respondents representing 12.5% not agree that digital technologies assist librarians in discharging and charging of library materials.

Research Question 2: What are the available digital technologies in Adeleke University library?

Available	SA	A	D	SD
Computer system	20(95.8%)	-	2(4.2%)	-
Digital projector	20(95.8%)	-	2(8.3%)	-
Scanner	19(87.5%)	-	3(12.5%)	-
Internet	18(83.3%)	-	4(16.7%)	-
Printer	17(70.8%)		4(16.7%)	-
Barcode reader	17(70.8%)		4(16.7%)	-
Photocopier	16(66.7%)		6(25%)	-
Mirco reader	15(62.5%)	6(25%)	3(12.5%)	-
Fax machine	-	9(37.5%)	13(54.2%)	2(8.3%)

Sources: Field survey 2023

The table above shows, available digital technologies in Adeleke University library out of 22 respondents, 20 respondents representing 95.8% agree that computer system is available, 20 respondents representing 95.8% agree that digital projector is available, 19 respondents representing 87.5% agree that scanner is available, 18 respondents representing 83.3% agree that internet is available, 17 respondents representing 70.8% agree that internet is available, 17 respondents representing 70.3% agree that barcode reader is available, 16 respondents representing 66.7% agree that photocopier is available.

Research Question 3: How does librarian make use of digital technology in Adeleke University library?

Use	SA	A	D	SD
Registration of users	21(95.8%)	-	1(4.2%)	-
Charging and discharging of information materials	21(95.8%)	-	(4.2%)	-
Stock taking/ inventory of materials	20(91.0%)	-	2(8.3%)	-
Cataloguing and classification	19 (87.5%)	-	3(12.5%)	-
Answering users' queries	19(83.3%)	2(8.3%)	2(8.3%)	-
Resource sharing / Document delivery	17 (79.2%)	2(8.3%)	3(12.5%)	-
Selection of and acquisition of library materials	19 (79.2%)		2(8.3%)	
Sending reference requests electronically	2(16.7%)	10(41.7%)	10(41.7%)	
Serials management	2(16.7%)	10(41.7%)	10(41.7%)	
Weeding of outdated materials	6(25%)	9(37.5%)	9(37.5%)	

Sources: Field survey 2023

The table above shows, use of digital technology in Adeleke University library out of 22 respondent, 21 respondents representing 95.8% agree that digital technology assist librarian in doing registration of users, 1 respondents representing 4.2% not agree that digital technology assist librarian in doing registration of users, 21 respondents representing 95.8% agree that digital technology assist librarian in charging and discharging of information materials, 2 respondents representing 4.2% not agree that digital technology assist librarian in charging and discharging of information materials, 20 respondents representing 91.7% agree that digital technology assist librarian in stock taking/ inventory of materials, 2 respondents representing 8.3% not agree that digital technology assist librarian in stock taking/ inventory of materials, 19 respondents representing 87.5% agree that digital technology assist librarian in cataloguing and classification, 2 respondents representing 12.5% not agree that digital technology assist librarian in cataloguing and classification.

Research Question 4: What are the challenges faced by digital technology in Adeleke university library?

Challenges	**SA**	**A**	**D**	**SD**
Epileptic power supply	21(95.8%)		2(4.2%)	-
Slow internet network	21(95.8%)		2(4.2%)	-
Inadequate finance	20(91.7.%)		2(8.3%)	
Compatibility of hardware and software	19(87.5%)		3(12.5%)	-
Lack of information and communication technology skills		18(83.3%)	2(8.3%)	2(8.3%)
Inadequate search skills	-	15(62.5%)	6(25%)	3(12.5%)
Library lacks the necessary equipment to implement ICTs in libraries	19(87.5%)		-	
3(12.5%)	-	Sources: Field survey 2023		

The table above shows, challenges faced by digital technology in Adeleke university library out of 22 respondents, 21 respondents representing 95.8% agree that epileptic power supply, 21 respondents representing 95.8% agree that slow internet network ,20 respondents representing 91.7% agree that inadequate finance, 19 respondents representing 91.7% agree that compatibility of hardware and software, 19 respondents representing 91.7% agree that library lacks the necessary equipment to implement ICTs in libraries.

Discussion of Findings

The finding shows that, the impacts of digital technology in employee productivity in library are answering users query, cataloguing and classification, referral services, discharging and charging of library materials.

The finding shows that available tools for digital technologies in library are computer system, photocopier, printer, scanner, internet, and laminating machine. The findings line with the findings Nwabueze and Ibeh (2013) examined the extent of ICT facilities in some libraries in Anambra State, Nigeria. Findings showed that the libraries had the basic ICT facilities available such as computers, printer, scanner, memory stick, mobile phone, compact disc read only memory (CD-ROM) and photocopier.

The finding shows that, how does librarian make use of digital technology in library are registration of users, charging and discharging of information materials, stock taking/ inventory of materials, cataloguing and classification. The findings revealed that the use of digital technology has a high influence on the job productivity of employees in academic libraries. This is similar to Angioha, Enukoha, Agba and Ikhizamah (2020) and Mutuka, and Nyaribo

(2015) discovery that the use of ICT facilities influences employees productivity in selected academic libraries in Nigeria and Kenya, respectively. Such areas of high influence include enhancing knowledge sharing activities, cataloguing and classification, registration of users, charging and discharging of information materials, and increase in collaboration among the librarians.

The finding shows that challenges faced by librarian in using digital technology in the library are epileptic power supply, slow internet network, inadequate finance, compatibility of hardware and software, library lacks the necessary equipment to implement ICTs in libraries. The findings line with the findings of Emasealu (2019); Daniel, Chima and Udoaku (2015), Ossai-Ugbah (2010) and Adegbore (2010) who pointed out that inadequate power supply, fluctuating network, limited access speed, and inadequate computer systems were some of the challenges encountered in the use of automated systems for effective library services delivery. The findings of this study were also in accordance with the work of Upadhyay at al. (2012) and Nayana (2019), who reported that the challenges included insufficient funds, lack of training of library staff, lack of support by management and lack of computer facilities. Sahabi and Otobo (2021) in their study on academic libraries and challenges of service delivery in Nigerian Universities libraries in the digital era mentioned low funding, incompetence, lack of technological knowledge, low Internet Connection and insufficient energy supply as some of the challenges of providing information services in a digital society.

Conclusion

The application of modern Digital Technology in the academic libraries is providing the library professional with new opportunities to improve their sources and services. Information is now published both electronically and by print making it accessible to users according to their demands. The findings show that digital technologies assist librarians in answering users query, cataloguing and classification, referral services, discharging and charging of library materials to the users and challenges faced by librarian in using digital technology in the library are epileptic power supply, slow internet network, inadequate finance, compatibility of hardware and software, library lacks the necessary equipment to implement ICTs in libraries.

Recommendations

Based on the study, the following recommendations were made;

1. The university management should endeavor to provide stable internet facility in order to improve the use of digital technology by librarians for more effective productivity.
2. The university management should provide alternative power supply such as generators, solar system etc.
3. More ICTs facilities must provide to library. The university management should provide more funds to the library.
4. The university management should provide more funds to the library.

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META-ANALYTIC REVIEW OF STATIC AND ANIMATED VISUALIZATION INSTRUCTION ON SECONDARY SCHOOL PHYSICS STUDENTS' ACADEMIC ACHIEVEMENT, RETENTION, AND MOTIVATION

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Abstract
This meta-analytic review explores the comparative effectiveness of static and animated visualizations in enhancing academic achievement, retention, and motivation among secondary school physics students. With the increasing integration of technology in education, visualizations have emerged as crucial tools for improving understanding of complex physics concepts, which are often abstract and difficult to grasp through traditional teaching methods. The review synthesizes findings from numerous studies, revealing that both static and animated visualizations significantly impact learning outcomes, albeit in different ways. Static visualizations, such as diagrams and graphs, tend to improve retention and understanding of fundamental concepts by providing clear and concise representations. In contrast, animated visualizations engage students more effectively and foster motivation by depicting dynamic processes and interactive scenarios. The findings suggest that a balanced approach, incorporating both visualization types, can optimize instructional design in physics education, ultimately enhancing student learning experiences. Recommendations for educators are also provided, emphasizing the importance of context in selecting the appropriate visualization type.

Keywords: Static Visualizations**,** Animated Visualizations**,** Academic Achievement**,** Retention**,** Motivation and Physics Education

Introduction
The debate surrounding the effectiveness of static versus animated visualizations in educational settings, particularly in the domain of physics, is a focal point in educational research. Physics concepts are often abstract and challenging for secondary school students, necessitating innovative teaching strategies that can enhance understanding and retention. Static visualizations, such as diagrams and graphs, provide clear and concise representations of information, while animated visualizations present dynamic sequences that illustrate processes and changes over time (Ploetzner, 2024). The debate between the two visualization types centers on how well each can facilitate comprehension and learning outcomes, particularly in a subject that heavily relies on students' ability to visualize complex phenomena.

Research suggests that animated visualizations may be particularly advantageous in physics education due to their capacity to depict motion, sequences, and transformations, which are fundamental to understanding physical processes (Liebig, 2021). For instance, animations can effectively illustrate concepts such as projectile motion, wave propagation, and electromagnetic fields, making them more accessible for students. In contrast, static visualizations can be beneficial in providing a stable reference point that students can analyze at their own pace. The effectiveness of these visual tools, however, may vary depending on learners' prior knowledge, cognitive load, and the specific content being taught (Demir &

Öksüz, 2022). Thus, understanding the nuanced effects of static and animated visualizations is crucial for optimizing instructional methods in physics education.

Academic achievement, retention, and motivation are three critical learning outcomes in educational research. Academic achievement refers to the extent to which students understand and can apply physics concepts, typically measured through assessments and exams (Cao & Hsu, 2023). Retention measures how well students can recall and utilize learned information over time, which is essential for building a strong foundation in physics as concepts often build upon one another (Liebig, 2021). Motivation, meanwhile, plays a vital role in influencing students' engagement and persistence in learning, directly impacting their overall success in physics (Berney & Bétrancourt, 2023). The interplay between these outcomes underscores the importance of effective instructional strategies that can enhance understanding and foster a long-term interest in the subject.

This meta-analytic review aims to synthesize existing studies evaluating the impacts of static and animated visualizations on academic achievement, retention, and motivation among secondary school physics students. By quantitatively assessing the effectiveness of each type of visualization, this review seeks to provide a comprehensive understanding of how these instructional tools can facilitate student learning outcomes. The findings from this review will help identify best practices for educators and inform the design of physics curricula that effectively integrate visualizations into the learning process.

Static Visualizations in Physics Education

Effectiveness of Diagrams and Charts

Static visualizations, including diagrams and flowcharts, play a significant role in physics education by aiding in the comprehension of complex concepts. Research has shown that well-designed static visualizations can enhance student understanding by providing clear and organized representations of information. For instance, a study by Opfermann *et al.,* (2022) highlighted that static diagrams effectively reduce cognitive load, allowing students to focus on essential relationships between variables rather than being overwhelmed by extraneous details. This reduction in cognitive load is crucial in physics, where abstract concepts such as forces, motion, and energy often require a deep understanding of relationships that are not immediately apparent through verbal descriptions alone (Skulmowski and Xu 2022). Furthermore, static visualizations can serve as cognitive tools that facilitate schema construction, enabling students to build mental models that enhance retention of the material over time (Guo *et al.,* 2020).

In the context of achievement, research indicates that the use of static visualizations can lead to improved academic performance among physics students. For instance, a meta-analysis by Liebig (2021) found that students exposed to diagrammatic representations in physics achieved better results compared to those who received traditional text-based instruction. This finding is consistent with the dual-coding theory, which posits that information presented in both verbal and visual formats is more likely to be retained and recalled (Mertens *et al.,* 2022). By leveraging static visualizations, educators can enhance students' comprehension and facilitate their ability to apply theoretical concepts in practical scenarios, thereby improving overall achievement in physics.

Motivation through Static Visuals

Beyond their cognitive benefits, static visualizations can also positively influence students' motivation to learn physics. Research has indicated that students often exhibit a preference for

static visuals over animated content, as static representations allow for more control over the pace of information processing (Farrokhnia *et al.,* 2020). This preference is particularly relevant in physics education, where students may find it beneficial to take their time analyzing diagrams or flowcharts before moving on to more complex ideas. A study by Ayu Made Yeni Lestari *et al.,* (2024) reported that students felt more engaged and motivated when working with static visualizations because these tools enabled them to actively interact with the content at their own pace. This autonomy fosters a sense of ownership over the learning process, which can enhance intrinsic motivation and lead to more meaningful learning experiences.

Additionally, the aesthetic qualities of static visualizations can contribute to increased motivation. Well-designed diagrams that incorporate visual appeal and clarity can capture students' interest and stimulate curiosity about the subject matter. As noted by Ayu Made Yeni Lestari *et al.,* (2024), visually appealing content can lead to enhanced motivation and engagement, which are critical factors in promoting persistence in challenging subjects like physics. By integrating static visualizations that are not only informative but also visually stimulating, educators can create a more inviting learning environment that encourages students to explore and deepen their understanding of physics concepts.

Animated Visualizations in Physics Education

Simulations and Dynamic Visualizations

Animated visualizations, encompassing simulations and animations, have become pivotal in the teaching and learning of physics concepts. These tools offer dynamic representations of physical phenomena, allowing students to visualize abstract concepts that are often challenging to grasp through static images alone. For example, animations can illustrate the motion of objects under various forces, demonstrating principles like inertia, acceleration, and the laws of motion in real-time (Cao & Hsu, 2023). Simulations, such as those found in PhET Interactive Simulations, enable learners to manipulate variables and observe outcomes, fostering a deeper understanding of cause-and-effect relationships in physics (Höffler and Leutner 2023). By engaging students with interactive and visually rich content, animated visualizations support the development of mental models, making complex topics more accessible and relatable.

Research on Achievement and Retention

Research consistently indicates that animated visualizations positively affect student achievement and retention in physics. A meta-analysis conducted by Hattie (2009) revealed that multimedia resources, particularly animated visualizations, significantly enhance learning outcomes compared to traditional teaching methods. Studies have shown that students exposed to animated representations of physical concepts score higher on assessments than those who learn through text-based materials or static visuals (Berney and Bétrancourt 2023). Furthermore, animations help improve retention by providing a more engaging learning experience that facilitates better recall of information over time. For instance, a study by Ploetzner (2024) demonstrated that students who learned through animated presentations were able to retain information longer and perform better in follow-up assessments than those who received instruction through static materials.

Motivation and Engagement

In addition to improving academic achievement and retention, animated visuals significantly impact student motivation and engagement in physics learning. Research has shown that dynamic visualizations create more immersive learning environments, which can lead to heightened interest and enthusiasm for the subject matter. For example, studies by Mertens *et al.,* (2022) have indicated that students reported higher motivation levels and a greater desire

to engage with physics concepts when learning through animations compared to traditional instructional methods. This increased motivation can be attributed to the interactive nature of animations, which often allow students to explore and experiment with concepts, fostering a sense of agency in their learning process (Skulmowski & Xu, 2022). Engaged students are more likely to persist through challenging material, ultimately leading to deeper learning and understanding of physics concepts.

Moreover, animated visualizations can cater to diverse learning styles, making physics education more inclusive. Students who may struggle with traditional learning formats often find that animated content resonates more with their individual learning preferences, thereby enhancing their engagement and overall educational experience (Farrokhnia et al., 2020). By offering a variety of visualization options, educators can address the varying needs of their students, creating a more equitable learning environment that fosters success for all learners.

Meta-Analytic Comparison

Simulations and Dynamic Visualizations

Animated visualizations, encompassing simulations and animations, have become pivotal in the teaching and learning of physics concepts. These tools offer dynamic representations of physical phenomena, allowing students to visualize abstract concepts that are often challenging to grasp through static images alone. For example, animations can illustrate the motion of objects under various forces, demonstrating principles like inertia, acceleration, and the laws of motion in real-time (Wei, 2020). Simulations, such as those found in PhET Interactive Simulations, enable learners to manipulate variables and observe outcomes, fostering a deeper understanding of cause-and-effect relationships in physics (Mertens et al., 2022). By engaging students with interactive and visually rich content, animated visualizations support the development of mental models, making complex topics more accessible and relatable.

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Conclusion

This meta-analytic review synthesizes findings on the effectiveness of static versus animated visualizations in physics education, highlighting their differential impacts on academic achievement, retention, and motivation. Overall, the evidence suggests that both types of visualizations serve unique and complementary roles in enhancing learning outcomes. Static visualizations, such as diagrams and charts, have been shown to effectively improve retention and understanding of foundational concepts through clear and focused representations. In contrast, animated visualizations are particularly beneficial for illustrating dynamic processes and complex interactions, significantly enhancing student engagement and motivation, especially when concepts are abstract Thus, neither visualization type can be deemed universally superior; rather, their effectiveness is contingent upon the specific learning objectives and the content being taught.

The implications of these findings for instructional design in physics education are substantial. Educators are encouraged to adopt a balanced approach that integrates both static and animated visualizations, tailoring their use based on the instructional context and the needs of diverse learners. For instance, static visuals may be employed during the introduction of new concepts to establish a solid foundation, while animations can be leveraged to deepen understanding through dynamic representations as students progress. By strategically combining these visualization modalities, educators can create a more enriching learning environment that optimally supports students' cognitive processes, enhances retention, and fosters greater motivation to engage with physics content.

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ENHANCING TEXTILE MANUFACTURING SYSTEM RELIABILITY, AVAILABILITY, MAINTAINABILITY AND DEPENDABILITY

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Abstract
This study aimed to increase textile manufacturing system dependability, reliability, maintainability, availability, and metrics like MTBF and MTTF by boosting RAMD. The textile system under investigation is a serial system consisting of five subsystems, which are; subsystem A is weaving section, subsystem B is the dry clean section, subsystem C is the cross cut section, subsystem D is the side seam section and subsystem E is the cleaning section. Each of the subsystem consist of main unit, warm standby unit and cold standby unit. For design and prediction, the Markovian birth-death method is employed to assemble the system governing the differential difference equation from the state-to-state transition diagram. The rates of repair and failure of each subsystem are exponentially distributed and statistically independent. For several subsystems of the system, the findings for RAMD, all of which are crucial to system performance, have been acquired and shown in figures and tables. Furthermore, the results of this study reveal that the highest system performance and dependability may be achieved when the overall system failure rate is low. The findings of this research are thought to be valuable for analyzing performance and determining the best system design and feasible maintenance strategies that may be used in the future to improve system performance, strength, effectiveness, production output as well as revenue mobilization.

Keywords: Availability; Exponential, Lindley; Exponentiated Weibull; Reliability; Textile

Introduction

RAMD is a logistical technique for assessing the strength, effectiveness, and performance of equipment at various levels. It ensures system safety and operation problems and identifies which of the system's units, components, or subsystems require adequate maintenance. RAMD (reliability, availability, maintainability, and dependability) management is critical to a company's success. These four measures of system strength, effectiveness, and performance can be used to forecast system speed, product quality, and volume production output.

Researchers have used a variety of approaches to assess reliability measures in the literature. RAMD analysis was used by Aggarwal et al. [1] to generate a mathematical model for assessing the effectiveness of serial mechanisms in a sugar plant's refining system. Aggarwal et al. [2] proposed a reliability and availability assessment of the skim industry powder business. Models for measuring the operational performance of serial units in sugar producing plants were developed by Aggarwal et al. [1]. The Markovian process is used to evaluate measures such as maintainability, reliability, dependability, and availability in determining its capability and reliability. Aggarwal et al. [2] estimate system strength parameters such as maintainability, reliability, dependability, and availability by examining the skim powder industry's reliability. Kumar et al. [21] concentrate on increasing the profit of engineering systems with serial subsystems by improving system performance indicators like availability and reliability. Corvaro et al. [4] investigate the reciprocating unit's system availability, maintainability, and dependability in the oil and gas industries in order to improve the unit's operating performance.

Garg [8] uses particle swamp optimization and fuzzy techniques to assess industrial reliability, maintainability, and availability. Velmurugan et al. [30] investigated the efficiency of the forming industry by assessing system maintainability, dependability, and availability. Jagtap et al. [11] developed Markov models for RAM performance estimation of circulation system of water. Jakkula [12] discuss the RAM evaluation of Load Haul Dumpers.

Table 1: Some related research on availability, maintainability, reliability and dependability of some complex systems

Reference	System	Standby used	Exponential distribution	Lindley distribution	Exponentiated Weibull	Reliability	Availability	Maintainability	Dependability
Goyal et al. [9]	Sewage treatment plant	N/A	yes	no	no	yes	yes	yes	yes
Danjuma et al. [6]	Series-parallel	Cold	yes	no	no	yes	yes	yes	yes
Choudhary et al.[3]	Cement	Cold	yes	no	no	yes	yes	yes	no
Gupta et al. [10]	Steam turbine power plant	N/A	yes	no	no	yes	yes	yes	no
Kumar et al. [19]	Water treatment plant	N/A	yes	no	no	yes	yes	yes	yes
Kumari et al. [18]	Tube-well	N/A	yes	no	no	yes	yes	yes	yes
Saini and Kumar [23]	Sugar Plant	N/A	yes	no	no	yes	yes	yes	yes
Saini et al. [24]	microprocessor	N/A	yes	no	no	yes	yes	yes	yes
Saini et al. [25]	sugar manufacturing plant	N/A	no	no	no	yes	no	yes	no
Saini et al. [26]	hot standby database systems	N/A	yes	no	no	yes	yes	yes	no
Abdullahi and Yusuf [27]	CBT	N/A	yes	no	no	yes	yes	yes	yes
Soltanali et al. [28]	Automotive manufacturing	N/A	yes	no	no	yes	yes	yes	yes
Kumari et al. [18]	power generating unit of sewage treatment plant	N/A	yes	no	no	yes	no	yes	no
Proposed study	Textile confection plant	mixed	yes	yes	yes	yes	yes	yes	yes

Available studies either neglects or overlooks the importance of warm and cold standby in strengthening system reliability, availability, mean time to failure, and MTBF. Most previous studies focused solely on system availability and effectiveness evaluation, paying little attention to the influence of warm and cold standby units on reliability, availability, mean time to failure, and generated revenue. More advanced designs with mixed standby units should indeed be established to reduce the likelihood of a complete breakdown, expenditures, overall reliability, availability, mean time to failure, and revenue generated (profit).

The aforementioned literature review presented in Table 1 above reveals that the RAMD evaluation of some industrial and manufacturing system having mixture of warm and cold

standby units when failure and repair rates as Lindley and Exponentiated Weibull distributed has not been explored so far. Motivated by the aforementioned studies in Table 1 above, the objective of this work is to perform RAMD analysis of textile system with mixed standby unit when failure rates follows Lindley and Exponentiated Weibull distribution. As a result, this study considers a textile manufacturing system that consists of five distinct subsystems equipped as a series-parallel system, each consisting of a combination of primary units, warm standby units, and cold standby units. The system's effectiveness is investigated via first order differential difference equations. Availability as one of the performance measures of system strength and effectiveness have been computed for each configuration. The present work will perform RAMD analysis of textile system with mixed standby unit when failure rates follows Lindley and Exponentiated Weibull distribution.

The following are the paper's contributions:

i. To formulated novel models of RAMD analysis of textile manufacturing system considering models; main, warm and cold standby units. Warm standby unit reduce energy use and recovery period because a standby unit is partly energized and subjected to maximum stress while the primary unit is up and running and completely powered and functional after the primary unit stops working.
ii. Developing the explicit expressions for the availability, reliability, mean time between failure, maintainability, mean time to failure and dependability for each subsystem.
iii. To see the performance of the system through ramd models under exponential, Lindley and exponentiated Weibull distributions.

The following is how this paper is structured. The framework for this study is described in Section 2. Section 3 discusses the methods and materials used. Section 4 is dedicated to the modelling approach. Section 5 presents the simulation studies and consequences discussion, and Section 6 concludes the paper.

Description of the System and Notations

Description of The System

The textile system under investigation is a serial system consisting of five subsystems, which are; weaving section, dry clean section, cross cut section, side seam section and cleaning section. Each of the subsystem consist of main unit, warm standby unit and cold standby unit as shown in Table 2. Warm standby unit are introduced in enhancing the performance of the system. Warm standby units have the capacity to reduce energy use and recovery period because a standby unit is partly energized and subjected to maximum stress while the primary unit is up and running and completely powered and functional after the primary unit stops working. When one of the primary units fails, the warm standby resumes to work with minimal service interruption. Sequel to this, system with warm or mixed standby units have gained the attention of different researchers. To cite few, Yen and Wang [31] analysed the cost benefit of warm standby retrial systems with imperfect coverage. Analysis of reliability and availability of a redundant k-out-of-n warm standby system in the presence of common cause failure has been presented in El-Ghamry et al. [7]. Evaluation of reliability and performance of power system having warm standby unit is given in Jia et al. [13]. Liu et al. [22] analysed reliability of warm standby serial system with switching mechanism and uncertain lifetimes. Tenekedjiev [29] presented reliability simulation of warm standby two component system having switching and back switching failures. Kumar et al. [15] focus on profit optimization of a warm standby non identical system in normal and abnormal environment. Kumar et al. [16] focus on economic analysis of warm standby system attended by single server. Kumar et al. [17] analysed the profit of warm standby system attended by single server with priority. Kumari and

Sharma [19] analysed the performance of warm standby machine repair problem with servers' vacation, impatient and controlling F-policy.

The system can be in perfect or initial state when new. At the failure of one of the primary unit, a warm standby unit will shift to take over the failed unit while the cold standby unit will take the position of warm standby unit. This failure is called the partial failure. When all the primary and warm standby failed, the system is down. This called complete failure.

Subsystem A (Weaving)
Any machine that weaves yarn into fabric is referred to as a weaving machine. They are used to render upholstery fabric, silk, and ornate carpets. They come in shuttle, circular, and narrow fabric options.

Subsystem B (Dry Clean): A dry cleaning machine is any sanitizing device that uses a solvent other than water to tidy clothing and textiles. Although liquid is still used in dry cleaning, clothes are submerged in a water-free liquid solvent and other detergent, which is the most commonly used solvent.

Subsystem C (Cross Cut): A cross cutter machine is an equipment that cuts both hard and soft wood.

Subsystem D (Side Seam): A seam is a method of joining a number of pieces of garment, typically with thread to form stitches. Seams can be hand-stitched or machine-stitched. A seam is a line that connects pieces of fabric and other materials in a garment.

Subsystem E (Cleaning): Cleaning is the mechanical removal of loosely bound fibers, such as brushing, sueding, or grinding. Cleaning processes that are solvent-free are workable alternatives to the traditional solvent-based regular cleaning. They reduce waste generation and remove potential risks caused by the use and application of toxic, ozone-depleting, and frequently flammable solvents. Sanding, grinding, polishing, brushing / sueding, cropping, and shearing are examples of cleaning operations.

Table 2: System Configuration

Machine/Subsystem	Primary Unit	Warm Standby Unit	Cold Standby Unit	Total
Weaving (A)	4	1	1	6
Dry Clean (B)	5	2	1	8
Cross Cut (C)	2	2	2	6
Side Seam (D)	3	2	1	6
Cleaning (E)	4	2	1	7

Notations

q : time variable

$\lambda_1 / \lambda_2 / \lambda_3 / \lambda_4 / \lambda_5$: main unit failure rate in weaving subsystem, dry clean subsystem, cross cot subsystem, side seam subsystem and cleaning subsystem.

$\alpha_1 / \alpha_2 / \alpha_3 / \alpha_4 / \alpha_5$: warm standby unit failure rate in weaving subsystem, dry clean subsystem, cross cot subsystem, side seam subsystem and cleaning subsystem.

$\mu_1 / \mu_2 / \mu_3 / \mu_4 / \mu_5$: warm standby unit failure rate in weaving subsystem, dry clean subsystem, cross cot subsystem, side seam subsystem and cleaning subsystem.

$\vartheta_k(q)$: probability that the system is in state S_k at time q.

Materials and Methods

Reliability Models

The chance that a system/machine will be up and running throughout a period of time q is defined as reliability. Thus, reliability $R(q) = P_r\{Q > q\}$, where Q is the time when the system is down and not running with $R(q) \geq 0, R(q) = 1$. (For a full description, see Ebeling (2000)). Thus,

$$R(q) = \int_q^{\infty} f(q_0)\, dq_0 \tag{1}$$

and

$$R(q) = e^{-mq} \tag{2}$$

$$R(q) = \left(\frac{1+m+mq}{1+m}\right) e^{-mq} \tag{3}$$

$$R(t) = 1 - \left(1 - e^{-(\lambda t)^{\gamma}}\right)^{\alpha} \tag{4}$$

for exponentially, Lindley and exponentiated Weibull distributed rate of failure respectively.

$$A(q) = limA(Q) = \frac{MTBF}{MTBF+MTTR}. \tag{5}$$

Maintainability

$$M(q) = P(Q \leq q) = 1 - e^{\left(\frac{-q}{MTTR}\right)} = 1 - e^{-\mu q}. \tag{6}$$

where μ is the constant system's repair rate.

Dependability

Dependability is a metric given by

$$D_{min} = 1 - \left(\frac{1}{h-1}\right)\left(e^{-log(h)/h-1} - e^{-hlog(h)/h-1}\right). \tag{7}$$

where

$$h = \frac{\mu}{\theta} = \frac{MTBF}{MTTR}. \tag{8}$$

Mean Time Between Failure

The average time between the failures is known as MTBF. It's usually expressed in hours. As the MTBF increases, so does the system's reliability. The MTBF is given by

$$MTBF = \int_0^{\infty} R(q)\, dq = \int_0^{\infty} e^{-mq}\, dq = \frac{1}{m}. \tag{9}$$

Mean Time to Repair

The reciprocal of the system repair rate is specified as MTTR given by

$$MTTR = \mu^{-1} \tag{10}$$

where μ is the system's repair rate.

Table 3: Failure and repair rate

Machine/Subsystem	Failure rate(λ) Operational Units	Failure rate(α) Warm standby Units	Repair rate (μ)
Weaving (A)	0.015	0.015	0.35
Dry Clean (B)	0.025	0.016	0.20
Cross Cut (C)	0.010	0.014	0.15
Side Seam (D)	0.035	0.017	0.40
Cleaning (E)	0.050	0.013	0.55

Formulation of Mathematical Models for Ramd

In this section, Chapman Kolmogorov differential equations for each subsystem have been constructed using the Markov birth-death process for mathematical modeling of textile manufacturing system. Table 3 displays various subsystem failure and repair rates. Table 4 below gives the description of the state of each subsystem.

RAMD Analysis for Subsystem A (Weaving unit)

This section consists of four primary operation unit (main unit), one warm standby unit and one cold standby unit. When one of the primary units failed, the warm standby unit switch to operation as primary unit and the cold standby unit switch to the position of warm standby unit. Through Table 4 below, the Chapman-Kolmogrov differential difference equations (11)-(14) are derived using Markovian birth-death process.

Table 4: Transition rate table for Subsystem A

	S_0	S_1	S_2	S_3
S_0	0	$4\lambda_1+\alpha_1$	0	0
S_1	μ_1	0	$4\lambda_1+\alpha_1$	0
S_2	0	$2\mu_1$	0	$4\lambda_1$
S_3	0	0	$3\mu_1$	0

Where S_0 is the perfect state, S_1, S_2 are partial failure states and S_3 is the complete failure state.

$$\frac{d}{dq}\vartheta_0(q) = -(4\lambda_1+\alpha_1)\vartheta_0(q) + \mu_1\vartheta_1(q) \tag{11}$$

$$\frac{d}{dq}\vartheta_1(q) = -(4\lambda_1+\alpha_1+\mu_1)\vartheta_1(q) + (4\lambda_1+\alpha_1)\vartheta_0(q) + 2\mu_1\vartheta_2(q) \tag{12}$$

$$\frac{d}{dq}\vartheta_2(q) = -(4\lambda_1+2\mu_1)\vartheta_1(q) + (4\lambda_1+\alpha_1)\vartheta_1(q) + 3\mu_1\vartheta_3(q) \tag{13}$$

$$\frac{d}{dq}\vartheta_3(q) = -3\vartheta_3(q) + 4\lambda_1\vartheta_2(q) \tag{14}$$

The normalizing condition for this problem is

$$\vartheta_0(q)+\vartheta_1(q)+\vartheta_2(q)+\vartheta_3(q)=1 \tag{15}$$

Availability of subsystem A is

$$A_{S1} = \vartheta_0(q)+\vartheta_1(q)+\vartheta_2(q) \tag{16}$$

Setting (11) to (14) to zero as $q \to \infty$ in steady state, availability of subsystem A in (16) is now

$$A_{S1}(\infty) = \frac{1+m_1+\frac{m_1^2}{2}}{1+m_1+\frac{m_1^2}{2}+\frac{2\lambda_1 m_1^2}{3\mu_1}} \tag{17}$$

Where $m_1 = \left(\frac{4\lambda_1+\alpha_1}{\mu_1}\right)$

The Corresponding reliability, maintainability, dependability and MTBF, MTTR for main and warm standby unit of subsystem A are

$$R_{S1}(q) = \exp^{-\lambda_1 q} \tag{18}$$

$$R_{S1}(q) = \exp^{-\alpha_1 q} \tag{19}$$

$$M_{S1} = 1 - \exp^{-\mu_1 q} \tag{20}$$

Mean time between failure (MTBF= $\lambda_1^{-1} = 66.6667\,h$ for main unit

Mean time between failure (MTBF)= $\alpha_1^{-1} = 66.6667\,h$ for warm standby unit

Mean time to repair (MTTR)= $\mu_1^{-1} = 2.8571h$

Dependability ratio d= $\frac{\mu_1}{\lambda_1} = 23.3345$ for main unit

Dependability ratio d= $\frac{\mu_1}{\alpha_1} = 23.3345$ for warm standby unit

$D_{\min}(s_1) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.9595$ for main and warm standby unit

RAMD Analysis for Subsystem B (Dry Clean section)

This section consist of five primary unit, two warm standby and one cold standby unit. Similar to the method described in section 4.1 above, from Table 5 the differential difference equations in (21)-(25) are derived using Markovian birth-death process.

Table 5: Transition rate table for Subsystem B

S_0	S_0	S_1	S_2	S_3	S_4
	0	$5\lambda_2 + 2\alpha_2$	0	0	0
S_1	μ_2	0	$5\lambda_2 + 2\alpha_2$	0	0
S_2	0	$2\mu_2$	0	$5\lambda_2 + \alpha_2$	0
S_3	0	0	$3\mu_1$	0	$5\lambda_2$
S_4	0	0	0	$4\mu_2$	0

Where S_0 is the perfect state, S_1, S_2, S_3 are partial failure states and S_4 is the complete failure state

$$\frac{d}{dq}\vartheta_0(q) = -(5\lambda_2 + \alpha_2)\vartheta_0(q) + \mu_2\vartheta_1(q) \tag{21}$$

$$\frac{d}{dq}\vartheta_1(q) = -(5\lambda_2 + 2\alpha_2 + \mu_2)\vartheta_1(q) + (5\lambda_2 + 2\alpha_2)\vartheta_0(q) + 2\mu_2\vartheta_2(q) \tag{22}$$

$$\frac{d}{dq}\vartheta_2(q) = -(5\lambda_2 + \alpha_2 + 2\mu_2)\vartheta_2(q) + (5\lambda_2 + 2\alpha_2)\vartheta_1(q) + 3\mu_2\vartheta_3(q) \tag{23}$$

$$\frac{d}{dq}\vartheta_3(q) = -(5\lambda_2 + 3\mu_2)\vartheta_3(q) + (5\lambda_2 + \alpha_2)\vartheta_2(q) + 4\mu_2\vartheta_4(q) \tag{24}$$

$$\frac{d}{dq}\vartheta_4(q) = -4\mu_2\vartheta_4(q) + 5\lambda_2\vartheta_3(q) \tag{25}$$

The normalizing condition for this problem is

$$\vartheta_0(q) + \vartheta_1(q) + \vartheta_2(q) + \vartheta_3(q) + \vartheta_4(q) = 1 \tag{26}$$

Availability of subsystem B is

$$A_{S2} = \vartheta_0(q) + \vartheta_1(q) + \vartheta_2(q) + \vartheta_3(q) \tag{27}$$

Setting (21) to (25) to zero as $q \to \infty$ in steady state, availability of subsystem B in (27) is now

$$A_{S2} = \frac{1 + m_2 + \frac{m_2^2}{2} + \frac{(5\lambda_2 + \alpha_2)m_2^2}{6\mu_2}}{1 + m_2 + \frac{m_2^2}{2} + \frac{(5\lambda_2 + \alpha_2)m_2^2}{6\mu_2} + \frac{5\lambda_2(5\lambda_2 + \alpha_2)m_2^2}{24\mu_2^2}} \tag{28}$$

Where $m_2 = \left(\frac{5\lambda_2 + 2\alpha_2}{\mu_2}\right)$

The Corresponding reliability, maintainability, dependability and MTBF, MTTR for main and warm standby unit of subsystem B are

$$R_{S2}(q) = \exp^{-\lambda_2 q} \tag{29}$$

$$R_{S2}(q) = \exp^{-\alpha_2 q} \tag{30}$$

$$M_{S2} = 1 - \exp^{-\mu_2 q} \tag{31}$$

Mean time between failure (MTBF)= $\lambda_2^{-1} = 40h$ for main unit

Mean time between failure (MTBF)= $\alpha_2^{-1} = 62.5h$ for warm standby unit

Mean time to repair (MTTR)= $\mu_2^{-1} = 5h$

Dependability ratio d= $\frac{\mu_2}{\lambda_2} = 8$ for main unit

$D_{\min}(s_2) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.8877$ for main unit

Dependability ratio d= $\frac{\mu_2}{\alpha_2} = 12.5$ for warm standby unit

$D_{\min}(s_2) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.9357$ for main and warm standby unit

RAMD Analysis for Subsystem C (Cross Cut Unit)

The cross-cut section consists of two primary operation unit, two warm standby unit and two cold standby unit. Using the method described in section 4.1 above, the Chapman-Kolmogrov differential difference equations (32)-(37) are derived using Markovian birth-death process from Table 6 below:

Table 6: Transition rate table for Subsystem C

	S_0	S_1	S_2	S_3	S_4	S_5
S_0	0	$2\lambda_3+2\alpha_3$	0	0	0	0
S_1	μ_3	0	$2\lambda_3+2\alpha_3$	0	0	0
S_2	0	$2\mu_3$	0	$2\lambda_3+2\alpha_3$	0	0
S_3	0	0	$3\mu_3$	0	$2\lambda_3+\alpha_3$	0
S_4	0	0	0	$4\mu_3$	0	$2\lambda_3$
S_5	0	0	0	0	$5\mu_3$	0

Where S_0 is the perfect state, S_1, S_2, S_3, S_4 are partial failure states and S_5 is the complete failure state

$$\frac{d}{dq}\vartheta_0(q) = -(2\lambda_3+2\alpha_3)\vartheta_0(q) + \mu_3\vartheta_1(q) \tag{32}$$

$$\frac{d}{dq}\vartheta_1(q) = -(2\lambda_3+2\alpha_3+\mu_3)\vartheta_1(q) + (2\lambda_3+2\alpha_3)\vartheta_0(q) + 2\mu_3\vartheta_2(q) \tag{33}$$

$$\frac{d}{dq}\vartheta_2(q) = -(2\lambda_3+2\alpha_3+2\mu_3)\vartheta_2(q) + (2\lambda_3+2\alpha_3)\vartheta_1(q) + 3\mu_3\vartheta_3(q) \tag{34}$$

$$\frac{d}{dq}\vartheta_3(q) = -(2\lambda_3+\alpha_3+3\mu_3)\vartheta_3(q) + (2\lambda_3+2\alpha_3)\vartheta_2(q) + 4\mu_3\vartheta_4(q) \tag{35}$$

$$\frac{d}{dq}\vartheta_4(q) = -(2\mu_3+4\mu_3)\vartheta_4(q) + (2\lambda_3+\alpha_3)\vartheta_3(q) + 5\mu_3\vartheta_5(q) \tag{36}$$

$$\frac{d}{dq}\vartheta_5(q) = -5\mu_3\vartheta_5(q) + 2\lambda_3\vartheta_4(q) \tag{37}$$

The normalizing condition for this problem is

$$\vartheta_0(t)+\vartheta_1(t)+\vartheta_2(t)+\vartheta_3(t)+\vartheta_4(t)+\vartheta_5(t)=1 \tag{38}$$

Availability of subsystem C is

$$A_{S3} = \vartheta_0(t)+\vartheta_1(t)+\vartheta_2(t)+\vartheta_3(t)+\vartheta_4(t) \tag{39}$$

Setting (32) to (37) to zero as $q \to \infty$ in steady state, availability of subsystem C in (39) is now

$$A_{S3} = \frac{1+\frac{m_3}{\mu_3}+\frac{m_3^2}{2\mu_3^2}\vartheta+\frac{m_3^3}{6\mu_3^3}+\frac{(2\lambda_3+\alpha_3)m_3^3}{24\mu_3^4}}{1+\frac{m_3}{\mu_3}+\frac{m_3^2}{2\mu_3^2}+\frac{m_3^3}{6\mu_3^3}+\frac{(2\lambda_3+\alpha_3)m_3^3}{24\mu_3^4}+\frac{2\lambda_3(2\lambda_3+\alpha_3)m_3^3}{120\mu_3^5}} \tag{40}$$

Where $m_3 = (2\lambda_3+2\alpha_3)$

The Corresponding reliability, maintainability, dependability and MTBF, MTTR for main and warm standby unit of subsystem C are

$$R_{S3}(q) = \exp^{-\lambda_3 q} \tag{41}$$

$$R_{S3}(q) = \exp^{-\alpha_3 q} \tag{42}$$

$$M_{S3} = 1 - \exp^{-\mu_3 q} \tag{43}$$

Mean time between failure (MTBF)= $\lambda_3^{-1} = 100h$ for main unit

Mean time between failure (MTBF)= $\alpha_3^{-1} = 71.4286h$ for warm standby unit

Mean time to repair (MTTR)= $\mu_3^{-1} = 5h$

Dependability ratio d= $\frac{\mu_3}{\lambda_3} = 14.9999$ for main unit

$D_{\min}(s_3) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.9451$ for main unit

Dependability ratio d= $\frac{\mu_3}{\alpha_3} = 14.2857$ for warm standby unit

$D_{\min}(s_3) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.9427$ for main and warm standby unit

RAMD Analysis for Subsystem D (Side Seam)

The side seam section consists of three primary operation unit, two warm standby unit and one cold standby unit. Using the method described in section 4.1 above, the Chapman-Kolmogrov differential difference equations (44)-(48) are derived using Markovian birth-death process from Table 7 below.

Table 7: Transition rate table for Subsystem D

S_0	S_0	S_1	S_2	S_3	S_4
	0	$3\lambda_4 + 2\alpha_4$	0	0	0
S_1	μ_4	0	$3\lambda_4 + 2\alpha_4$	0	0
S_2	0	$2\mu_4$	0	$3\lambda_4 + \alpha_4$	0
S_3	0	0	$3\mu_4$	0	$3\lambda_4$
S_4	0	0	0	$4\mu_4$	0

Where S_0 is the perfect state, S_1, S_2, S_3 are partial failure states and S_4 is the complete failure state

$$\frac{d}{dq}\vartheta_0(q) = -(3\lambda_4 + 2\alpha_4)\vartheta_0(q) + \mu_4\vartheta_1(q) \tag{44}$$

$$\frac{d}{dq}\vartheta_1(q) = -(3\lambda_4 + 2\alpha_4 + \mu_4)\vartheta_1(q) + (3\lambda_4 + 2\alpha_4)\vartheta_0(q) + 2\mu_4\vartheta_2(q) \tag{45}$$

$$\frac{d}{dq}\vartheta_2(q) = -(3\lambda_4 + \alpha_4 + 2\mu_4)\vartheta_2(q) + (3\lambda_4 + 2\alpha_4)\vartheta_1(q) + 3\mu_4\vartheta_3(q) \tag{46}$$

$$\frac{d}{dq}\vartheta_3(q) = -(3\lambda_4 + 3\mu_4)\vartheta_3(q) + (3\lambda_4 + \alpha_4)\vartheta_2(q) + 4\mu_4\vartheta_4(q) \tag{47}$$

$$\frac{d}{dq}\vartheta_4(q) = -4\mu_4\vartheta_4(q) + 3\lambda_4\vartheta_3(q) \tag{48}$$

The normalizing condition for this problem is

$$\vartheta_0(q)+\vartheta_1(q)+\vartheta_2(q)+\vartheta_3(q)+\vartheta_4(q)=1 \tag{49}$$

Availability of subsystem D is

$$A_{S4}=\vartheta_0(q)+\vartheta_1(q)+\vartheta_2(q)+\vartheta_3(q) \tag{50}$$

Setting (44) to (48) to zero as $q\to\infty$ in steady state, availability of subsystem D in (50) is now

$$A_{S4}=\frac{1+\frac{(2\lambda_2+2\alpha_2)}{\mu_2}+\frac{m_4^2}{2\mu_2^2}+\frac{(3\lambda_4+\alpha_4)m_4^2}{6\mu_2^3}}{1+\frac{(2\lambda_2+2\alpha_2)}{\mu_2}+\frac{m_4^2}{2\mu_2^2}+\frac{(3\lambda_4+\alpha_4)m_4^2}{6\mu_2^3}+\frac{3\lambda_4(3\lambda_4+\alpha_4)m_4^2}{24\mu_2^4}} \tag{51}$$

$$m_4=(3\lambda_4+2\alpha_4)$$

The Corresponding reliability, maintainability, dependability and MTBF, MTTR for main and warm standby unit of subsystem D are

$$R_{S4}(q)=\exp^{-\lambda_4 q} \tag{52}$$

$$R_{S4}(q)=\exp^{-\alpha_4 q} \tag{53}$$

$$M_{S4}=1-\exp^{-\mu_4 q} \tag{54}$$

Mean time between failure (MTBF)= $\lambda_4^{-1}=28.5714h$ for main unit

Mean time between failure (MTBF)= $\alpha_4^{-1}=58.8235h$ for warm standby unit

Mean time to repair (MTTR)= $\mu_4^{-1}=2.5h$

Dependability ratio d= $\frac{\mu_4}{\lambda_4}=11.4286$ for main unit

$D_{\min}(s_4)=1-\left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}}-\exp^{\frac{d\ln d}{d-1}}\right)=0.9307$ for main unit

Dependability ratio d= $\frac{\mu_4}{\alpha_4}=23.5294$ for warm standby unit

$D_{\min}(s_4)=1-\left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}}-\exp^{\frac{d\ln d}{d-1}}\right)=0.9630$ for main and warm standby unit

RAMD Analysis for Subsystem E (Cleaning)

The cleaning section consists of four primary operation unit, two warm standby unit and one cold standby unit. Using the method described in section 4.1 above, the Chapman-Kolmogrov differential difference equations (55)-(59) are derived using Markovian birth-death process from Table 8 below.

Table 8: Transition rate table for Subsystem E

	S_0	S_1	S_2	S_3	S_4
S_0	0	$4\lambda_5+2\alpha_5$	0	0	0

S_1	μ_5	0	$4\lambda_5+2\alpha_5$	0	0
S_2	0	$2\mu_5$	0	$4\lambda_5+\alpha_5$	0
S_3	0	0	$3\mu_5$	0	$4\lambda_5$
S_4	0	0	0	$4\mu_5$	0

Where S_0 is the perfect state, S_1, S_2, S_3 are partial failure states and S_4 is the complete failure state

$$\frac{d}{dq}\vartheta_0(q) = -(4\lambda_5+2\alpha_5)\vartheta_0(q) + \mu_5\vartheta_1(q) \tag{55}$$

$$\frac{d}{dq}\vartheta_1(q) = -(4\lambda_5+2\alpha_5+\mu_5)\vartheta_1(q) + (4\lambda_5+2\alpha_5)\vartheta_0(q) + 2\mu_5\vartheta_2(q) \tag{56}$$

$$\frac{d}{dq}\vartheta_2(q) = -(4\lambda_5+\alpha_5+2\mu_5)\vartheta_2(q) + (4\lambda_5+2\alpha_5)\vartheta_1(q) + 3\mu_5\vartheta_3(q) \tag{57}$$

$$\frac{d}{dq}\vartheta_3(q) = -(4\lambda_5+3\mu_5)\vartheta_3(q) + (4\lambda_5+\alpha_5)\vartheta_2(q) + 4\mu_5\vartheta_4(q) \tag{58}$$

$$\frac{d}{dq}\vartheta_4(q) = -4\mu_5\vartheta_4(q) + 4\lambda_5\vartheta_3(q) \tag{59}$$

The normalizing condition for this problem is

$$\vartheta_0(q)+\vartheta_1(q)+\vartheta_2(q)+\vartheta_3(q)+\vartheta_4(q)=1 \tag{60}$$

Availability of subsystem E is

$$A_{S5} = \vartheta_0(q)+\vartheta_1(q)+\vartheta_2(q)+\vartheta_3(q) \tag{61}$$

Setting (55) to (59) to zero as $q \to \infty$ in steady state, availability of subsystem E in (61) is now

$$A_{S5} = \frac{1+\frac{m_5}{\mu_5}+\frac{m_5^2}{2\mu_5^2}+\frac{(4\lambda_5+\alpha_5)m_5^2}{6\mu_5^3}}{1+\frac{m_5}{\mu_5}+\frac{m_5^2}{2\mu_5^2}+\frac{(4\lambda_5+\alpha_5)m_5^2}{6\mu_5^3}+\frac{\lambda_5(4\lambda_5+\alpha_5)m_5^2}{24\mu_5^4}} \tag{62}$$

$m_5 = (4\lambda_5+2\alpha_5)$

The Corresponding reliability, maintainability, dependability and MTBF, MTTR for main and warm standby unit of subsystem D are

$$R_{S4}(q) = \exp^{-\lambda_5 q} \tag{62}$$

$$R_{S4}(q) = \exp^{-\alpha_5 q} \tag{63}$$

$$M_{S5} = 1-\exp^{-\mu_5 q} \tag{64}$$

Mean time between failure (MTBF)= $\lambda_5^{-1} = 20h$ for main unit

Mean time between failure (MTBF)= $\alpha_5^{-1} = 76.9230h$ for warm standby unit

Mean time to repair (MTTR)= $\mu_5^{-1} = 1.8182h$

Dependability ratio d= $\frac{\mu_5}{\lambda_5} = 10.9285$ for main unit

$$D_{\min}(s_5) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.9285$$ for main unit

Dependability ratio d= $\frac{\mu_5}{\alpha_5} = 42.3072$ for warm standby unit

$$D_{\min}(s_5) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.9784$$ for main and warm standby unit

NUMERICAL SIMULATIONS AND DISCUSSION

Numerical simulations of reliability, availability, maintainability, and dependability are discussed in this section.

Table 9: Variation in Availability of system due to with respect to availability of individual subsystem

	Availability					
Failure rate	Subsystem A	Subsystem B	Subsystem C	Subsystem D	Subsystem E	System
0.00	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.02	1.0000	1.0000	0.9998	1.0000	1.0000	0.9998
0.04	0.9999	0.9999	0.9994	1.0000	0.9999	0.9991
0.06	0.9998	0.9998	0.9989	1.0000	0.9999	0.9984
0.08	0.9997	0.9996	0.9982	0.9999	0.9998	0.9972

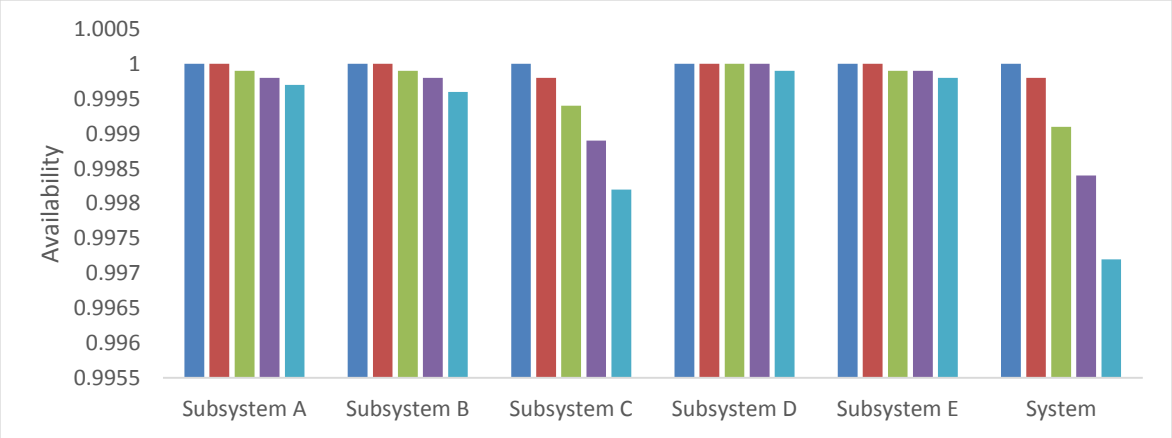

Figure 1: Availability of the system and individual subsystems

Reliability Using Exponential Distribution

Table 10: Variation in reliability of system due to changes in Exponential failure rate of subsystems for main unit

Time	Reliability of Subsystem A $\lambda_1 = 0.015$	Reliability of Subsystem B $\lambda_2 = 0.025$	Reliability of Subsystem C $\lambda_3 = 0.010$	Reliability of Subsystem D $\lambda_4 = 0.035$	Reliability of Subsystem E $\lambda_5 = 0.050$	System Reliability
0	1.000000000	1.000000000	1.000000000	1.000000000	1.000000000	1.00000000
20	0.74081822	0.60653066	0.81873075	0.49658530	0.36787944	0.06720551
40	0.54881164	0.36787944	0.67032005	0.24659696	0.13533528	0.00451658
60	0.40656966	0.22313016	0.54881164	0.12245642	0.04978706	0.00030353

80	0.30119421	0.13533528	0.44932896	0.06081006	0.01831563	0.00002039
100	0.22313016	0.082084999	0.36787944	0.03019738	0.00673794	0.00000137

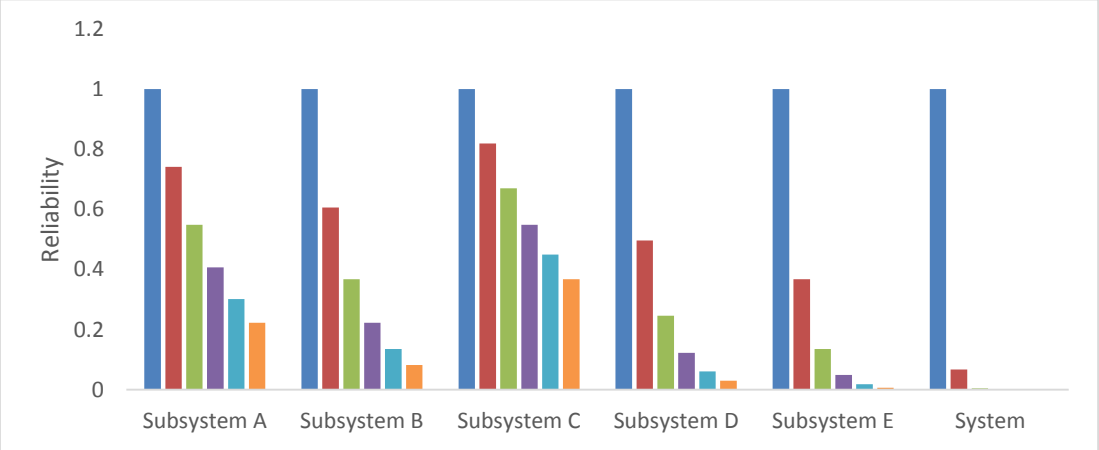

Figure 2: Variation in reliability of system due to changes in Exponential failure rate of subsystems for main unit

Table 11: Variation in reliability of system due to changes in Exponential failure rate of subsystems for warm standby unit

Time	Reliability of Subsystem A $\alpha_1 = 0.015$	Reliability of Subsystem B $\alpha_2 = 0.016$	Reliability of Subsystem C $\alpha_3 = 0.014$	Reliability of Subsystem D $\alpha_4 = 0.017$	Reliability of Subsystem E $\alpha_5 = 0.013$	System Reliability
0	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
20	0.74081822	0.72614903	0.75578374	0.7117703	0.77105158	0.22313016
40	0.54881163	0.52729242	0.57120906	0.50661699	0.59452054	0.04978706
60	0.40656965	0.38289288	0.43171052	0.36059494	0.45840601	0.01110899
80	0.30119421	0.27803730	0.32627979	0.25666077	0.35345468	0.00247875
100	0.22313016	0.2018965	0.24659696	0.18268352	0.27253179	0.00055308

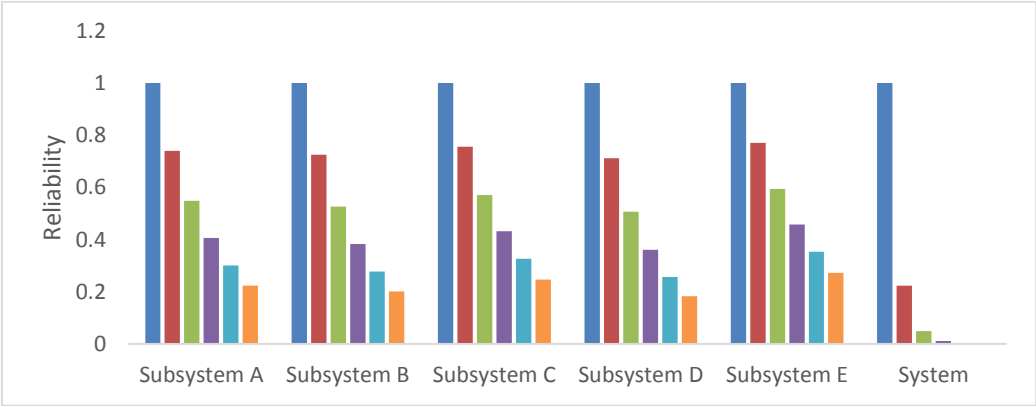

Figure 3: Variation in reliability of system due to changes in Exponential failure rate of subsystems for warm standby unit

Reliability Using Lindley Distribution

Table 12: Variation in reliability of system due to changes in Lindley failure rate of subsystems for main unit

Time	Reliability of Subsystem A $\lambda_1 = 0.015$	Reliability of Subsystem B $\lambda_2 = 0.025$	Reliability of Subsystem C $\lambda_3 = 0.010$	Reliability of Subsystem D $\lambda_4 = 0.035$	Reliability of Subsystem E $\lambda_5 = 0.050$	System Reliability
0	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.0000000
20	0.95977927	0.90239927	0.98085565	0.83244010	0.71824081	0.14697050
40	0.87323231	0.72678621	0.93579333	0.58015807	0.39311677	0.00590089
60	0.76707478	0.54966210	0.87483835	0.37091875	0.19203583	0.00014415
80	0.65728589	0.39940413	0.80523309	0.22532037	0.08808950	0.00000267
100	0.55287917	0.28229231	0.73211651	0.13231414	0.03882340	0.0000004

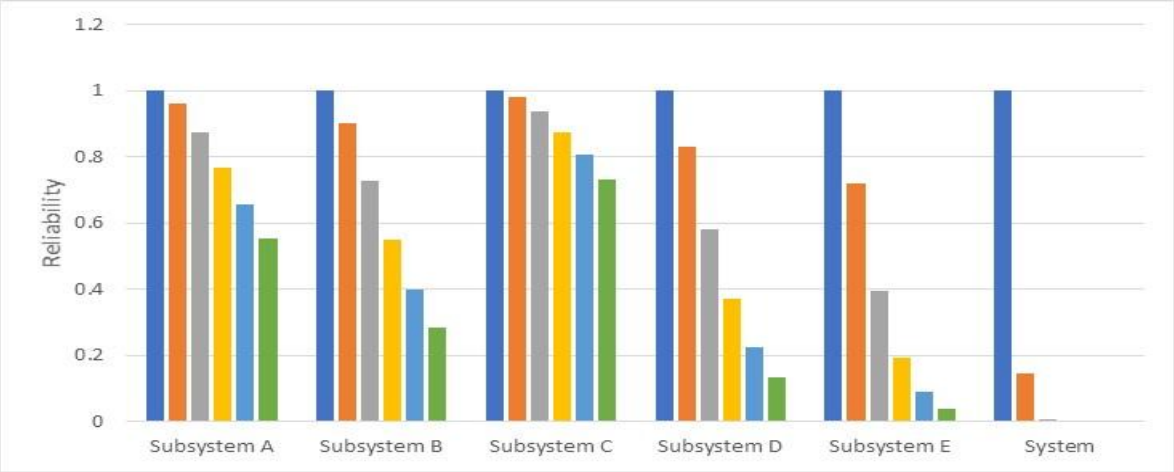

Figure 4: Variation in reliability of system due to changes in Lindley failure rate of subsystems for main unit

Table 13: Variation in reliability of system due to changes in Lindley failure rate of subsystems for Warm standby Unit

Time	Reliability of Subsystem A $\alpha_1 = 0.015$	Reliability of Subsystem B $\alpha_2 = 0.016$	Reliability of Subsystem C $\alpha_3 = 0.014$	Reliability of Subsystem D $\alpha_4 = 0.017$	Reliability of Subsystem E $\alpha_5 = 0.013$	System Reliability
0	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
20	0.95977927	0.95485739	0.96448142	0.94972696	0.96895228	0.50827697
40	0.87323231	0.85944513	0.88666969	0.84535795	0.89970384	0.03210535
60	0.76707478	0.74468143	0.78934054	0.72225358	0.81137411	0.00096330
80	0.65728589	0.62832051	0.68666773	0.59988462	0.71633017	0.00002017
100	0.55287917	0.51984379	0.58706614	0.48805421	0.62227644	0.0000004

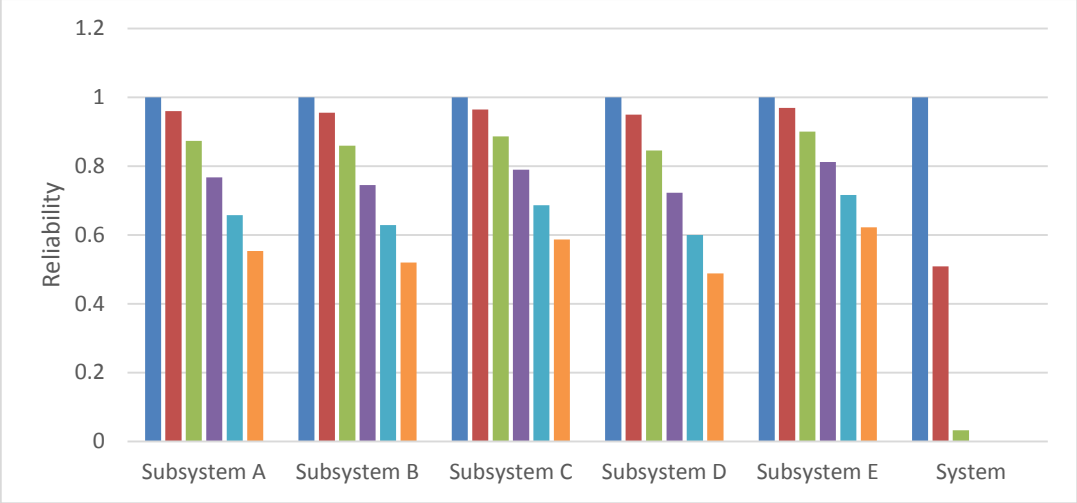

Figure 5: Variation in reliability of system due to changes in Lindley failure rate of subsystems for warm standby unit

Reliability Using Exponentiated Weibull Distribution

Table 14: Variation in reliability of system due to changes in Exponentiated Weibull failure rate of subsystems for main unit

Time	Reliability of Subsystem A $\lambda_1 = 0.015$	Reliability of Subsystem B $\lambda_2 = 0.025$	Reliability of Subsystem C $\lambda_3 = 0.010$	Reliability of Subsystem D $\lambda_4 = 0.035$	Reliability of Subsystem E $\lambda_5 = 0.050$	System Reliability
0	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.0000000
20	0.99660863	0.99094408	0.89131112	0.982932729	0.93282480	0.83679084
40	0.98721301	0.96714146	0.69676141	0.94035841	0.79642906	0.55758066
60	0.97286409	0.93282480	0.51167047	0.88238311	0.64784043	0.32632241
80	0.95447233	0.89131112	0.36303083	0.81613833	0.51167047	0.17562407
100	0.93282480	0.84518187	0.25235492	0.74657364	0.39647325	0.08918513

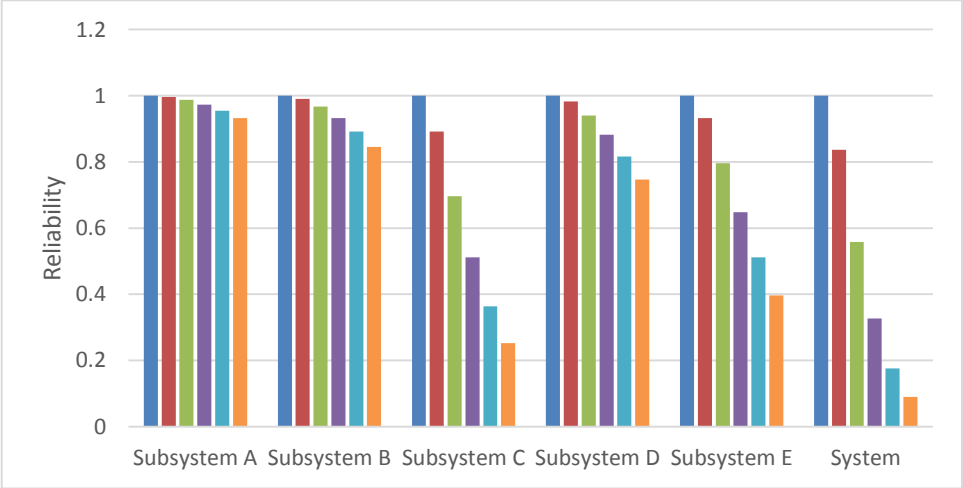

Figure 6: Variation in reliability of system due to changes in Exponentiated Weibull failure rate of subsystems for main unit

Table 15: Variation in reliability of system due to changes in Exponentiated Weibull failure rate of subsystems for warm standby unit

Time	Reliability of Subsystem A $\alpha_1 = 0.015$	Reliability of Subsystem B $\alpha_2 = 0.016$	Reliability of Subsystem C $\alpha_3 = 0.014$	Reliability of Subsystem D $\alpha_4 = 0.017$	Reliability of Subsystem E $\alpha_5 = 0.013$	System Reliability
0	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
20	0.99660863	0.99615661	0.99703401	0.99567831	0.99743243	0.98302549
40	0.98721301	0.98556478	0.98877338	0.98383100	0.99024355	0.93724977
60	0.97286409	0.96948230	0.97608456	0.96594586	0.97913685	0.87071433
80	0.95447233	0.94898814	0.95972558	0.94328660	0.96473380	0.79108357
100	0.93282480	0.92500565	0.94035841	0.91692365	0.94758262	0.70499843

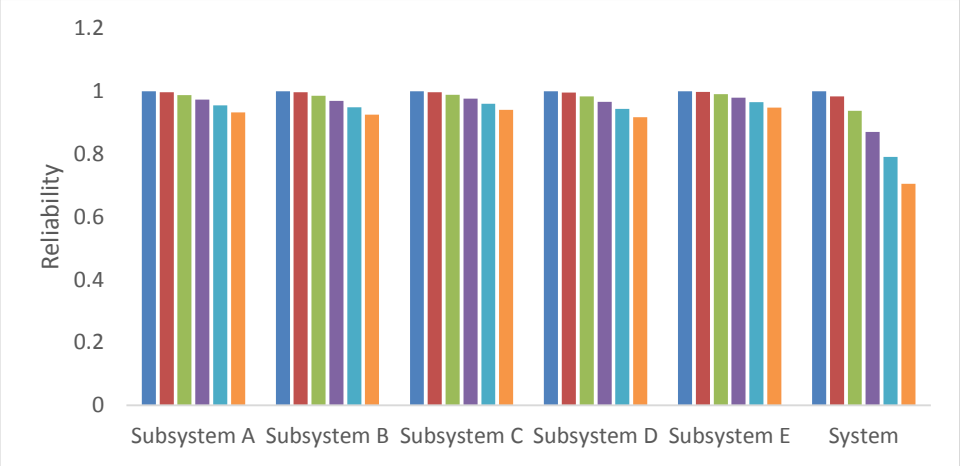

Figure 7: Variation in reliability of system due to changes in Exponentiated Weibull failure rate of subsystems for warm standby unit

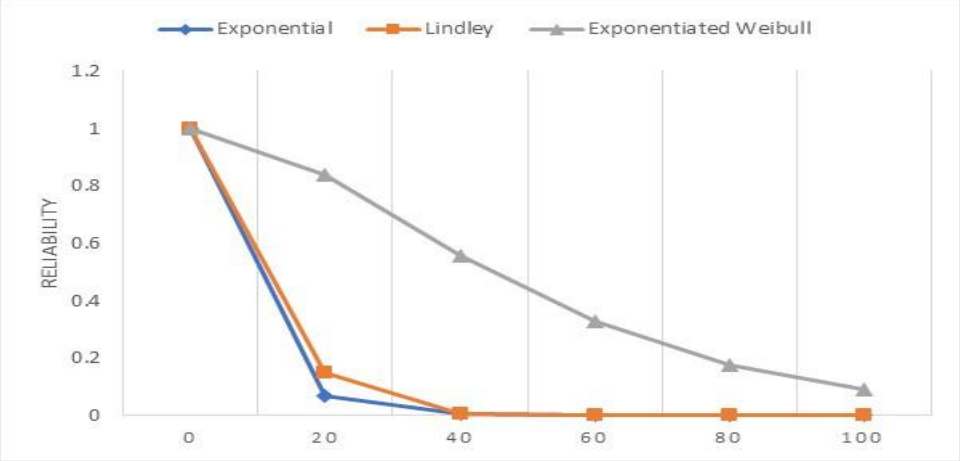

Figure 8: Reliability for main unit failure against time for different distributions

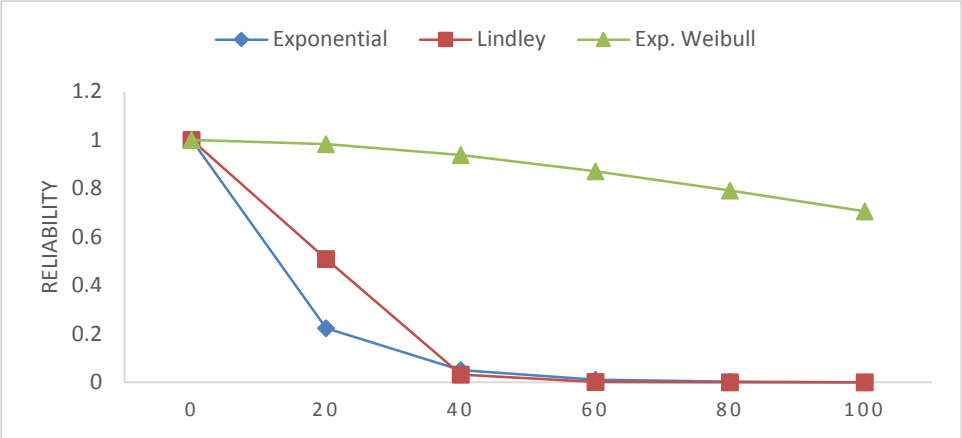

Figure 9: Reliability for warm standby unit failure against time for different distributions

Table 16: Variation in maintainability of system due to with respect to of individual subsystem

Time	Maintainability of Subsystem A $\mu_1 = 0.35$	Maintainability of Subsystem B $\mu_2 = 0.20$	Maintainability of Subsystem C $\mu_3 = 0.15$	Maintainability of Subsystem D $\mu_4 = 0.40$	Maintainability of Subsystem E $\mu_5 = 0.55$	System Maintainability
0	0. 000000000	0. 000000000	0. 000000000	0. 000000000	0. 000000000	0. 000000000
20	0.9990881180	0.9816843611	0.9502129316	0.9996645374	0.9999832983	0.9316303655
40	0.9999991685	0.9996645374	0.9975212478	0.9999998875	0.9999999997	0.9971856751
60	0.9999999992	0.9999938558	0.9998765902	1.000000000	1.000000000	0.9998704460
80	1.000000000	0.9999998875	0.9999938558	1.000000000	1.000000000	0.9999937433
100	1.000000000	0.9999999979	0.9999996941	1.000000000	1.000000000	0.9999996920

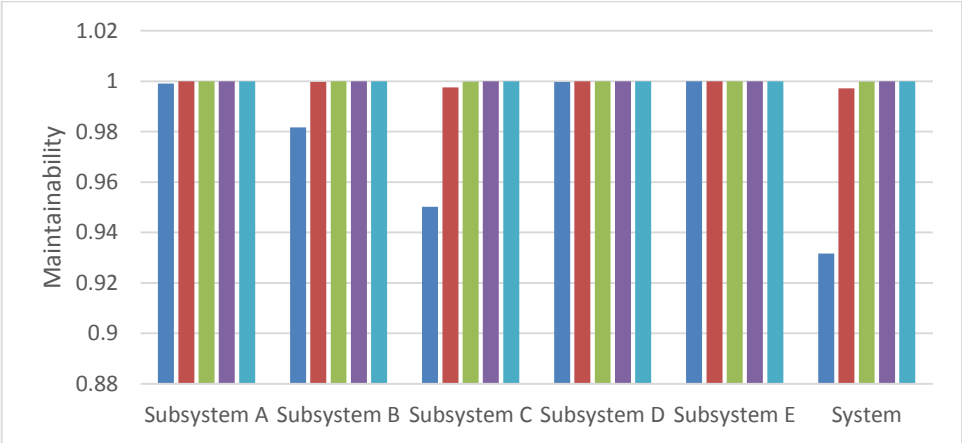

Figure 10: Variation in maintainability of system and subsystems

Table 17: Ramd indices

Indices	Subsystem A	Subsystem B	Subsystem C	Subsystem D	Subsystem E
Reliability Main	$\exp^{-0.015q}$	$\exp^{-0.025q}$	$\exp^{-0.010q}$	$\exp^{-0.035q}$	$\exp^{-0.050q}$
Reliability Warm	$\exp^{-0.015q}$	$\exp^{-0.016q}$	$\exp^{-0.014q}$	$\exp^{-0.017q}$	$\exp^{-0.013q}$

Reliability Main	$\frac{1.015+0.015q}{1.015}e^{-0.015q}$	$\frac{1.025+0.025q}{1.025}e^{-0.025q}$	$\frac{1.010+0.010q}{1.010}e^{-0.010q}$	$\frac{1.035+0.035q}{1.035}e^{-0.035q}$	$\frac{1.050+0.050q}{1.050}e^{-0.050q}$
Reliability Warm	$\frac{1.015+0.015q}{1.015}e^{-0.015q}$	$\frac{1.016+0.016q}{1.016}e^{-0.016q}$	$\frac{1.014+0.014q}{1.014}e^{-0.014q}$	$\frac{1.017+0.017q}{1.017}e^{-0.017q}$	$\frac{1.013+0.013q}{1.013}e^{-0.013q}$
Maintainability	$1-\exp^{-0.35q}$	$1-\exp^{-0.20q}$	$1-\exp^{-0.15q}$	$1-\exp^{-0.40q}$	$1-\exp^{-0.55q}$
Reliability Main	$1-\left(1-e^{-(0.015q)^{0.2}}\right)^2$	$1-\left(1-e^{-(0.025q)^{0.2}}\right)^2$	$1-\left(1-e^{-(0.010q)^{0.2}}\right)^2$	$1-\left(1-e^{-(0.035q)^{0.2}}\right)^2$	$1-\left(1-e^{-(0.050q)^{0.2}}\right)^2$
Reliability Warm	$1-\left(1-e^{-(0.015q)^{0.2}}\right)^2$	$1-\left(1-e^{-(0.016q)^{0.2}}\right)^2$	$1-\left(1-e^{-(0.014q)^{0.2}}\right)^2$	$1-\left(1-e^{-(0.017q)^{0.2}}\right)^2$	$1-\left(1-e^{-(0.013q)^{0.2}}\right)^2$
Availability	0.9996	0.9995	0.9978	0.9999	0.9997
Dependability Main	0.9595	0.8877	0.9451	0.9307	0.9784
Dependability Warm	0.9595	0.9357	0.9427	0.9630	0.9784
MTTR	2.8571	5	5	2.5	1.8182
MTBF Main	66.6667	40	100	28.5714	20
MTBF Warm	66.6667	62.5	71.4286	58.8235	76.9230
Dependability ratio Main	23.3345	8	14.9999	11.4286	10.9285
Dependability ratio Warm	2345.33	12.5	14.2857	23.5294	42.3072

This section discusses the numerical simulations in order to obtain understanding of how the strength, efficacy, and performance of the model under review are evaluated at various levels. Here, we employ the exponential, Lindley, and exponentiated Weibull distributions as three alternative distributions to first choose the optimum distribution that will improve system reliability. On the basis of this, the performance of the model is evaluated.

Table 9 and Figure 1 displayed the results of availability of individual subsystems and the entire system with respect to failure rates. From the table and figure, it is noted that availability of individual subsystems and the entire system decreases with increase in failure rate. It is clear from the table and figure that the availability of the system is lower than the availability of the individual subsystems. This can lead to decrease in production which will in turn culminated in less revenue mobilization. To avert this problem adequate preventive maintenance before such as regular inspection, oiling, greasing etc should be invoke to avoid system failure. From the table and figure, it is worthwhile to notice that subsystem C has the least availability. Therefore, maintenance priority should be set aside to subsystem C in order to improve its availability.

Table 10 and Figure 2 and table 11 and Figure 3 presents the results of reliability of the individual subsystems and the system when the failure rate of the main and warm standby unit follows exponential distribution. The table and figure show that reliability decreases drastically with passage of time from 0 to 100. From the table and figure it can be seen that reliability of the system is less than the reliability of each subsystem. Subsystem E has the least reliability among the subsystems from the Table 10 and Figure 2 when the failure rate of the main unit obeys exponential distribution while subsystem D has the least reliability from Table 11 and Figure 3 when the failure rate of the warm standby unit obeys exponential distribution.

From Table 12 and Figure 4 and Table 13 and Figure 5 for reliability analysis of the individual subsystems and the system when the failure rate of the main and warm standby unit obeys Lindley distribution. It is observed from the tables and figures that reliability decreases slightly with passage of time from 0 to 100 in which reliability of the system is less than the reliability of each subsystem. It is evident from the tables and figures that subsystem E has the least reliability among the subsystems when the failure rate of the main obeys Lindley distribution and subsystem D for warm standby unit obeys Lindley distribution.

On other hand, when the failure follows exponentiated Weibull distribution for both main and warm standby unit From Table 14 and Figure 6 and Table 15 and Figure 7 for reliability analysis of the individual subsystems and the system it is clear that reliability decreases slightly with passage of time from 0 to 100 in which reliability of the system is less than the reliability of each subsystem. It is evident from the tables and figures that subsystem C for main unit has the least reliability among the subsystems and subsystem D is the least when the failure rate of warm standby unit obeys exponentiated Weibull distribution.

Exponentiated Weibull distribution, in contrast, has a higher system reliability than the other two distributions for both main unit and warm standby units. This is seen in Figure 8 and 9, Table 14 and Figure 6 and Table 15 and Figure 7. The variation in system reliability caused by variations in the exponentiated Weibull failure rate of subsystems for main units is depicted in table 13 and figure 6. From this table 13 and its corresponding figure 6, we can see that the system reliability's equivalent values for main unit at time $t = 40$ are $Rel._{subsystem\ A} = 0.98721301, Rel._{subsystem\ B} = 0.96714146, Rel._{subsystem\ C} = 0.69676141, Rel._{subsystem\ D} = 0.94035841,\ and Rel._{subsystem\ D} = 0.79642906.$ In time $t = 40$, there is $Main._{system} = 0.32632241$ chance of successfully completing maintenance and repairs, and $Main._{subsystem\ A} = 0.99999916,\ Main._{subsystem\ B} = 0.99966453,\ Main._{subsystem\ C} = 0.99752124,\ Main._{subsystem\ D} = 0.99999988$ and $Main._{subsystem\ E} = 0.999999999$. The system is 0.33632241 times reliable at $t = 60$ due to a form decline. This is brought on by the low reliability value of subsystem C. This demonstrates that subsystem C is the main unit's key subsystem. The value of availability is another indicator of how important subsystem C is to the main unit.

Table 9-15 and Figure 1-7 show the variation in system reliability caused by changes in the exponential, Lindley and exponentiated Weibull failure rate of the main and warm standby unit's subsystems. Subsystems with the lowest reliability value among the other subsystems need adequate attention of the management for proper maintenance in order to avoid system breakdown and subsequent loss of production and revenue as the tables and figures make sufficient evident. This demonstrates that critical subsystems are the most important and delicate part of the system and needs careful consideration.

Conclusion

In this study, the metrics of RAMD for both weaving, dry clean, cross cut, side seam and cleaning section of the textile are analyzed to assess the performance of the textile manufacturing system. Expressions associated with metrics for weaving, dry clean, cross cut, side seam and cleaning section have been derived and numerical experiments are performed. The assumed values for failure and repair rates for each subsystem are given in table 1. Table 16 lists all RAMD measurements, while tables 3 and 4 capture the variation in reliability and maintainability over time, respectively. Tables 9, 10, 11, 13 and 14 indicate the impact of

different failure rates on subsystems and system reliability and figures 2-7 that side seam is the most important and delicate component of the system. The models/results described in this work, if modified, will allow management to stop poor reliability assessments and decision-making, which will cause high expenditures. Moreover, the accepted framework for the model under consideration's inspection and maintenance could be proposed and incorporated to satisfy the client and lower failure rates. These are the findings of the current investigation. This work can be enlarged to include both offline and online routine maintenance at both partial and total failure states. This study will be carried out in the future.

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INFLUENCE OF UTILISATION OF LIBRARY INFORMATION RESOURCES ON POSTGRADUATE STUDENTS' ACADEMIC ACTIVITIES IN LIBRARY SCHOOLS IN NORTH-CENTRAL, NIGERIA

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Abstract
This paper examined the influence of utilisation of library information resources on postgraduate students' academic activities in library schools in North-Central, Nigeria. The study was guided by to objectives and two corresponding research questions. Descriptive survey research design was adopted by the study. The population of the study was 1,080 postgraduate students. The sample size of the population was 294. This sample size was obtained by subjecting the target population of 1,080 to Krejcie and Morgan 1970 recommended table for determining sample size of a population. Questionnaire was the instrument used for data collection. Descriptive statistical tools such as frequency counts, percentages, and mean and standard deviations was used to measure the research questions. The findings of the study revealed that the level of utilisation of library information resources among postgraduate students is moderately high in preparing for test and examinations, carrying out research, writing of theses/dissertations and writing of conference papers. The study concluded that the utilisation of library information resources by library and information science postgraduate students cannot be overemphasised especially towards satisfying their academic and research needs. The study recommended that the management of federal universities in North-central, Nigeria should organise training in form of conferences, seminars and workshops to library and information science postgraduate students on the usefulness of consulting library information resources especially in writing their seminar and workshop papers and even virtual presentation whenever the need arises.

Keywords: Academic activities, Library information resources, Utilisation

Introduction
Over the past few decades, there has been a global shift toward a knowledge-based economy, emphasizing the importance of higher education in producing skilled professionals and contributing to intellectual advancements. Postgraduate education, in particular, is designed to foster critical thinking, research skills, and a deep understanding of specialized fields. As such, access to a rich array of information resources becomes imperative for postgraduate students (Tarus *et al.*, 2022). In the dynamic landscape of higher education, access to information plays a pivotal role in shaping the academic success of postgraduate students.

The academic activities of students plays considerable roles in producing top quality graduates who will become great leaders, nation builders and total men and women in all sectors of the nation's economy in the future. Academic performance connotes any academic involvement that results in educational excellence. It is usually ascertained at the end of every semester after test or examinations have been conducted to the students. Hence, the idea of measurement of students' academic performance is inevitable in a formal educational setting. According to Molepo (2018), academic performance is the ability of students to study and remember facts and being able to communicate their knowledge verbally or written on a paper in an academic

environment. The postgraduate students encompass all the students studying and pursuing programmes beyond their Higher National Diploma HND or first degree programmes in any academic discipline in institutions of higher learning. They are the imminent hope of any nation; their ambitions among others is to become ambassadors, administrators, scientists, engineers, doctors, senators, governors and possibly the president of a nation in the near future. However, for them to achieve these great feats as postgraduate students the need to consult adequate information resources. Libraries serve as crucial hubs for scholarly resources, offering an array of books, journals, and electronic databases. The effectiveness of postgraduate education is not solely determined by the availability of these resources but also by the extent to which students utilise them in their academic pursuits.

Barfi and Oluwaniyi, (2018) defined library information resources as the raw materials that provide vital services in the teaching and learning process. Barfi and Oluwaniyi, (2018) stressed further that librarians are accountable for gathering, selecting, organising, disseminating and preserving recorded knowledge and information in all forms and for providing assistance and instruction in their use so that anyone who needs library resources might access them easily to support in reading, teaching, learning process and doing different researches in any academic community.

Effective utilisation of the information resources highlighted above is however predicated on the postgraduate students' information literacy. Information literacy is the ability to access, evaluate and use information effectively, is a key component of academic success. Postgraduate students, engaged in advanced research and coursework, rely heavily on their ability to navigate the wealth of information available. Libraries, as providers of information literacy programs, contribute to enhancing students' skills in utilising resources critically and judiciously. Postgraduate students therefore, must be encouraged to avail themselves the opportunities of utilising the library resources. The effectiveness of any library as an instrument of learning is determined by the attainment with which it's capable of providing the users with the information that they need. As a result, it's imperative for institutions of higher learning with postgraduate students to make efforts to investigate the level of utilisation of their library resources from time to time and how it affects postgraduate students' academic performance.

Statement of the Research Problem

Postgraduate education is a critical phase in the academic journey where students are expected to engage deeply with scholarly literature, conduct advanced research, and contribute meaningfully to their respective fields. The effectiveness of postgraduate education is inherently linked to the availability and utilisation of information resources within university libraries. Despite the acknowledged importance of library resources, it could be observed from preliminary investigation that there is a gap in understanding the specific implication of how the utilisation of these resources impact the academic activities of postgraduate students. It is against this background that the researcher decided to carry out this study on the influence of utilisation of library information resources on postgraduate students' academic activities in library schools in North-Central, Nigeria.

Objectives of the Study

The specific objectives were to:

1. determine the level of utilisation of library information resources in library schools in North-Central, Nigeria;
2. ascertain the influence of utilisation of library information resources on academic activities of postgraduate students in library schools in North-Central, Nigeria.

Literature Review

Information resources utilisation

Utilisation in library and information science means to use. Information utilisation is the practical and maximum use of library resources identified and acquired for the purpose of solving a problem or achieving a set goal. Information resources' utilisation in university libraries is a process comprising of initiation, selection, formulation, collection and use of information resources. It is simply the process which initiates the search and use of information resources for answering pertinent questions of great importance to the information seeker. In a similar vein, Bitagi and Garba (2014) asserted that utilisation of information resources is the extent to which the resources of the library are actually used for teaching, learning and research. Also, Ibrahim and Sakiyo (2015) opined that utilisation of information resources connotes pattern and frequency of information resources usage by the library's community of users. Therefore, information resources utilisation is the actual putting into appropriate use of acquired information and may differ from person to person, one discipline to another, one faculty to another as well as from one corporate organisation to the other according to their information needs and other socio-economic imperatives.

Utilisation entails the action of making practical and effective use of something, steps to increase the utilisation of resources, or action taken to increase the use of something. The increase in the utilisation of library resource can be influence by factors which leads to usage, in the case of information resource utilisation by user, strategies most be put in place to enhance the utilisation of the resource, especially actions taken to acquire skills that will enable the user to utilise the resources. Uzoagba *et al.* (2012) also affirmed that library information resources in print, non-print, and electronic forms are the major components of any library. Library information utilisation entails library users visit to the library to consult its information resources; and the services that it offers to in order to satisfy their information needs. Utilisation entails that one party offers something that the other party desires; and the desiring party comes to get that thing. In essence, the library offers information services that the users desire; thus, they patronize the library by coming to the library to seek for the services, in order to satisfy their needs. Even though the influence and implementation of information and communication technology (ICT) in library practices enables users to remotely patronize the services of the library, there is need also to influence their patronage and utilisation of the physical library resources. The university library has the mandate to strategize and adopt services to ensure users' frequent utilisation of resources.

Utilisation is the extent to which library resources and services are consulted to meet users' information and academic needs. The capacity and capability of the university libraries at providing information resources and services can never be appreciated without adequate utilisation of these resources by the users. On this note that Olorunfemi and Ipadeola (2021) opined that the effectiveness of the university library to a large extent depends on the utilisation of its resources and services which is premised on the quality of services rendered as well as the availability and accessibility of information resources to the user community. It would amount to waste of funds when the information resources acquired, are not utilised by the library users.

Reporting on the importance of utilisation of information resources and services in the library, Jamogha, *et al.* (2019) asserted that the utilisation of information resources and services is the extent to which library resources like books and journals are exploited and used for study, teaching learning and research activities.

Methodology

This study adopted survey research design. Survey research was suitable for the study because, according to Kratochwill *et al.* (2023), a survey assesses a situation to correct inadequacies or effect improvements. The population of the study was 1,080 postgraduate students. The sample size of the population was 294. This sample size was obtained by subjecting the target population of 1,080 to Krejcie and Morgan 1970 recommended table for determining sample size of a population. Questionnaire was the instrument used for data collection. Descriptive statistical tools such as frequency counts, percentages, and mean and standard deviations was used to measure the research questions.

Results and Discussion

Table 1: Level of Utilisation of Library Information Resources among Postgraduate Students

S/N	Statements	VH 4	H 3	L 2	VL 1	n 247	FX	$\bar{x}$	STD	Decision
1	I use information resources in the university library in preparing for test and examinations	83	98	37	29	247	729	2.95	0.45	High
2	I use information resources in the university library for carrying out research	101	119	19	8	247	807	3.28	0.78	Very High
3	I use information resources in the university library in writing theses/dissertations	86	107	39	15	247	758	3.07	0.58	Very High
4	I use information resources in the university library for virtual presentations	69	88	55	35	247	685	2.77	0.27	Low
5	I use information resources in the university library in writing conference papers	89	94	42	22	247	744	3.01	0.51	Very High
6	I use information resources in the university library in writing seminar papers	81	99	34	33	247	722	2.92	0.42	Low
7	I use information resources in the university library in	73	69	56	49	247	660	2.67	0.17	Low

	writing workshop papers	
	Weighted mean	2.95

Key: Very High (VH), High (H), Low (L), Very Low (VL), n = Number of Retrieved Copies of Questionnaire, $\overline{X}$=Mean and (Weighted mean = 2.95)

Table 1 showed the level of utilisation of library information resources by library and information science postgraduate students. Out of the seven items listed, four items produced high mean scores which were above the weighted mean of 2.95. These items include item 2: I use information resources in the university library for carrying out research (x□=3.32; SD=0.71), item 3: I use information resources in the university library in writing theses/dissertations (x□=3.07; SD=0.58), item 5: I use information resources in the university library in writing conference papers (x□=3.01; SD=0.51) and item 1: I use information resources in the university library in preparing for test and examinations (x□=2.95; SD=0.45). On the other hand, three items produced low mean scores which were below the weighted mean of 2.95. These items include item 6: I use information resources in the university library in writing seminar papers (x□=2.92; SD=0.42), item 4: I use information resources in the university library for virtual presentations (x□=2.77; SD=0.27) and item 7: I use information resources in the university library in writing workshop papers (x□=2.67; SD=0.17). The weighted mean of 2.95 and above is considered as the mean rate level of utilisation of library information resources by library and information science postgraduate students in the study areas. Above all, the highest mean score was discovered from item 2 on the use information resources in the university library for carrying out research. From the analysis, the study revealed that item 2, 3 and 5 were rated very high by the respondents, while item 1 and 5 were rated high by the respondents as the level of their use of library information resources. On the other hand items 4, 6 and 7 were rated very low by the respondents as the level of their use of library information resources.

Table 2: Influence of Utilisation of Library Information Resources on Academic Activities of Postgraduate Students

S/N	Statements	SA 4	A 3	D 2	SD 1	n 247	FX	$\bar{x}$	STD	Decision
1	The use of library information resources influence the writing of my assignments	90	104	32	21	247	757	3.06	0.56	Agreed
2	The use of library information resources influence the writing of my tests	88	102	39	18	247	754	3.05	0.55	Agreed
3	The use of library information resources influence the writing of my examinations	99	97	32	19	247	770	3.12	0.62	Agreed

4	The use of library information resources influence the writing of my theses/dissertations	101	111	27	8	247	799	3.23	0.73	Agreed
5	The use of library information resources influences my knowledge on general education	92	105	36	14	247	769	3.11	0.61	Agreed
6	The use of library information resources influences my workshop presentations	86	94	45	22	247	738	2.99	0.49	Disagreed
7	The use of library information resources influences my virtual presentations	82	96	49	20	247	734	2.97	0.47	Disagreed
8	The use of library information resources influences my conference presentations	81	99	36	31	247	724	2.93	0.43	Disagreed
	Weighted mean							3.05		

Key: Strongly Agreed (SA), Agreed (A), Disagreed (D), Strongly Disagreed (SD), n = Number of Retrieved Copies of Questionnaire, $\bar{X}$=Mean and (Weighted mean = 3.05)

Table 2 showed the influence of influence of utilisation of library information resources on academic activities of postgraduate students. Out of the eight items listed, five items produced high mean scores which were above the weighted mean of 3.05. These items include item 4: The use of library information resources influence the writing of my theses/dissertations (x□=3.23; SD=0.73), item 3: The use of library information resources influence the writing of my examinations (x□=3.12; SD=0.62), item 5: The use of library information resources influences my knowledge on general education (x□=3.11; SD=0.61), item 1: The use of library information resources influence the writing of my assignments (x□=3.06; SD=0.56) and item 2: The use of library information resources influence the writing of my tests (x□=3.05; SD=0.55). On the other hand, three other items produced low mean scores which were below the weighted mean of 3.05. These items include item 6: The use of library information resources influences my workshop presentations (x□=2.99; SD=0.49), item 7: The use of library information resources influences my virtual presentations (x□=2.97; SD=0.47) and item 8: The use of library information resources influences my conference presentations (x□=2.93; SD=0.43). The weighted mean of 3.05 and above is considered as the mean rate

influence of utilisation of library information resources on academic activities of postgraduate students in the study areas. Above all, the highest mean score was discovered from item 4 on the use of library information resources influence the writing of theses/dissertations. From the analysis, the study revealed that item 1, 2, 3, 4 and 5 were strongly agreed by the respondents, while item 6, 7 and 8 were disagreed by the respondents as the influence of utilisation of library information resources on their academic activities.

Discussion

As regards to research question 1, the study revealed that the level of utilisation of library information resources among postgraduate students is moderately high. Library and information science postgraduate students revealed that the use of information resources in the university library in preparing for test and examinations, carrying out research, writing of theses/dissertations and writing of conference papers.

On the other hand, library and information science postgraduate students revealed low use of information resources in the university library for virtual presentations, writing seminar papers and workshop papers.

In response to research question 2, the study revealed that the influence of utilisation of library information resources on the academic activities of library and information science postgraduate students is high is moderate. Library and information science postgraduate students indicated that they use library and information resources in the writing of assignments, tests, examinations, theses/dissertations and also influence their knowledge on general education.

However, the respondents indicated that the influence of their utilisation of library information resources for academic activities were low in terms of workshop presentations, virtual and conference presentations.

Conclusion

From the findings of this study, it can be concluded that the utilisation of library information resources by library and information science postgraduate students cannot be overemphasised especially towards satisfying their academic and research needs. Library and information science postgraduate students revealed high use of library information resources in the university library in terms of preparing for test and examinations, carrying out research, writing of theses/dissertations and writing of conference papers, while there were low use of library information resources for virtual presentations, writing seminar papers and workshop papers among the respondents.

Recommendation

1. The management of federal universities in North-central, Nigeria should organise training in form of conferences, seminars and workshops to library and information science postgraduate students on the usefulness of consulting library information resources especially in writing their seminar and workshop papers and even virtual presentation whenever the need arises.
2. The management of federal universities in North-central, Nigeria should encourage postgraduate students to participate or attend library-organised training sessions on the effective use of library information resources. These trainings will facilitate their workshop and conference presentations and their personal development.

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RELATIVE EFFECTIVENESS OF THREE MODES OF BLENDED LEARNING ON PRE-SERVICE MATHEMATICS TEACHERS' LEARNING OUTCOMES IN COLLEGES OF EDUCATION, NORTH-CENTRAL, NIGERIA.

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Abstract

The paper present a review on the use of Relative Effectiveness of Three Modes of Blended Learning on Pre-service Mathematics Teachers' Learning Outcomes in Colleges of Education, North-central, Nigeria. Technology significantly enhances the three modes of mathematics learning under study Rotational Blended Learning, Flex Model, and Enriched Virtual Model by facilitating interactive, personalized, and flexible learning experiences. In the Rotational Blended Learning model, technology enables seamless transitions between online and face-to-face instruction, allowing pre-service teachers to engage with digital resources that reinforce in-class learning (Alkaabi et al., 2023). The Flex Model leverages technology to offer students control over their learning paths, providing access to extensive online content and adaptive learning platforms that cater to individual learning paces and needs (Vetrivel et al., 2024). The Enriched Virtual Model benefits from technology by offering a hybrid approach where students primarily learn online with periodic in-person sessions, enhancing their ability to engage deeply with mathematical concepts through virtual simulations and interactive tools (Yuan, 2022). Overall, technology empowers these blended learning models by promoting active learning, improving accessibility, and fostering a more engaging and effective educational environment for pre-service mathematics teachers. This review summarise relevant research on the meaning of overview of Flex Model of Blended Learning, benefit of flex learning model for mathematics teaching, application of flex model in teacher education, Enriched Virtual Model of Blended Learning, Benefit of the Enriched Virtual Model for Mathematics Teaching, Benefits of Implementing Blended learning in educational setting and ways of overcoming challenges in educational setting which consist of access to personalized learning improvement of student's performance were also identified in the study. The paper concluded by advocating for further researches on the use of Relative Effectiveness of Three Modes of Blended Learning on Pre-service Mathematics Teachers' Learning Outcomes in Colleges of Education, North-central, Nigeria. Government organizations, agencies and non-governmental organization should fund more researches on the use of Three Modes of Blended Learning on Pre-service Mathematics Teachers' Learning Outcomes in Colleges of Education, North-central, Nigeria. Procure technologies that can enhance the use of Three Model for teaching and learning in colleges of education. more seminars conference and workshops should be organized for educational stakeholders to meet up with global technologies.

Key words: Three Model of Blended Learning, Rotational Model, Flex Model and Enriched Virtual Model

Introduction

Technology has revolutionized education by transforming traditional teaching methods into more dynamic, interactive, and personalized learning experiences. In general, technology

serves as a powerful tool that enhances the accessibility, efficiency, and effectiveness of education (Huang, 2019). It provides diverse resources, such as digital textbooks, online tutorials, and interactive simulations, which cater to various learning styles and needs. The integration of technology in education has also facilitated remote and blended learning models, allowing students to learn at their own pace and on their own schedules. Furthermore, technology fosters collaboration and communication among students and educators through platforms like discussion forums, video conferencing, and cloud-based tools.

Technology significantly enhances the three modes of mathematics learning under study Rotational Blended Learning, Flex Model, and Enriched Virtual Model by facilitating interactive, personalized, and flexible learning experiences. In the Rotational Blended Learning model, technology enables seamless transitions between online and face-to-face instruction, allowing pre-service teachers to engage with digital resources that reinforce in-class learning (Alkaabi *et al*., 2023). The Flex Model leverages technology to offer students control over their learning paths, providing access to extensive online content and adaptive learning platforms that cater to individual learning paces and needs (Vetrivel *et al*., 2024). The Enriched Virtual Model benefits from technology by offering a hybrid approach where students primarily learn online with periodic in-person sessions, enhancing their ability to engage deeply with mathematical concepts through virtual simulations and interactive tools (Yuan, 2022). Overall, technology empowers these blended learning models by promoting active learning, improving accessibility, and fostering a more engaging and effective educational environment for pre-service mathematics teachers.

Mathematics education is a critical component of teacher training programs, particularly for pre-service teachers who will be responsible for teaching this foundational subject in schools. The effectiveness of mathematics education relies heavily on the instructional methods used to convey complex concepts and principles to students. As highlighted by Harahap *et al*., (2024), mathematics education is not just about imparting knowledge but also about developing students' problem-solving skills, logical reasoning, and ability to think critically. For pre-service mathematics teachers, the quality of their training significantly influences their future teaching effectiveness. According to Wang *et al*., (2024) a deep understanding of mathematical content and pedagogical strategies is essential for effective mathematics instruction.

In the context of this study, mathematics education is the subject matter that the pre-service teachers are being trained to teach, and the effectiveness of this education is measured through their learning outcomes. Blended learning models, such as the Rotational, Flex, and Enriched Virtual models, offer innovative approaches to teaching mathematics by integrating digital tools with traditional instructional methods. These models cater to the diverse learning needs of pre-service mathematics teachers, enabling them to grasp abstract mathematical concepts more effectively and to develop the pedagogical skills necessary for teaching these concepts to students (Anthony *et al*., 2020).

Blended learning has become a prominent approach in modern education, combining traditional face-to-face instruction with digital and online learning methods. This approach is particularly effective in bridging the gap between theoretical knowledge and practical application, offering students the flexibility to learn at their own pace while still benefiting from direct interaction with instructors (Graham, 2022). In the context of teacher education, blended learning models have been identified as crucial in developing the pedagogical skills and content knowledge of pre-service teachers. According to Hrastinski (2019), blended learning not only enhances learning outcomes but also fosters greater engagement and

motivation among students. The integration of technology in education has transformed the traditional classroom, making learning more accessible and personalized (Boelens *et al*., 2017). As such, the adoption of blended learning in Colleges of Education is seen as a strategic move to improve the quality of teacher training programs, particularly in mathematics education.

The Rotational model is a type of blended learning where students rotate between different learning stations, each offering a unique mode of instruction, such as online learning, group work, and individual tutoring (Staker & Horn, 2018). This model is particularly effective in accommodating different learning styles and paces, making it an ideal approach for diverse classrooms. In mathematics education, the Rotational model allows pre-service teachers to engage with complex mathematical concepts through varied instructional methods, enhancing their understanding and retention (Anthony, *et al*., 2020). Research by Wang *et al*. (2021) indicates that the Rotational model not only improves academic performance but also increases student engagement and motivation. The flexibility offered by this model enables students to take ownership of their learning, thus promoting a deeper understanding of mathematical concepts. The model's effectiveness in addressing individual learning needs makes it a valuable tool in teacher training programs, where the goal is to produce well-rounded educators capable of catering to diverse student populations.

The Flex model is another blended learning approach where most of the instruction is delivered online, with students having the flexibility to choose when and where to engage in learning activities (Joshi and Khan, 2024). This model is particularly suited to adult learners, such as pre-service teachers, who may need to balance their studies with other responsibilities. The Flex model's emphasis on self-directed learning encourages students to develop critical thinking and problem-solving skills, which are essential in mathematics education (Rai, 2024). According to a study by Means *et al*. (2014), the Flex model has been shown to significantly improve learning outcomes, particularly in higher education settings. The autonomy provided by the Flex model allows pre-service mathematics teachers to engage with course materials at their own pace, leading to a more personalized learning experience (AlAli and Wardat, 2024). This flexibility is crucial in mathematics education, where students often need time to fully grasp complex concepts. The model's ability to accommodate different learning styles and schedules makes it an effective approach in teacher training programs, where flexibility is often required.

The Enriched Virtual model is a blended learning approach where students complete most of their coursework online but are required to attend face-to-face sessions for specific activities or assessments (Qamar *et al*., 2024). This model offers the best of both worlds: the convenience of online learning and the benefits of direct interaction with instructors and peers. In mathematics education, the Enriched Virtual model allows pre-service teachers to engage with mathematical concepts online while applying their knowledge in face-to-face sessions (Bingham, 2020). According to recent research by Drysdale *et al*. (2022), the Enriched Virtual model has been effective in improving student satisfaction and learning outcomes. The model's structure provides students with the flexibility to learn independently while still benefiting from the guidance and support of their instructors. This balance between online and face-to-face learning is particularly beneficial in teacher training programs, where hands-on practice and peer interaction are essential for developing teaching skills. The Enriched Virtual model's ability to combine the advantages of online and traditional learning makes it a powerful tool in enhancing the learning outcomes of pre-service mathematics teachers.

Overview of Flex Learning Model

Flex Model of blended learning is an instructional approach where students primarily learn online while accessing teachers and support as needed, rather than through scheduled direct instruction. Unlike traditional classroom settings, the Flex Model allows students to move fluidly between online and face-to-face instruction, depending on their individual learning needs (AlAli and Wardat, 2024). This model gives students a more personalized learning experience, enabling them to work at their own pace and engage with content in a way that suits their learning preferences. The teacher's role in the Flex Model shifts from delivering content to providing support and facilitation, often in the form of one-on-one or small group instruction.

Application of the Flex Model in Teacher Education

In teacher education, the Flex Model can be implemented through a combination of online modules and in-person practical experiences. Pre-service teachers can access instructional content and resources online at their own pace, allowing them to delve deeper into areas they find challenging while receiving immediate feedback through digital platforms (Garrison and Vaughan, 2018). The face-to-face component of the Flex Model can be used for collaborative projects, peer discussions, and hands-on teaching practice, which are crucial for developing effective teaching skills. This blended approach not only enhances the flexibility of teacher education programs but also prepares pre-service teachers for the diverse and technology-rich classrooms they will encounter in their professional careers (Kang & Gyorke, 2018).

Benefits of the Flex learning Model for Mathematics Teaching

The Flex Model offers several benefits for mathematics teaching, particularly in creating a more individualized learning experience. By allowing students to control the pace of their learning, the Flex Model enables them to spend more time on complex mathematical concepts, leading to a deeper understanding and mastery of the subject (Cirillo *et al*., 2024). The integration of technology in the Flex Model also allows for immediate feedback and assessment, which can help students identify and address their misconceptions in real-time (Bell and Ryan, 2024). This personalized approach to mathematics instruction can reduce math anxiety and increase student confidence, ultimately leading to improved learning outcomes.

Enriched Virtual Model

The Enriched Virtual Model of blended learning represents a structured educational approach that combines both online and face-to-face learning experiences (Ozyurt and Ozyurt, 2024). In this model, students typically begin their learning journey in a traditional classroom setting, where foundational concepts are introduced. Afterward, students continue their learning remotely through virtual platforms, with periodic face-to-face sessions designed for deeper engagement and support. This model provides students with the flexibility to complete a significant portion of their learning online, while still benefiting from direct interactions with instructors and peers during in-person sessions (Mehta *et al*., 2024). The Enriched Virtual Model has gained traction due to its ability to blend the strengths of both online and in-person learning, offering a more personalized and adaptive learning experience.

Benefits of the Enriched Virtual Model for Mathematics Teaching

The Enriched Virtual Model offers several benefits for mathematics teaching, particularly in terms of flexibility and personalized learning (Vargas-Montoya *et al*., 2024). One of the main advantages is the ability to provide students with on-demand access to instructional content, allowing them to revisit challenging concepts at their own pace. This is particularly valuable in mathematics, where students often require additional practice and reinforcement to master

complex skills (Yavuzkan *et al*., 2024). The face-to-face sessions in this model can be used to address specific difficulties, offer personalized support, and engage students in collaborative problem-solving activities that enhance their mathematical understanding (Vargas-Montoya *et al*., 2024).

Benefits of Implementing Blended Learning in Educational Settings

Blended learning, which combines traditional in-person instruction with online components, offers numerous benefits that enhance both teaching and learning experiences in educational settings. One of the most significant advantages is the flexibility it provides to learners and educators. Students can access learning materials at their own pace and on their own schedule, which caters to diverse learning styles and needs (Garrison and Vaughan, 2021). This approach allows for more personalized learning experiences, where students can review content multiple times and seek additional resources as needed, leading to improved understanding and retention of information (Means *et al*., 2020). Educators also benefit from the ability to diversify instructional methods, incorporating multimedia, interactive activities, and real-time feedback, which can lead to more engaging and effective teaching (Graham *et al*., 2022).

In addition to flexibility, blended learning promotes higher levels of student engagement and interaction. By integrating online discussions, collaborative projects, and interactive simulations, students can actively participate in their learning process, fostering deeper comprehension and critical thinking skills (Bernard *et al*., 2022). The combination of face-to-face and online environments also facilitates continuous communication between students and instructors, providing more opportunities for feedback and support (Hrastinski, 2019). Research indicates that blended learning environments often result in higher academic achievement compared to traditional classroom settings, as students are more motivated and engaged when they have control over their learning paths (Allen and Seaman, 2020). Moreover, blended learning prepares students for the digital demands of the modern workforce, equipping them with essential technological skills and competencies (Watson, 2021).

Ways of Overcoming Challenges in Implementing Blended Learning in Educational Settings

Overcoming the challenges of implementing blended learning in educational settings involves a multifaceted approach addressing technological, instructional, and support needs. Key strategies include:

1. Enhancing Technological Infrastructure and Access

To address disparities in technological access, educational institutions should invest in infrastructure improvements and provide resources that ensure all students and educators have the necessary tools. This includes upgrading internet connectivity, providing affordable or subsidized devices, and creating technology lending programs (Watson, 2022). Schools can collaborate with governments and private sector partners to secure funding and resources aimed at reducing the digital divide (Sweeney *et al*., 2023). Additionally, offering technical support and training for both students and educators can help mitigate issues related to digital literacy and ensure effective use of technology (Harris *et al*., 2021).

2. Investing in Professional Development

Educators play a critical role in the success of blended learning programs, and their effective integration of technology requires ongoing professional development. Training programs should focus on both the pedagogical and technological aspects of blended learning. Workshops, webinars, and collaborative learning communities can provide teachers with the

skills needed to design and manage blended learning environments effectively (Smith and O'Dowd, 2022). Providing time for educators to plan and reflect on their blended learning practices can also enhance their ability to deliver high-quality instruction (Miller, 2021). Institutions should consider establishing mentorship programs where experienced educators support their peers in integrating blended learning techniques.

3. Designing Effective Instructional Models

Successful blended learning requires well-designed instructional models that integrate online and face-to-face components seamlessly. Schools should adopt instructional design frameworks that emphasize alignment between online content and in-person activities. This includes creating clear learning objectives, using engaging and interactive digital content, and ensuring that online and classroom activities complement each other (Garrison and Kanuka, 2022). Institutions can also engage in iterative design processes, where feedback from students and educators is used to continuously refine and improve the blended learning experience (Graham *et al*., 2021).

4. Providing Ongoing Support and Resources

To alleviate the increased workload associated with blended learning, schools should provide adequate support resources, including administrative assistance and technical help. This can involve setting up dedicated support teams for blended learning initiatives, offering help desks for technology-related issues, and creating resource hubs where educators can access instructional materials and best practices (Chen and Jang, 2021). Additionally, schools should foster a collaborative environment where educators can share experiences, strategies, and resources related to blended learning (Bower *et al*., 2020).

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A COMPREHENSIVE REVIEW OF FACTORS INFLUENCING E-LEARNING PLATFORM ADOPTION AND USAGE AMONG UNIVERSITY LECTURERS

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Abstract
This paper examines the factors influencing e-Learning platform usage among university lecturers in North-West Nigeria. The rapid advancement of information and communication technologies (ICT) has revolutionized education, particularly in higher education. However, the adoption and utilization of e-Learning systems face numerous challenges, especially in developing countries like Nigeria. This study aims to develop a predictive model for e-Learning utilization by university lecturers, drawing on established theories such as the Technology Acceptance Model (TAM) and Technology Readiness (TR). The paper reviews key concepts including ICT in education, e-Learning systems, and their development in Nigeria. It also explores various factors that may influence e-Learning adoption, such as perceived usefulness, perceived ease of use, subjective norms, and technology self-efficacy. By synthesizing existing literature and theoretical frameworks, this review sets the foundation for empirical research to enhance understanding of e-Learning adoption in Nigerian universities and potentially inform policy and practice in higher education.

Keywords: e-Learning, higher education, ICT in education, university lecturers

Introduction
The rapid proliferation of the Internet and digital technologies has revolutionized education, leading to the widespread adoption of e-learning. This shift has transformed traditional teaching and learning methods globally, creating new opportunities for knowledge acquisition and dissemination (Cabaleiro-Cervino & Vera, 2020; Alvino et al., 2020; Di Vaio et al., 2020).

Information and Communication Technology (ICT) has become integral to education at all levels, enhancing the effectiveness and efficiency of learning processes (Priyanto et al., 2021). The evolution of e-learning has led to innovations such as adaptive learning environments, playful learning approaches, and the integration of ICT tools in teacher training programs (Fernández-Oliveras, 2017; Ogunnowo, 2016). The growth of online education has been driven by various factors, including financial constraints, the increasing number of non-traditional students, and technological advancements (Dziuban et al., 2016). E-learning systems have become particularly prominent in higher education, offering flexibility and innovative options for students (Al-Rahmi et al., 2018; Revythi & Tselios 2019). The COVID-19 pandemic accelerated the adoption of e-learning, highlighting its potential as more than just a stopgap solution (Andreas, 2020). E-learning offers numerous advantages, including cost-effectiveness, wider coverage, and the promotion of collaborative learning (Eduard & Lucian, 2020). However, the implementation of e-learning systems faces challenges, including user acceptance, technological readiness, and the need for effective content curation (Mohebi, 2019; Ahmed et al., 2018). The Technology Acceptance Model (TAM) has been widely used to investigate factors influencing e-learning adoption and utilization (Scherer et al., 2018; Davis, 1989; Venkatesh & Bala, 2008). In Nigeria, the shift towards e-learning has presented challenges related to learning quality, content design, and implementation efficiency. Factors

such as technology self-efficacy, perceived usefulness, and facilitating conditions play crucial roles in lecturers' adoption of e-learning systems (Osuafor & Emeji, 2015). This paper aim to explore the factors influencing e-learning utilization among university lecturers in Nigeria, with a focus on developing a model to describe and predict e-learning adoption in teaching.

Literature Review

Concept of ICT in Education

The rapid increase of the Internet and Internet-based applications has brought about profound changes in education, influencing teaching and learning methods worldwide (Cabaleiro-Cervino & Vera, 2020). ICT has been used at every level of education to provide quality education and increase effectiveness and efficiency (Priyanto et al., 2021). The integration of computers and the internet has given rise to a novel culture of exchanging educational content known as e-learning culture.

E-Learning Systems

E-learning utilizes the power of the web, with interfaces designed for distant learning students by providing modules from university lecturers (Mohebi, 2019). It offers a unique opportunity to strengthen higher education learning and teaching by creating more accessible and temporally situated learning content (Guo & Li, 2023). E-learning is not limited to any environment or time (Tseng et al., 2023).

E-Learning in Nigeria

In Nigeria, the paradigm shift towards e-learning posed serious challenges regarding learning quality and how content is designed and implemented efficiently. Despite efforts to incorporate e-learning in the education system, many tertiary institutions across the country have not sufficiently harnessed this digitization (Osuafor & Emeji, 2015). The integration of e-learning is faced with difficulties such as attitudinal changes and acceptance enhancements through the advancement of high-tech aptitudes of staff.

Theoretical Framework

The Technology Acceptance Model (TAM) is widely used to investigate factors that influence technology utilization and performance of individuals (Scherer et al., 2018; Davis, 1989; Venkatesh & Bala, 2008). This model examines users' positive perception of e-learning and several factors influencing its use in teaching.

Factors Influencing e-Learning Adoption

Several factors affect e-learning utilization among university lecturers:

i. Subjective norm: The degree to which lecturers perceive they are expected to use e-learning systems in their teaching activities.
ii. Technology self-efficacy (TSE): The extent to which lecturers have confidence in their ability to use technology-related tools for teaching.
iii. Job relevance: The degree to which a lecturer believes that utilizing e-learning systems is applicable to their job.
iv. Perceived enjoyment: The extent to which lecturers find using e-learning systems pleasant and enjoyable.
v. Facilitating conditions: The degree to which lecturers believe they are supported with e-learning hardware/tools by their institutions.
vi. Perceived usefulness and ease of use: How much lecturers believe e-learning systems will enhance their teaching activities and be easy to use.

vii. Attitude towards use and behavioral intention: Lecturers' disposition toward and commitment to using e-learning systems.

Challenges and Barriers

Lecturers in Nigerian universities face numerous challenges when embracing e-learning, including:

1. Technological barriers
2 Pedagogical challenges
3 Changed learning styles
4 Time and cost constraints
5 Low satisfaction and participation rates among students in some cases (Ismail et al., 2016)

This literature review provides a foundation for understanding the factors influencing e-learning platform usage among university lecturers in North-West Nigeria. It highlights the importance of technology acceptance models, various influencing factors, and the specific challenges faced in the Nigerian context.

Conclusion

This paper provides a comprehensive overview of the factors influencing e-Learning platform usage among university lecturers in North-West Nigeria, setting the stage for further empirical research in this critical area of educational technology.

The paper suggests areas for future research, including:
Empirical testing of the proposed predictive model

1. Comparative studies across different regions in Nigeria
2. Longitudinal studies to track changes in e-Learning adoption over time
3. Investigation of the impact of e-Learning on educational outcomes

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REVIEW ON EFFECT AUDIO TUTORIAL SYSTEM ON STUDENTS' ACHIEVEMENT AND RETENTION IN ECONOMICS, AMONG SENIOR SECONDARY SCHOOLS IN MINNA METROPOLIS, NIGER STATE

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Abstract
This review examines the influence of Audio-Tutorial (AT) systems on students' achievement and retention in Economics among senior secondary school students in Minna Metropolis, Niger State. The study explores how AT systems, as a learner-centered approach, enhance educational outcomes by providing flexibility and fostering active learning. By integrating audio instructions with other instructional materials, these systems promote better understanding and retention of complex concepts, making them particularly effective in subjects like Economics. The review begins with a historical overview of AT systems in educational settings, tracing their evolution from early science-focused applications to their broader integration across various subjects. The effectiveness of AT systems is discussed in terms of their ability to boost student engagement, motivation, and overall learning outcomes, highlighting empirical evidence from different fields of study. A specific focus is placed on the application of AT systems in Economics, showcasing how they can simplify abstract economic theories and improve students' performance. The review also addresses significant challenges and barriers to the adoption of AT systems, including inadequate technological infrastructure, insufficient teacher training, and contextual factors that influence the integration of educational technology in classrooms. Finally, the study presents policy implications and offers recommendations for enhancing the implementation of AT systems in schools. These include the development of supportive policy frameworks, teacher training initiatives, and curriculum adaptations that foster the effective use of educational technologies. Suggestions for future research emphasize the need to explore the long-term impact of AT systems on diverse student populations and investigate innovative ways to overcome existing barriers to their implementation.

Keywords: Audio-Tutorial Systems, Student Achievement, Retention, Economics Education, Educational Technology, and Technology Integration.

Introduction
The integration of technology in education has revolutionized teaching methodologies, providing new tools and techniques to enhance student learning and retention. One such innovative approach is the audio-tutorial system, which combines audio recordings with visual aids and interactive activities to offer a multisensory learning experience. This method is particularly significant in the field of economics education, where students often struggle with abstract concepts and theories. The audio-tutorial system was first conceptualized by Samuel Postlethwait in the 1969s as an innovative approach to enhance the teaching of biology. Bjerk, *et al.,* (1969) designed this method to address the limitations of traditional lecture-based teaching, which often failed to engage students effectively and accommodate diverse learning styles. The primary goal was to create a self-paced, learner-centered environment where students could interact with the material in a more dynamic and engaging manner. The audio-

tutorial system combined recorded audio instructions with visual aids, such as diagrams, charts, and models, along with hands-on activities and experiments. This multisensory approach aimed to make complex biological concepts more accessible and comprehensible. The early success of this system in biology education paved the way for its adaptation in other disciplines, demonstrating its versatility and potential to transform teaching and learning across various fields.

Additionally, the flexibility of audio-tutorial systems allows for self-paced learning, enabling students to revisit challenging material as needed and progress at their own pace. This personalized learning experience can lead to increased student engagement and motivation, ultimately contributing to better academic performance. Studies, such as those by Kozma (2020), have shown that students exposed to multimedia instructional methods, including audio-tutorial systems, consistently outperform their peers who rely solely on conventional teaching approaches. This evidence underscores the potential of audio-tutorial systems to revolutionize education by making learning more accessible, engaging, and effective. As educational institutions strive to improve teaching outcomes and address the diverse needs of their student populations, the adoption of audio-tutorial systems represents a promising and impactful strategy. The integration of these systems into the curriculum not only enhances the learning experience but also prepares students for a future where digital literacy and adaptive learning skills are increasingly important. Therefore, the importance of incorporating audio-tutorial systems into modern educational practices cannot be overstated, as they offer a dynamic and effective solution to some of the most pressing challenges in education today. By integrating audio-tutorial systems into science curricula, educators can address diverse learning needs, enhance student engagement, and improve overall educational outcomes, ultimately fostering a deeper interest and proficiency in science among students.

Economics, as a subject, demands a deep understanding of intricate concepts such as supply and demand, market structures, and economic policies. These concepts often involve abstract theories and mathematical models that can be challenging for students to grasp through traditional teaching methods alone. Textbooks and lectures, the mainstays of conventional instruction, typically present information in a linear and text-heavy format, which may not effectively engage all students or cater to their diverse learning preferences. As Nwosu and Oyekwe (2019) note, such methods often result in disengaged students who struggle to comprehend and retain key economic principles, leading to low academic performance and poor long-term retention. This issue is compounded by the varying abilities and learning styles of students in a typical classroom, which traditional methods fail to accommodate. Consequently, many students find economics daunting and uninspiring, which can hinder their overall educational experience and future interest in the subject.

Achievement and retention are critical components in assessing the effectiveness of educational interventions, particularly in the context of economics education using audio-tutorial systems. Achievement, in this study, refers to the immediate learning outcomes measured through assessments conducted after students have been exposed to audio-tutorial instruction. Traditional metrics such as test scores and performance in structured assessments will be used to gauge how well students have grasped economic concepts like supply and demand, market structures, and economic policies. By employing pre-tests and post-tests, this study aims to quantify the direct impact of audio-tutorial systems on students' immediate academic achievements in economics. This assessment of achievement not only provides insights into the short-term effectiveness of the intervention but also serves as a basis for evaluating the

practical utility of audio-tutorial systems in enhancing student learning outcomes in economics education.

Historical development and evolution in educational settings

The historical development and evolution of audio-tutorial systems in educational settings have their roots in the mid-20th century, with significant contributions from innovators like Samuel Postlethwait. The initial concept, developed in the 1960s, aimed to improve the effectiveness of biology education by combining audio instructions with visual aids and hands-on activities (Postlethwait, Novak, & Murray, 1969). This approach was revolutionary at the time, addressing the limitations of traditional lecture-based teaching methods by providing a more interactive and engaging learning experience. The early adoption of audio-tutorial systems was driven by the need to cater to diverse learning styles and improve student outcomes, particularly in complex and content-heavy subjects. Over the decades, the basic principles of audio-tutorial instruction have been refined and expanded to various educational contexts, demonstrating versatility and adaptability (Mayer, 2021).

In the contemporary educational landscape, the evolution of audio-tutorial systems has been significantly influenced by advancements in digital technology. The integration of digital audio tools, multimedia resources, and internet-based platforms has transformed the way audio-tutorial systems are implemented and accessed. Modern iterations of audio-tutorial systems include podcasts, audiobooks, interactive multimedia applications, and adaptive learning technologies that personalize the educational experience based on individual learner needs (Clark & Mayer, 2019). These digital tools offer greater flexibility and accessibility, allowing students to engage with educational content anytime and anywhere, thus accommodating different learning paces and schedules. Research indicates that these advancements have not only enhanced the effectiveness of audio-tutorial systems but also expanded their applicability across various disciplines beyond the sciences, including economics, humanities, and social sciences (Hattie, 2021). Studies have shown that students who utilize modern audio-tutorial systems exhibit higher levels of engagement, improved comprehension, and better retention of material compared to those who rely solely on traditional teaching methods (Nwosu & Oyekwe, 2021; Kozma, 2020). This evolution underscores the critical role of technology in advancing educational practices and addressing the diverse needs of learners in an increasingly digital world.

In the educational realm, audio technology gained prominence with Samuel Postlethwait's development of the audio-tutorial system in the 1960s. Postlethwait, an educator, and researcher, aimed to enhance biology teaching by integrating audio instructions with visual aids and hands-on activities. His approach was based on the premise that engaging multiple senses could improve learning outcomes and retention (Postlethwait, Novak, & Murray, 1969). Today, audio technology is widely used in education through podcasts, audiobooks, language learning apps, and interactive audio-based learning platforms. These tools leverage the principles of multisensory learning to cater to diverse learning styles and enhance educational experiences (Hattie, 2021).

The evolution of audio technology from Edison's phonograph to modern digital audio has profoundly impacted various fields, including music, broadcasting, and education. Each technological advancement has built upon previous innovations, leading to increasingly sophisticated and accessible audio experiences.

Effectiveness of Audio-Tutorial Systems in Education

I. *Impact on student engagement and motivation*

The effectiveness of audio-tutorial systems in education has been a subject of extensive research, with numerous studies highlighting their positive impact on student engagement and motivation. These systems are designed to create a more interactive and immersive learning environment by combining auditory instructions with visual aids and practical activities. This multisensory approach caters to different learning styles, making it easier for students to grasp complex concepts and retain information. According to Mayer's (2019) Cognitive Theory of Multimedia Learning, the use of both auditory and visual channels in learning materials enhances understanding and retention by leveraging the brain's dual processing capabilities. This approach has been shown to increase student engagement by making lessons more interesting and less monotonous compared to traditional lecture-based methods.

Furthermore, audio-tutorial systems have been found to significantly boost student motivation. The self-paced nature of these systems allows students to control their own learning process, which can reduce anxiety and increase confidence. Research by Clark and Mayer (2019) indicates that students who use audio-tutorial systems are more likely to take an active role in their learning, leading to higher levels of intrinsic motivation. This is particularly important in subjects that are traditionally perceived as challenging, such as economics and the sciences. For instance, a study by Kozma (2020) revealed that students who utilized multimedia tools, including audio-tutorial systems, showed greater enthusiasm for the subject matter and were more motivated to complete their assignments and participate in class discussions. This heightened motivation often translates into better academic performance and a deeper understanding of the course content.

II. Enhancement of learning outcomes in various subjects

Audio-tutorial systems have demonstrated considerable efficacy in enhancing learning outcomes across various subjects, including traditionally challenging areas like economics, sciences, and mathematics. These systems facilitate a more comprehensive understanding of subject matter by integrating auditory, visual, and kinesthetic learning modalities. This multimodal approach caters to diverse learning preferences, thereby improving comprehension and retention of complex concepts. According to Mayer (2019), when information is presented through both auditory and visual channels, it leverages the brain's dual coding process, leading to better retention and understanding. This principle is particularly beneficial in subjects that require the assimilation of intricate and abstract concepts.

In the sciences, for instance, audio-tutorial systems have been shown to significantly enhance students' grasp of complex theories and experimental procedures. A study by Hattie (2021) found that students using these systems exhibited improved performance in biology and chemistry compared to their peers who were taught through traditional methods. The interactive nature of audio-tutorial systems, which often includes simulations and hands-on activities, helps students better understand scientific concepts and processes. This approach not only enhances their theoretical knowledge but also improves practical skills, which are crucial for success in scientific disciplines.

Application of Audio-Tutorial Systems in Economics

The application of audio-tutorial systems in economics education has yielded significant benefits, as evidenced by several successful case studies and implementations worldwide. These systems leverage audio instructions along with visual aids to enhance learning experiences, making economic concepts more accessible and engaging for students. One

notable example is the integration of audio-tutorial systems in secondary schools in urban areas of the United States. Research by Kozma (2020) highlighted that students exposed to audio-tutorial systems showed improved comprehension of economic principles such as supply and demand, market structures, and economic policies. The interactive nature of these systems, which often includes simulations and real-world examples, helped students relate theoretical concepts to practical scenarios, thereby enhancing their understanding and application skills.

In developing countries like Nigeria, audio-tutorial systems have been employed to address the challenges of inadequate teaching resources and large class sizes in economics education. Research by Oyeleke et al. (2022) explored the implementation of these systems in secondary schools in rural areas. The study reported that students exposed to audio-tutorial systems demonstrated enhanced comprehension of economic concepts compared to their peers taught through traditional methods. The accessibility of audio-tutorial resources, which can be accessed offline and on low-bandwidth networks, proved crucial in bridging educational gaps and improving learning outcomes in resource-constrained environments.

Challenges and Barriers to Implementing Audio-Tutorial Systems

I Technological infrastructure and resource constraints

A significant challenge lies in the availability and adequacy of technological infrastructure necessary to support audio-tutorial systems. Schools in rural or underserved areas often lack sufficient access to reliable internet connectivity and modern computing devices, hindering the deployment and accessibility of audio tutorials. Moreover, acquiring and maintaining the necessary hardware and software can pose financial burdens on educational institutions, limiting widespread implementation (Garcia & Patel, 2021).

II Teacher training and professional development

Effective utilization of audio-tutorial systems requires teachers to possess adequate training and professional development. Many educators may lack familiarity with digital learning tools and pedagogical techniques needed to integrate audio tutorials effectively into their teaching practices. Training programs that focus on instructional design, multimedia content creation, and interactive engagement are essential to empower teachers and enhance their confidence in using audio tutorials as educational tools (Brown & Smith, 2021).

III Cultural and contextual factors influencing adoption

Cultural attitudes towards technology in education and institutional readiness vary significantly across different regions and educational contexts. Lee and Wong (2021) highlight that conservative attitudes towards digital learning methods and resistance to change among stakeholders, including administrators, teachers, students, and parents, can impede the adoption of audio-tutorial systems. Moreover, educational policies and curriculum frameworks may not always align with the integration of digital technologies, further complicating implementation efforts.

Addressing these challenges requires concerted efforts to improve technological infrastructure, provide comprehensive teacher training programs, and foster a supportive cultural environment that values and encourages innovation in educational practices. Collaborative initiatives between policymakers, educational leaders, technology providers, and community stakeholders are crucial to overcoming these barriers and realizing the full potential of audio-tutorial systems in enhancing learning outcomes in economics education.

Policy Implications and Recommendations.

Policy frameworks supporting educational technology integration

Policy frameworks supporting educational technology integration are crucial for fostering effective use of audio-tutorial systems in educational settings. Governments and educational authorities should prioritize investments in infrastructure and provide incentives for schools to adopt and sustain digital learning tools. Policies should also include guidelines for teacher training programs that equip educators with the necessary skills to integrate audio tutorials into their teaching practices. Additionally, frameworks should ensure equitable access to technology across all schools, addressing disparities in resource allocation and promoting inclusive educational opportunities for all students.

Recommendations for curriculum development and instructional practices

Recommendations for curriculum development and instructional practices advocate for a more dynamic and flexible approach to integrating audio tutorials into the curriculum. Curriculum developers should collaborate with educators and technology experts to design learning modules that align with audio tutorial capabilities, emphasizing interactive and multimedia-rich content. This approach not only enhances engagement but also supports diverse learning styles and promotes deeper understanding and retention of subject matter. Furthermore, incorporating assessments that measure both short-term achievement and long-term retention can validate the effectiveness of audio tutorials in achieving educational outcomes.

Future directions for research and practice in audio-tutorial systems

Future directions for research and practice in audio-tutorial systems should focus on expanding evidence-based research to understand their long-term impact on student learning and academic achievement. Research efforts should explore adaptive learning technologies within audio tutorials, personalized learning pathways, and the integration of artificial intelligence to enhance instructional effectiveness. Practitioners and researchers should collaborate to develop best practices and guidelines for optimizing the use of audio tutorials across different educational contexts and subject areas, fostering innovation and continuous improvement in educational technology integration.

These policy implications and recommendations underscore the importance of strategic planning and collaboration among policymakers, educators, researchers, and technology providers to harness the full potential of audio-tutorial systems in advancing educational outcomes and preparing students for a digitally driven future.

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IMPACT OF PEER FEEDBACK AND SELF-REGULATED INSTRUCTIONAL TECHNIQUES ON SECONDARYSCHOOL STUDENTS' LEARNING OUTCOMES IN COMPUTER STUDIES IN YOBE STATE: A REVIEW

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Abstract
This review paper critically examines the influence of peer feedback and self-regulated instructional techniques on the learning outcomes of secondary school students in computer studies within Yobe State, Nigeria. In an era where educational efficacy is increasingly linked to student engagement and active learning, this review synthesizes current literature to underscore the pivotal role of these instructional strategies in fostering a more interactive and student-centered learning environment. Peer feedback, characterized by students providing constructive critiques to one another, is explored for its potential to enhance collaborative learning, critical thinking, and self-reflection among students. In contrast, self-regulated instructional techniques are analyzed for their effectiveness in promoting autonomy, motivation, and personalized learning pathways. The integration of these approaches not only aligns with contemporary pedagogical frameworks but also addresses the diverse needs of learners in a rapidly evolving digital landscape. Additionally, this paper identifies the challenges associated with implementing these instructional techniques in the unique educational context of Yobe State, including infrastructural limitations, varying levels of teacher preparedness, and socio-economic disparities among students. By highlighting both the opportunities and obstacles, this review aims to provide valuable insights for educators, policymakers, and stakeholders in education, ultimately advocating for innovative practices that can improve academic performance and engagement in computer studies.

Keywords: Peer Feedback, Self-Regulated Learning, Instructional Techniques, Learning Outcomes and Educational Strategies

Introduction

Effective teaching strategies play a critical role in the academic success of students, particularly in fields like computer studies, where practical skills and theoretical knowledge converge. In an increasingly digital world, the demand for proficient computer skills has risen sharply, making it essential for educational institutions to adopt teaching methods that not only impart knowledge but also encourage active participation and critical thinking among students (Olelewe *et al*., 2023). The complexity of computer studies, which encompasses a wide range of topics from programming to information technology, necessitates an instructional approach that promotes engagement, problem-solving, and collaboration. Traditional teacher-centered methods often fail to foster the skills required for students to navigate this dynamic field effectively (Patience, 2022). Therefore, the integration of innovative instructional strategies, such as peer feedback and self-regulated learning, is vital to enhance student outcomes and prepare them for future challenges in the workforce.

In Yobe State, Nigeria, the educational landscape presents both challenges and opportunities for secondary education. The state has faced significant hurdles, including infrastructural deficits, a shortage of qualified teachers, and socio-economic factors that hinder student participation and performance (Md *et al*., 2020). Despite these challenges, there is a growing

recognition of the importance of improving educational practices to enhance learning outcomes. Recent initiatives have sought to reform teaching methodologies in secondary schools, emphasizing the need for student-centered approaches that promote engagement and collaboration (Olelewe *et al*., 2023). The implementation of effective teaching strategies in computer studies is particularly crucial, as the region seeks to cultivate a technologically literate workforce capable of contributing to the nation's socio-economic development.

This review aims to evaluate the impact of peer feedback and self-regulated instructional techniques on students' learning outcomes in computer studies within Yobe State. Peer feedback involves students assessing each other's work, providing constructive criticism, and fostering a collaborative learning environment that encourages interaction and shared understanding (Ateş Akdeniz, 2023). This approach not only enhances students' learning experiences but also cultivates essential skills such as critical thinking and communication. Self-regulated instructional techniques, on the other hand, empower students to take control of their own learning processes by setting goals, monitoring their progress, and reflecting on their achievements (Theobald, 2021).

By synthesizing current literature on these pedagogical strategies, this review seeks to provide insights into how these techniques can address the unique challenges faced bystudents in Yobe State's educational context. The paper will explore how peer feedback and self-regulation contribute to improved engagement, understanding, and performance in computer studies, thereby informing educators and policymakers about effective methods to enhance secondary education. Ultimately, the findings of this review will aim to support the development of a more interactive and responsive educational framework that meets the needs of learners in Yobe State.

Educational Context in Yobe State

Overview of Secondary Education

The current state of secondary education in Yobe State is characterized by a combination of significant challenges and emerging opportunities. As a region that has faced socio-political instability and economic constraints, Yobe State's educational infrastructure has suffered from a lack of resources, inadequate facilities, and a shortage of qualified teachers (Bürgermeister *et al*., 2022). According to Izere (2024), the literacy rate in Yobe State is notably lower than the national average, highlighting a pressing need for educational reform. Many secondary schools are underfunded and lack essential teaching materials, which hampers effective instruction and student learning outcomes.

Moreover, factors such as poor internet connectivity, especially in rural areas, exacerbate the educational challenges faced by students and teachers alike. These constraints have resulted in limited access to modern teaching methods and technologies, leaving students ill-prepared for the demands of the 21st-century workforce (Federal Ministry of Education, 2019). Despite these hurdles, there are ongoing initiatives aimed at improving educational standards in Yobe State, including government interventions and partnerships with non-governmental organizations (NGOs) that seek to enhance the quality of education through innovative programs and teacher training (Yobe State Universal Basic Education Board, 2022).

Significance of Computer Studies

In this context, computer education plays a vital role in equipping students with essential skills for the digital age. As the world becomes increasingly interconnected through technology, proficiency in computer studies is crucial for students to thrive academically and

professionally. Computer studies encompass a broad range of topics, including programming, information technology, and digital literacy, all of which are integral to understanding the modern workplace (Simonsmeier *et al*., 2020).

Furthermore, computer studies empower students to become creators rather than just consumers of technology. The integration of computer education in secondary schools fosters critical thinking, problem-solving skills, and creativity, which are essential for success in various career paths (Kumar *et al*., 2023). For instance, students learn to utilize software applications for data analysis, coding, and digital content creation, preparing them for the growing job market in technology and related fields.

In Yobe State, emphasizing computer studies can also address the challenges of unemployment and underemployment among youth. By providing students with relevant digital skills, the educational system can help bridge the gap between education and the labor market, contributing to the region's socio-economic development (Ibe *et al*., 2024). Therefore, enhancing computer education in secondary schools is not merely an academic concern but a strategic imperative for fostering sustainable development in Yobe State and beyond.

Self-Regulated Instructional Techniques

Self-Regulated Learning (SRL) refers to the processes by which learners activate and sustain their thoughts, behaviors, and emotions in the pursuit of their goals (Ateş Akdeniz, 2023). It encompasses a range of activities that allow students to take control of their own learning experiences, such as goal setting, self-monitoring, self-reflection, and the strategic use of learning resources. In the context of secondary education, particularly in subjects like computer studies, SRL is crucial as it empowers students to navigate the complexities of the curriculum independently and effectively. The theoretical framework surrounding SRL is largely grounded in social-cognitive theory, which emphasizes the interplay between personal factors, behavioral factors, and environmental influences in the learning process (Patience, 2022).

The relevance of SRL in secondary education cannot be overstated, especially in a rapidly evolving field such as computer studies, where students must continuously adapt to new technologies and methodologies. By fostering self-regulation skills, educators can help students develop lifelong learning habits that extend beyond the classroom. Students who engage in self-regulated learning are more likely to persist in the face of challenges, seek help when needed, and take initiative in their educational journeys (Theobald, 2021). This autonomy not only enhances their academic performance but also prepares them for future professional environments that require self-directed problem-solving and critical thinking.

A review of the literature on SRL strategies reveals a wealth of evidence supporting their effectiveness in improving academic outcomes across various disciplines, including computer studies. For instance, research has shown that interventions designed to enhance self-regulation—such as goal-setting exercises, self-reflection journals, and formative assessments can lead to significant gains in student achievement (Zhang & Zhang, 2024).

Moreover, SRL strategies have been linked to improved metacognitive awareness, enabling students to monitor their understanding and adjust their learning strategies accordingly. This heightened awareness is particularly important in computer studies, where students often encounter complex problem-solving tasks and must be able to assess their comprehension of

coding languages, algorithms, and software applications. Research indicates that students who practice self-regulation demonstrate not only better academic performance but also increased confidence in their ability to tackle challenging tasks (Dastidar, 2021; Bürgermeister*et al*., 2021). Consequently, the integration of SRL techniques into computer studies curriculacan be a transformative approach to enhancing learning outcomes.

Impact on Learning Outcomes

The impact of self-regulation on students' learning outcomes is multifaceted, particularly concerning motivation, autonomy, and problem-solving skills. Students who exhibit strong self-regulation tend to have higher intrinsic motivation, as they set personal goals and take ownership of their learning processes (Vasu *et al*., , 2021). In computer studies, this translates to increased engagement with the material, as students are more likely to explore topics in depth and seek out additional resources to enhance their understanding.

Furthermore, self-regulation fosters a sense of autonomy among students, allowing them to approach learning tasks with greater confidence and independence. Research by Kumar *et al*. (2023) highlights that self-regulated learners are better equipped to manage their time effectively, prioritize tasks, and adapt their strategies based on feedback. This autonomy is essential in a discipline like computer studies, where students often work on projects that require critical thinking and innovative problem-solving.

Additionally, self-regulated learning techniques enhance students' problem-solving skills, equipping them with the tools to analyze complex situations and develop effective solutions. By employing SRL strategies, students learn to break down problems into manageable parts, set realistic goals, and assess their progress toward these goals (Simonsmeier *et al*., 2020). This systematic approach not only leads to better academic performance but also prepares students for real-world challenges in their future careers. In summary, the integration of self-regulated instructional techniques in secondary education, particularly in computer studies, holds immense potential for improving student learning outcomes and preparing them for success in an increasingly digital world.

Challenges in Implementing These Techniques

Technical and Infrastructure Limitations

Implementing peer feedback and self-regulated instructional techniques in Yobe State's secondary schools faces significant challenges, particularly concerning technical and infrastructure limitations. Many schools lack essential resources such as computers, projectors, and reliable internet connectivity, which are vital for facilitating technology-enhanced learning (Simonsmeier *et al*., 2020; Theobald, 2021). Inadequate infrastructure can hinder the effective integration of digital tools that support peer feedback mechanisms and self-regulated learning strategies. For instance, without stable internet access, students cannot engage with online platforms for collaborative learning or utilize educational software that fosters self-assessment and reflection. This limitation exacerbates existing inequalities in educational opportunities, as students in well-resourced schools can leverage technology to enhance their learning experiences, while others remain at a disadvantage.

Moreover, the lack of technical support staff in schools further complicates the implementation of these instructional techniques. Teachers may face challenges in troubleshooting technical issues, leading to disruptions in the learning process (Md *et al*., 2020). Such disruptions can diminish the effectiveness of peer feedback and self-regulated learning strategies, as consistent access to technology is necessary for students to engage in

these practices. Consequently, addressing the infrastructural deficiencies in Yobe State is essential for the successful adoption of innovative instructional techniques that can enhance learning outcomes.

Teacher Preparedness

Teacher preparedness is another critical factor influencing the successful implementation of peer feedback and self-regulated instructional techniques. Many teachers in Yobe State may lack the necessary training and professional development to effectively integrate these methods into their instructional practices. Research indicates that professional development programs focused on enhancing teachers' pedagogical skills and technology integration are crucial for fostering a conducive learning environment (Vasu *et al*., 2022; Zhang & Zhang, 2024). Without adequate training, teachers may struggle to facilitate peer feedback sessionsor guide students in developing self-regulation skills, leading to suboptimal learning experiences.

Additionally, teachers must be comfortable using technology and incorporating it into their teaching. Many educators in Yobe State may have limited exposure to educational technology, resulting in anxiety or reluctance to employ these strategies in their classrooms (Patience, 2022). Providing ongoing professional development opportunities that focus on both pedagogical practices and technological proficiency can help equip teachers with the skills necessary to implement peer feedback and self-regulated learning effectively. This support is crucial in ensuring that teachers can create an engaging and supportive learning environment that fosters student autonomy and collaboration.

Socio-Economic Factors

Socio-economic factors significantly impact the implementation of peer feedback and self-regulated instructional techniques in Yobe State's secondary schools. Disparities in access to technology and educational resources among students from different backgrounds can lead to unequal learning opportunities. Students from low-income families may lack access to personal devices or a stable internet connection, limiting their ability to engage in collaborative online learning or utilize self-regulation tools (Olelewe *et al*., 2023). This inequity can create a divide in the effectiveness of peer feedback practices, as students with better access to resources can participate more actively and benefit more from these strategies.

Furthermore, socio-economic challenges can affect students' motivation and engagement in learning activities. Students from disadvantaged backgrounds may face additional stresses that impact their academic performance, such as financial instability or family responsibilities (Kumar *et al*., 2023). These factors can hinder their ability to engage fully in peer feedback and self-regulated learning practices, ultimately affecting their overall learning outcomes. Addressing these socio-economic disparities through targeted interventions, such as providing access to technology and supporting families, is essential for fostering an equitable educational environment that promotes the successful implementation of innovative instructional techniques.

Conclusion

In conclusion, this review has highlighted the significant potential of peer feedback and self-regulated instructional techniques in enhancing learning outcomes for secondary school students in computer studies within Yobe State. These instructional strategies can foster student engagement, autonomy, and collaboration, ultimately leading to improved academic performance. However, the successful implementation of these techniques is hindered by various challenges, including technical and infrastructure limitations, inadequate teacher

preparedness, and socio-economic disparities among students. Addressing these challenges is critical for creating a supportive educational environment that allows all students to benefit from innovative instructional practices.

Future Research Directions

To further explore the impact of peer feedback and self-regulated instructional techniques, future research should focus on longitudinal studies that assess the long-term effects of these strategies on academic achievement and personal development in students. Additionally, research that examines specific instructional strategies, such as the role of technology in facilitating peer feedback or the effectiveness of particular self-regulated learning interventions, would provide valuable insights for educators and policymakers. By investigating these areas, researchers can contribute to the development of evidence-based practices that support the continuous improvement of educational outcomes in Yobe State and beyond.

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SYSTEMATIC REVIEW OF MICROLEARNING MODE ON BIOLOGY STUDENTS' ACADEMIC ACHIEVEMENT IN NIGER STATE, NIGERIA

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Abstract
This paper presents a systematic review of the use of microlearning platforms in enhancing academic achievement among biology students in Niger State, Nigeria. Microlearning platforms have emerged as innovative tools that offer concise, focused learning content tailored to the needs of individual learners. This review synthesizes findings from studies conducted between 2010 and 2024, focusing on their impact on academic performance in secondary school biology education. The study highlights the effectiveness of microlearning in promoting student engagement, retention, and improved test scores. Furthermore, it identifies challenges related to the implementation of these platforms in the Nigerian context, such as infrastructure gaps and teacher readiness.

Keywords: Microlearning, Academic Achievement, Biology Education, Niger State, Educational Technology, Secondary Schools

Introduction
The integration of technology in education has revolutionized how content is delivered and consumed, and microlearning platforms have gained attention for their ability to provide bite-sized, on-demand learning materials. Microlearning refers to short, focused learning experiences designed to meet specific learning objectives (Hug, 2007). These platforms allow students to access educational content in small chunks, making it easier to digest and retain information. In subjects like biology, where understanding complex concepts is key to academic success, microlearning can enhance students' learning experiences and boost achievement (Buchem & Hamelmann, 2010).

In Nigeria, secondary school biology has been a subject of concern due to persistent challenges in student performance (Owolabi & Etuk, 2020). Traditional teaching methods often fail to cater to the diverse learning needs of students, leading to poor retention and understanding of core concepts (Fakoya, 2019). This has prompted educators to explore digital learning solutions, including microlearning platforms, to improve academic outcomes.

This systematic review aims to evaluate the impact of microlearning platforms on biology students' academic achievement in Niger State, Nigeria. The review focuses on empirical evidence from studies that explore the use of these platforms in secondary school settings.

Methodology
This systematic review follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Moher et al., 2009). A comprehensive search was conducted across academic databases, including Google Scholar, ERIC, JSTOR, and Scopus,

to identify peer-reviewed studies published between 2010 and 2024. The search terms used included "microlearning," "biology education," "academic achievement," "Niger State," and "secondary schools."

Literature Review

Microlearning in Education

Microlearning platforms have gained popularity for their ability to deliver educational content in short, manageable segments (Hug, 2007). These platforms use digital media such as videos, quizzes, and infographics to engage learners in interactive learning experiences. Research has shown that microlearning is particularly effective in promoting knowledge retention and improving learning efficiency (Buchem & Hamelmann, 2010). In biology education, microlearning can support students in mastering complex topics by breaking them down into smaller, more digestible units (Larsen & Butler, 2013).

Biology Education in Nigeria

Biology is a core subject in the Nigerian secondary school curriculum, and it is essential for students pursuing careers in science, technology, and healthcare (Fakoya, 2019). Despite its importance, student performance in biology has been suboptimal, with many students struggling to understand key concepts such as genetics, ecology, and cell biology (Owolabi & Etuk, 2020). Traditional teaching methods often rely on rote memorization, which fails to promote deep understanding or critical thinking. This has led to calls for innovative teaching methods, including the use of technology to improve learning outcomes.

Impact of Microlearning on Academic Achievement

Studies have demonstrated the positive impact of microlearning on student achievement across various subjects. For example, research by Embi and Nordin (2013) found that students who used microlearning platforms performed better on tests compared to those who received traditional instruction. In biology, microlearning has been shown to enhance students' ability to grasp complex topics by providing clear, concise explanations followed by interactive assessments (Buchem & Hamelmann, 2010).

Findings and Discussion

Effectiveness of Microlearning Platforms in Biology Education

The review found that microlearning platforms significantly improve academic achievement in biology. Studies conducted in Niger State report that students who used microlearning platforms demonstrated higher test scores and better retention of biological concepts compared to their peers who relied on traditional teaching methods (Fakoya, 2019; Adeyemi & Suleiman, 2021). This is particularly evident in topics like photosynthesis, human anatomy, and reproduction, where students benefited from the segmented, focused approach of microlearning.

Student Engagement and Motivation

One of the key benefits of microlearning is its ability to increase student engagement and motivation. In biology classes, students often struggle with maintaining attention during lengthy lectures, but microlearning offers an alternative by presenting content in short, engaging bursts (Embi & Nordin, 2013). Several studies found that students using microlearning platforms reported higher levels of satisfaction and a greater sense of accomplishment as they progressed through the course materials (Owolabi & Etuk, 2020).

Challenges in Implementing Microlearning in Niger State

Despite its potential, the implementation of microlearning platforms in Niger State faces several challenges. Infrastructure limitations, such as inconsistent access to electricity and internet connectivity, hinder the widespread adoption of these platforms in rural areas (Owolabi & Etuk, 2020). Additionally, teachers often lack the necessary training to effectively integrate microlearning into their lesson plans, limiting its impact on student achievement (Fakoya, 2019).

Gender Differences in Academic Achievement

Several studies included in the review explored the impact of microlearning on male and female students. While both genders benefited from the use of microlearning platforms, some studies suggested that female students showed greater improvement in certain biology topics, such as cell division and human reproduction, due to the personalized nature of the learning experience (Adeyemi & Suleiman, 2021). However, the overall impact of microlearning on academic achievement did not show significant gender disparities.

Conclusion and Recommendations

The systematic review confirms that microlearning platforms have a positive impact on biology students' academic achievement in Niger State, Nigeria. These platforms not only improve test scores but also enhance student engagement and motivation, making them a valuable tool for biology education. However, challenges such as infrastructure limitations and teacher preparedness must be addressed to fully realize the potential of microlearning in secondary schools.

To enhance the effectiveness of microlearning in biology education, the following recommendations are made:

Infrastructure investment: The government should invest in improving internet access and electricity supply in rural schools to facilitate the use of digital learning platforms (Owolabi & Etuk, 2020).

Teacher training: Professional development programs should be designed to equip teachers with the skills needed to integrate microlearning into their teaching practices (Fakoya, 2019).

Further research: Future studies should explore the long-term impact of microlearning on biology achievement and examine ways to overcome barriers to its adoption in Nigeria.
By addressing these challenges, microlearning platforms can play a pivotal role in transforming biology education in Niger State and beyond.

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DEVELOPMENT AND EVALUATION OF INTERACTIVE MOBILE APPLICATIONS FOR ENHANCING CLASSROOM MANAGEMENT STRATEGIES AMONG STUDENT TEACHERS IN NIGERIAN COLLEGES OF EDUCATION: A REVIEW

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Abstract
This review paper explores the development and evaluation of interactive mobile applications designed to enhance student teachers' understanding of classroom management strategies in Nigerian Colleges of Education. Classroom management is a critical skill for educators, particularly in developing nations where classroom environments often pose unique challenges. The integration of technology in teacher education, especially through mobile applications, has shown promise in addressing pedagogical gaps by providing flexible, interactive, and self-paced learning opportunities. This review synthesizes current literature on mobile learning technologies in teacher education, focusing on their role in improving classroom management competencies. It examines key studies that highlight the effectiveness of mobile applications in fostering active learning, collaboration, and better classroom control among student teachers. Additionally, the paper discusses the challenges and opportunities of implementing these tools in the Nigerian context, including issues such as technological infrastructure, digital literacy, and institutional support. The review concludes by recommending strategies for further research and suggesting improvements to make mobile learning applications more effective and widely adopted in teacher education programs in Nigeria.

Keywords: Interactive mobile applications, classroom management strategies, teacher education, Nigerian Colleges of Education, student teachers, educational technology, mobile learning, pedagogical innovation.

Introduction
Classroom management is a cornerstone of effective teaching and learning, especially in teacher education programmes. It involves a set of strategies and practices that teachers employ to create an organized, productive, and supportive learning environment (Emmer & Sabornie, 2021). The goal of classroom management is to minimize disruptions, manage student behavior, and foster student engagement to enhance academic performance. In the context of Nigerian Colleges of Education, student teachers face several challenges in managing classrooms, including large class sizes, limited resources, and students from diverse cultural and socio-economic backgrounds (Ajayi, 2022). These challenges make it essential for teacher education programs to provide comprehensive training on classroom management techniques to better prepare future educators for the realities of the teaching profession.

Research shows that poor classroom management can lead to increased student misbehavior, reduced learning time, and teacher burnout, highlighting its importance in the broader educational context (Wubbels *et al.,* 2021). Moreover, effective classroom management not only promotes a conducive learning environment but also helps in meeting educational goals such as improved student academic performance and emotional well-being (Evertson &

Weinstein, 2022). For student teachers in Nigeria, developing strong classroom management skills is critical for addressing the country's unique educational challenges, such as overcrowded classrooms, lack of instructional resources, and varying student learning needs.
In recent years, the integration of technology in education has emerged as a promising solution to various pedagogical challenges. Digital tools such as mobile applications provide flexible and engaging platforms that can support the learning process in teacher education programs. Specifically, mobile learning (m-learning) has become increasingly popular as it offers student teachers access to instructional materials and resources anytime and anywhere (Adebayo *et al.*, 2023). This flexibility is particularly important in Nigeria, where student teachers may have limited access to traditional educational resources, especially in rural areas.

Mobile applications designed for classroom management instruction enable student teachers to practice techniques in simulated environments, where they can experiment with different approaches without the pressure of real-time consequences (Ibrahim & Suleiman, 2021). These applications often include features such as scenario-based learning, quizzes, and real-time feedback, which enhance the learning experience and help student teachers internalize key classroom management concepts. Additionally, mobile apps encourage self-regulated learning, allowing student teachers to monitor their progress and adjust their learning strategies as needed (Oyeleke *et al.,* 2023).

In addition to physical and material challenges, student teachers also face the issue of managing diverse student populations. Nigerian classrooms are often composed of students from different cultural, linguistic, and socio-economic backgrounds, each with unique learning needs (Oyeleke *et al.,* 2023). As a result, student teachers must be equipped with the skills to manage this diversity while maintaining an inclusive and supportive learning environment. Classroom management training that incorporates cultural competence and differentiated instruction is essential for addressing these challenges and ensuring that student teachers can meet the needs of all their students.

The primary purpose of this review is to evaluate the effectiveness of interactive mobile applications in enhancing student teachers' classroom management competencies in Nigerian Colleges of Education. This review synthesizes recent literature on mobile learning and its application in teacher education, with a particular focus on classroom management training. It aims to highlight the benefits and challenges of implementing mobile applications in teacher education programs, particularly in the Nigerian context, where there are significant resource and infrastructural limitations. Furthermore, this review provides recommendations for future research and development, including the need for longitudinal studies to assess the long-term impact of mobile applications on student teachers' classroom management skills. By examining the current state of mobile learning in teacher education, this review aims to contribute to the ongoing efforts to improve the quality of teacher training in Nigeria and address the challenges faced by student teachers in managing classrooms.

Development of an Interactive Mobile Application

The interactive mobile application designed for student teachers in Nigerian Colleges of Education was developed with the specific goal of enhancing their understanding and practical application of classroom management strategies. The app is structured around four key features aimed at addressing the gaps in traditional teacher training methods. First, **video tutorials** are provided to give users a visual and auditory explanation of critical concepts such as setting classroom rules, managing disruptive behaviors, and promoting student engagement. These videos are designed to be accessible, allowing users to revisit them as needed to reinforce their

learning (Adesina *et al.*, 2023). Second, **scenario-based simulations** offer an interactive component that mimics real-world classroom situations, allowing users to make decisions in response to various classroom challenges. These simulations serve as practical exercises that bridge the gap between theoretical knowledge and real-life application, making learning more experiential (Gbenro & Oye, 2022). Third, **quizzes and feedback** are integrated at the end of each module to test the users' comprehension of the content. Immediate feedback is provided to help users identify areas for improvement, thus facilitating a formative learning process (Olawale & Bello, 2021). Lastly, the app incorporates **collaboration tools** such as forums and chat features, enabling peer-to-peer learning and the sharing of classroom management strategies, fostering a community of practice among student teachers.

Pilot Testing and Evaluation

To assess the effectiveness and usability of the app, a pilot test was conducted in several Nigerian Colleges of Education. This pilot study involved inviting student teachers to integrate the app into their classroom management training over a designated period. The objectives of the pilot were to evaluate the app's user interface, its impact on learning outcomes, and its overall relevance to the training needs of student teachers (Adebisi & Ugwu, 2023). Data were collected using a mixed-methods approach, including surveys, interviews, and performance assessments. Surveys measured user satisfaction, ease of use, and perceived educational value, while interviews provided qualitative insights into the users' experiences with the app. Performance assessments were used to gauge the improvement in classroom management skills, comparing pre- and post-app usage scores on standardized tests related to classroom management. This comprehensive approach ensured that both qualitative and quantitative data were available to assess the app's impact.

Impact on Learning Outcomes

Engagement and Motivation

The pilot testing of the interactive mobile application demonstrated a notable increase in student teachers' engagement and motivation. The dynamic nature of the app, particularly its interactive features like scenario-based simulations and video tutorials, contributed significantly to sustaining the users' interest. This is in line with contemporary research which shows that **mobile learning platforms**, by offering personalized and flexible learning experiences, tend to foster higher levels of engagement among students (Bozkurt & Sharma, 2021). The convenience of being able to access learning materials anytime and anywhere through mobile devices allows users to learn at their own pace, leading to a more immersive experience. Additionally, the interactive nature of these platforms not only attracts student teachers but also keeps them motivated by offering real-time feedback and tailored content, ensuring that they remain actively involved in the learning process.

Retention and Application of Classroom Management Skills

Another critical impact of the mobile application was its ability to enhance the retention and application of classroom management strategies among student teachers. The **combination of multimedia content**, such as video tutorials, quizzes, and hands-on scenario-based simulations, reinforced learning by engaging multiple senses, which is key to long-term retention. Studies have consistently demonstrated that **interactive learning environments**, particularly those integrating diverse formats such as video and simulations, improve knowledge retention and support the transfer of learned skills into practical settings (Xie *et al.*, 2022). By allowing student teachers to repeatedly practice classroom management scenarios in a safe, virtual environment, the app facilitated their ability to confidently apply the learned strategies during real-life teaching experiences. This suggests that integrating digital tools into

teacher education not only improves the theoretical understanding of concepts but also aids in practical implementation.

Collaboration and Peer Learning

The mobile app also made significant strides in promoting **collaboration and peer learning** among student teachers. Through its forums and chat features, the app created a collaborative environment where users could exchange ideas, share classroom management strategies, and discuss real-world classroom challenges. Peer learning is widely acknowledged as an effective method for improving learning outcomes, as students benefit from different perspectives and experiences (Johnson & Johnson, 2023). The collaborative aspect of the app aligns with **social constructivist theories** of learning, which emphasize the importance of interaction and shared knowledge in the learning process. By allowing student teachers to engage in meaningful discussions and provide feedback to one another, the app fostered a sense of community and collective problem-solving, which are essential for developing practical teaching skills.

Feedback and Continuous Improvement

The real-time feedback feature embedded within the app proved highly beneficial in reinforcing learning and encouraging continuous improvement. As student teachers engaged with quizzes and scenario-based tasks, they received immediate feedback on their performance, highlighting areas of strength and those requiring further development. This **formative assessment approach** is critical for sustained improvement, as it allows learners to monitor their progress and adjust their learning strategies accordingly (Shute, 2022). The continuous cycle of learning, practicing, and receiving feedback cultivated an environment where student teachers could refine their classroom management skills iteratively, leading to more robust and confident application of these strategies in actual classroom settings.

Impact on Learning Outcomes Beyond the Classroom

Beyond the immediate gains in classroom management skills, the app's broader impact on **learning outcomes** for student teachers was evident. It fostered critical thinking, problem-solving, and decision-making skills by simulating real-life classroom scenarios. These competencies are crucial not only for managing classrooms but also for overall professional growth as educators. Mobile learning platforms such as this have been found to promote **self-regulated learning**, where students take more ownership of their learning process (Zimmerman, 2021). In this context, student teachers who used the app were not only better equipped to manage classroom behavior but also demonstrated greater autonomy and responsibility in shaping their pedagogical approaches, contributing to their overall effectiveness as future educators. The app's ability to integrate theory with practice, coupled with its collaborative features, suggests its potential to significantly elevate the quality of teacher education programs.

Future Directions and Recommendations

Further Research on Effectiveness

While the pilot study of the interactive mobile application for classroom management in Nigerian Colleges of Education has yielded encouraging results, further research is necessary to evaluate the long-term impact of the app on student teachers' skills. The initial data demonstrated improvements in confidence and competence in classroom management. However, it remains unclear whether these improvements translate into sustained performance once student teachers enter real classroom environments. **Longitudinal studies** could provide valuable insights by tracking the app’s influence over extended periods, possibly following student teachers through their teaching practice and into their early years as full-time educators.

This would help determine whether the app's benefits endure beyond the training phase and identify any additional areas for enhancement (Eze, 2023). Furthermore, research could focus on the app's effect on specific classroom challenges, such as managing diverse learning needs or integrating inclusive education practices.

Addressing Challenges of Teacher Preparedness and Socio-Economic Disparities

One of the primary concerns in ensuring the success of this app is the **preparedness of teachers to integrate technology** into their training and classroom management practices. Teacher educators must be adequately trained not only in how to use the app but also in how to facilitate its integration into broader teaching and learning activities. This requires investment in **professional development programs** for teacher trainers, ensuring that they are equipped with the necessary skills to mentor student teachers in the use of the app (Olawale & Bello, 2021). Moreover, socio-economic disparities in access to technology—particularly in underserved or rural areas—pose significant challenges. Addressing this requires comprehensive strategies, such as providing low-cost devices or partnerships with tech companies to reduce the financial barriers for student teachers. Solutions like pre-loading educational materials on mobile devices or setting up local hubs where students can access the app could help mitigate these challenges and ensure equitable access across different socio-economic groups.

Conclusion

In conclusion, the development and evaluation of the interactive mobile application designed to enhance classroom management strategies in Nigerian Colleges of Education hold great potential for improving the quality of teacher education. The integration of mobile technologies into teacher training has proven to enhance engagement, knowledge retention, and the application of critical classroom management skills. However, several challenges remain, including technical limitations, teacher preparedness, and socio-economic disparities in access to technology. **Collaboration among stakeholders**, ongoing research into the long-term effectiveness of the app, and efforts to scale and customize the application to meet diverse educational needs are crucial for fully realizing the potential of this tool. As mobile learning continues to evolve, it is vital to ensure that these innovations become an integral part of teacher education in Nigeria, fostering more effective, well-prepared educators for the future (Eze, 2023; Gbenro & Oye, 2022).

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THE USE OF 21ST CENTURY TECHNOLOGY SKILLS AS AN INNOVATIVE PEDAGOGICAL TOOL

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Abstract
The current state of teaching mathematics in most Nigeria schools today is faced with significant challenges. These challenges range from poor teaching strategies, poor learning outcomes, and non usage of technological skills, amongst others. This is due to the fact that, traditional methods have proven ineffective in engaging students. Innovative teaching approaches are required in order to improve mathematics education in Nigeria schools. Teachers need to adapt new methods of enhancing student engagement and achievement, through the use of 21st century technology skills and real-world applications; this will make mathematics more relevant. Innovation in teaching mathematics can spark interest and passion for the subject; it can also lead to better problem-solving skills and critical thinking abilities. This paper therefore seeks to highlight these numerous technology skills as well as enumerate their importance and method of application.

Keywords: 21st century skills, technology, innovative pedagogy.

Introduction
Mathematics describes the structure of order and relation evolving from century (Dictionary Britannica, 2004). Mathematics is pivotal to almost all science related courses, this includes, physics, engineering, computer science and so on (Gambari, 2006). Mathematics means operation with numbers; these operations are based on our daily life activities. It is asserted that if each operation is well explained to the students and related to their daily life activities, students would be able to analyze, synthesize as well as apply such knowledge to their everyday life problems. (Kurumeh, 2004) These aspects of the blooms taxonomy are referred to as the higher order objectives; hence mathematics if well taught can foster the higher order thinking skills. Approaching mathematics, as a daily life requirement, makes mathematics enjoyable at every stage of learning. To crown it all herein lies the aim of this study, which includes enhancing assessment, critical reasoning, logical thinking and problem solving all through the use of 21st century technology skills.

Mathematics education is known as the didactics or pedagogy of mathematics as the practice pf teaching, learning and carrying out scholarly research aimed at transferring mathematical knowledge (Badmus, 2002). Mathematics education is not only about learning numbers, formulas, and equations, it also encapsulates developing critical thinking, problem-solving, creativity, and communication skills that are essential for the 21st century. 21st century technology skills on the hand refers to all of the following, critical thinking, problem solving, logical reasoning, creativity and innovation, decision making, meta-cognition, communication, collaborative learning, information literacy, and life and career skills (Suh, 2010).

Technology
This is the application and use of some specific or defined instruments, gadgets, software and programs, made by humans that are capable of assisting human in solving some life challenging

problems, so as to achieve the required desire. Some of these technologies includes, the use of magic slate, magic lantern, blackboard, OHP, radio, Slide rule videotape, television, calculator, computer, interactive board, Apple I pad all others that comes with such technologies (KingSears, 2009).

The current state of teaching mathematics in most Nigeria schools today is faced with significant challenges. These challenges may range from poor teaching and poor learning outcomes, lack of interest from learners, non readiness to learn, lack of technological infrastructure among others. This challenges could stem from the inefficiency of the traditional methods of teaching which has been proven to be ineffective in engaging students, lack innovative teaching approaches and hence unable improve mathematics education in Nigeria schools (Dick, 2010). This simply implies that teachers need to adapt new methods of enhancing student engagement and achievement through technology and real-world applications that can make mathematics more relevant.

Innovative pedagogy

Innovative pedagogy refers to instructional strategies or instructional approaches that positively impact students learning, behaviors and attitudes and are capable of ensuring, that all students achieve the defined course, or program learning outcome, necessary to demonstrate the expected graduate attributes (Maharaj et al, 2019). Innovative pedagogy fosters solving a real problem in a new, simple way to promote learning (Adolphus, 2011). Innovation in teaching mathematics can spark interest and passion for the subject; it can also lead to better problem-solving skills and critical thinking abilities.

Technology in the Mathematics Classroom:

In primary school, it is important to learn to do arithmetic fluently, using technology to do this thinking for the pupils at primary school level, would be inappropriate. But in secondary school, however, students have mastered arithmetic and should focus more on advanced skills and concepts. Here incorporating computational support is very important and not out of place. Nelson, J,et'al (2019). Therefore teaching mathematics using technology is the best solution for this. By applying technology, teachers can develop students' higher-order thinking skills and creativity. The use of technology when studying mathematics is not a new issue, since humankind always has been looking for solutions to avoid time consuming routine work (Gadanidis, 2010). The use of technology has a long history in mathematics. Technology is an essential tool for learning mathematics in the 21st century, and all educational institutions must ensure that all their students have to access technology.

According to (Abaniel,2021), while there is a growing trend towards integrating technology in mathematics classes, not all teachers and students are equally familiar with its usage, with many educators still needing to develop their skills in effectively incorporating technology tools into their curriculum and for students to learn how to use them appropriately for mathematical learning; a significant portion of teachers and students are now comfortable using technology in mathematics class, but there is still room for improvement in understanding how to best utilize its potential for deeper learning.

Teachers Role in the use of 21st century technology skills

In a balanced mathematics program, the strategic use of technology enhances mathematics teaching and learning. Teachers must be knowledgeable decision makers in determining when and how their students can use technology most effectively. Knowledgeable teachers have

adequate resources to support their work and are continually growing as professionals (Dick, 2011).

They serve as facilitators of learning: This implies teachers must develop new teaching strategies that are radically different in order to help students develop higher thinking skills.

The controller: Here the teacher is completely in charge of the class, what students do what they say, and how they say it. The teacher ensures this so as to ensure 21st century technology skills are integrated.

The prompter: Teachers encourage students to practice and make suggestion about how students may proceed, in an activity thereby helping students only where necessary.

The resource manager: The teacher is a kind of working resource centre ready to offer help when needed.

Use of ICTs in Mathematics Teaching and Learning in School

The teachers of the school should be guided urgently, In this case, on the importance of the use of ICTs skills as they work hand in hand with these 21st century technology skills (Koehler et al., 2014). This is because if the trained teachers are taught to connect with ICT in mathematics, they will be able to apply it in future school courses, various mathematical images of geometry can be presented to the students using a projector. The use of ICT in two-dimensional and three-dimensional imagery will give an obvious idea to the students. With the help of the Internet, new information and data are always available to the students. With different theories of trigonometry, it is possible to make ICT dependent on practical applications. Self-Regulated students are aware of their academic strengths and weaknesses and are well versed in the strategies they use to address the day-to-day challenges of academic work (Dweck & Leggett, 2019).

Benefits of Technology in Math Classrooms

Technology can help students develop 21st century skills in mathematics teaching and learning in a number of ways, this includes;

Visualizing concepts: Technology can help students visualize abstract mathematical concepts and make connections between ideas through digital tools.

Increasing engagement: Technology can help students become more engaged, interested, and motivated in learning math.

Developing creativity: Digital technology can help students develop creativity, which is considered a 21st century skill.

Using tools strategically: Students can use tools like graphing calculators, spreadsheets, and computer algebra systems strategically.

Communicating insights: Students can use technology to communicate mathematical insights by constructing graphical representations of functions and data.

Other 21st century skills that are important in mathematics education include: Mathematical literacy, Critical thinking, Self-awareness, and Planning and organizing learning.

Educators can also use technology to create more dynamic, student-centered approaches to teaching, such as flipped classrooms, gamification, and blended learning.

Problem solving: Students can learn to identify problems, select strategies, and find solutions. They can also learn to use past knowledge to solve new problems.

Creativity and innovation: Students can learn to find creative solutions to problems, and to look for patterns that can be used as shortcuts.

Logical reasoning: Students can learn to give reasons for their thinking, and to use logic to explain arguments.

Collaboration: Students can learn to work together, and to promote each other's viewpoints. Other ways to support 21st century skills in math education include: Aligning standards and assessments with desired outcomes, Promoting inquiry and exploration, Supporting equity and diversity, and Enhancing professional learning for teachers and leaders.

Personalized Learning: Technology allows educators to cater to individual student needs.
Real-Time Feedback: Students receive immediate feedback on their performance.
Access to Resources: Technology provides access to a wide range of math resources.

Challenges in Learning both Mathematics Content and Computer Technology
Difficulties in using ICT and math software are related to the weakness of any mathematics teacher's knowledge of what technology is available and how to use them when teaching mathematics. There are a significant number of teachers and students in most public secondary schools in Nigeria who are yet to get familiarized with the usage of technological skills in teaching and learning mathematics at this 21st century (Koehler et al., 2014). Despite the fact that technology has been acknowledged as one of the leading incredible instrument in education and has been utilized more and more in teaching and learning of mathematics (Berg et al., 2020). Without adequate familiarity and usage of these Technological skills for mathematics classrooms in secondary schools, teaching and learning will continue to face set back especially because some students have alleged that mathematics is an impossible discipline.

People who have worked on the use of the 21st century technology skills
There is however scarcity of research documents that has covered secondary schools in some parts of Nigeria on this topic. Some sizable body of research that has been done on the use of ICT in teaching and learning in schools includes: Kariuki and Wachira, (2016) and Brinda (2019). Therefore, there is need for more research on familiarity and usage of technological skills on teaching and learning of mathematics among secondary schools teachers.

Some excellent research works are in supports of incorporation of ICT into teaching and learning, demonstrating its positive impact on student engagement, achievement, and overall learning outcomes (Kariuki, 2016). The educators must be encourage where necessary to migrate from traditional method to embraces ICTs tools and utilize them to create dynamic and interactive learning atmosphere. ICT provides educators with tools that facilitate personalized learning experiences, adapt to the unique needs of each student, and enhance knowledge retention.

In addition, it improves the transparency of attendance and grading processes, facilitating communication among teachers, students, and parents. This comprehensive approach generates

a more engaging, effective, and student-centered learning environment that prepares students for success in the digital age. Mathematics teachers will have to take considerable challenges in both math content and computer technology.

Environment Factors Affecting Students' Learning towards Mathematics

Multiple studies have attempted to explain the impact of mathematics education on a variety of factors. Recently, many researchers have demonstrated that students' learning is influenced by elements of their learning environment such as course curriculum, teacher support, assessment methodology, parenting influence, teaching facilities, and so on. (Yüksel Dede, 2016). This can be corrected through 21st century technology and ICTs Tools that are environmental friendly.

Students' Factors towards Mathematics Learning

According to many, students' factors with environmental factors can affect their mathematics learning effectiveness. Studies show that teaching methods in mathematics should be developed in terms of students' reasons. The students' attitude towards mathematics is the main factor influencing the learning outcomes of mathematics. This can be checkmated via technology and ICTs Tools that motivate and tantalizes students' enthusiasm toward learning.

Needed skills in ICT to tackle effective teaching and learning

ICT in Teaching and Learning environment: Information and Communication Technology (ICT) has emerged as a powerful force for enhancing teaching and learning in our today's educational environment. ICT in teaching and learning refers to the use of technology, such as notebooks (such as Chrome books and Prime books), and tablets with learning applications, with or without the Internet, to improve the educational experience for both teachers and students.

It involves the implementation of various software applications and methodologies designed to enhance the quality and effectiveness of education. This integration seeks to streamline instructional power and practices, making them more accessible and effective for all stakeholders, going beyond mere hardware and software.

Conclusion

Researchers have found that when technology makes abstract ideas tangible,

1. Teachers can more easily build upon students' prior knowledge and skills,
2. Emphasize the connections among mathematical concepts,
3. Connect abstractions to real-world settings.
4. Accept that technology is used not only to complement mathematics teaching and learning, but also to prepare all students for their future lives.

Recommendations

It is recommended that considering the fact that the use of the 21st century technological skills cannot be ignored, the following is very important;

1. All teachers should be properly trained in these skills
2. It should be noted that 21st century technology skills do not only involve the use of ICT but also social and empathetic skills such as emotional intelligence critical thinking and a whole lot of others.
3. Where possible conference and workshops should be frequently organized to keep teachers informed of innovations in the industry.

4. Learners should be allowed to learn from their mistakes through experimentations and not protecting them from making mistakes.

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COMPOSITE AND RELATIVE EFFECT OF INFORMATION LITERACY SKILLS AND UTILIZATION OF ELECTRONIC INFORMATION RESOURCES AND JOB PERFORMANCE OF LEGAL PRACTITIONERS IN NORTHERN NIGERIA

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Abstract
This study examined the composite and relative effect of information literacy skills and electronic information resources utilisation as correlate and job performance of legal practitioners in Northern Nigeria. The study was guided by 2 research objective and 2 research hypothesis. The population of the study consisted of 2,150 legal practitioners in 20 in Northern States including Abuja. The study employed descriptive survey research design to elicit information from the respondents. Multi-stage sampling procedure was used for selecting sample size of 362 legal practitioners from the population of 2,150 within the 20 states of Northern Nigeria including Abuja. The instruments used in collecting data are observation checklist and questionnaire. Three hundred and sixty-two (362) copies of questionnaire were administered out of which Three hundred and fourty-six (346) copies were filled, returned and found useful. Data were analysed using inferential statistics. Hypotheses testing showed that there the independent variables (information literacy skills and utilization of electronic information resources) jointly contributed significantly to job performance of legal practitioners and there are relative contributions of the independent variables (information literacy skills and utilization of electronic information resources) to job performance of legal practitioners in Northern Nigeria. Based on the findings from the study conclusion is drawn, and recommendations were provided.

Keyword: information literacy skills, Utilisation, Electronic information resources, Job performance, Legal Practitioners, Nigeria

Introduction

The legal profession is a globally recognized and influential field that operates on the foundation of accurate and timely information. Lawyers rely on access to updated legal resources to effectively interpret laws, present arguments, and provide informed counsel. In

today's digital age, electronic information resources have become indispensable to the practice of law, enhancing both efficiency and accuracy. According to recent literature, legal practitioners increasingly depend on advanced information technology to access comprehensive legal databases, stay informed on new developments, and enhance their research capabilities (Mulligan and Barstow, 2023). The integration of digital tools into legal practice has reshaped how legal professionals gather and apply information, underlining the importance of staying up-to-date in this dynamic field.

Job performance in the legal profession refers to how effectively a legal practitioner fulfills their duties and responsibilities, which encompass providing sound legal advice, representing clients, drafting legal documents, and appearing in court. According to Beaton and Shepherd (2022) legal practitioner's performance is largely evaluated based on their ability to achieve favorable outcomes for clients, maintain ethical standards, and contribute positively to the judicial system. Key determinants of job performance in this field include legal knowledge, analytical skills, communication proficiency, and professional conduct.

A significant aspect influencing the job performance of legal practitioners today is the effective use of up-to-date information resources. According to recent studies, the advent of digital legal databases and other electronic information systems has become essential for legal professionals to maintain high standards of performance. Lawyers who utilize these resources can efficiently gather relevant case law, statutes, and other legal precedents, thereby improving their case preparation and argumentation (Mulligan and Barstow, 2023).

Adekoya (2021) highlighted that in Nigeria, where the legal system continues to evolve, the job performance of lawyers is further influenced by their adherence to procedural standards and their ability to navigate the complexities of local and international laws. As technology becomes more integral to legal practice, the performance of legal practitioners will increasingly depend on their capacity to harness these digital tools effectively. This reliance underscores the importance of continuous learning and adaptation in maintaining high levels of performance in the legal profession.

To effectively utilize electronic information resources, legal practitioners must be information literate. Information literacy encompasses the skills to locate, evaluate, and ethically use information from a variety of digital sources. In the legal profession, where access to accurate and timely information is crucial, being information literate enables lawyers to efficiently navigate online legal databases, interpret legal precedents, and apply relevant case law to their practice. As Eisenberg (2022) points out, the ability to critically assess the quality and relevance of digital information is vital for effective decision-making in legal practice. Furthermore, Owens and Macmillan (2021) emphasize that information literacy in the legal field is increasingly seen as a core competency, as it enhances research efficiency and ensures that practitioners remain well-informed in a fast-evolving legal landscape.

In the context of Nigeria, Akinola (2020) highlighted the growing need for information literacy among Nigerian legal professionals, noting that those who are capable in navigating platforms like LawPavilion and Legalpedia perform better in legal research and courtroom argumentation. As the profession continues to embrace digital tools, being information literate will be an essential skill for maintaining high standards of legal practice.

Statement of the Research Problem

The legal profession in Northern Nigeria, like in many parts of the world, is increasingly reliant on electronic information resources for legal research, case management, and overall job performance. However, the effective utilization of these resources is largely dependent on the information literacy skills of legal practitioners. While electronic legal databases and online resources offer immense potential for improving efficiency and accuracy in legal practice, many legal practitioners in Northern Nigeria struggle with fully harnessing these tools due to varying levels of information literacy.

This poses a significant challenge to their job performance, particularly in staying up-to-date with legal developments, applying relevant precedents, and effectively managing cases. The problem is compounded by the fact that inadequate information literacy skills can lead to inefficiencies, errors in legal interpretation, and a general decline in the quality of legal services provided. Thus, there is a pressing need to understand the composite and relative effects of information literacy skills and the utilization of electronic information resources on the job performance of legal practitioners in Northern Nigeria. Identifying these relationships will help address the skill gaps and improve the overall efficiency and competence of legal professionals in the region (**Eisenberg, 2022; Akinola, 2020**).

Aim and Objective of the Study

The study titled "Composite and Relative Effect of Information Literacy Skills and Utilization of Electronic Information Resources on Job Performance of Legal Practitioners in Northern Nigeria" will be guided by the following objectives:

1. To ascertain if there is any composite effect of information literacy skills and utilization of electronic information resources and job performance of legal practitioners in Northern Nigeria.
2. To determine if there is any relative effect of information literacy skills and utilization of electronic information resources and job performance of legal practitioners in Northern Nigeria

Research Hypotheses

The following null hypothesis will be tested at 0.05 level of significance:

1. There is no significant composite effect of information literacy skills and utilisation of electronic information resources and job performance of legal practitioners in Northern Nigeria.
2. There is no significant relative effect of information literacy skills and utilisation of electronic information resources and job performance of legal practitioners in Northern Nigeria.

Significance of the Research

The research on the "Composite and Relative Effect of Information Literacy Skills and Utilization of Electronic Information Resources on Job Performance of Legal Practitioners in Northern Nigeria" holds significant importance for various stakeholders in the legal profession, education, and broader societal development.

This study will provide valuable insights to ministry of justice into how information literacy and the use of electronic information resources directly affect the efficiency and effectiveness of legal practitioners in Northern Nigeria.

The research results could serve as a basis for policymakers in Nigeria to formulate strategies aimed at improving access to electronic legal resources and enhancing information literacy training for legal practitioners. Legal practitioners with strong information literacy skills and proficient use of electronic resources are better equipped to deliver informed, timely, and accurate legal services.

By focusing on the utilization of electronic resources and improving information literacy, this study may help address disparities in the legal profession and contribute to the growing body of literature on the intersection of legal practice, technology, and information literacy Northern Nigeria.

Scope of the Study

Content Scope: The study focuses on analyzing the composite and relative effect of information literacy skills and utilization of electronic information resources and job performance legal practitioners', and the impact on their job performance. It examines the composite (combined) and relative (individual) effects of these factors on how effectively legal practitioners perform their duties, including legal research, case preparation, and courtroom performance.

Geographical Scope: The study is geographically limited to Northern Nigeria, including legal practitioners working in various ministries of justice, law firms, and legal departments in the following states: Abuja (Federal Capital Territory), Adamawa, Bauchi, Benue, Borno, Gombe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Kogi, Kwara, Nasarawa, Niger, Plateau, Sokoto, Taraba, Yobe, and Zamfara.

Literature Review

Research conducted by Danjuma (2023) on composite Effects of Information Literacy Skills and Electronic Resources on Legal Practice: Northern Nigeria (Kano, Katsina, and Jigawa States). the population of the study are 250 legal practitioners in northwest Nigeria. A quasi-experimental design was used, with practitioners divided into two groups: one receiving training on information literacy and electronic resource usage and the other not. Job performance was measured before and after the intervention using performance appraisal metrics from employers.

Findings of the study revealed that the group receiving training showed significant improvement in job performance metrics, including research accuracy and time management, compared to the control group. The composite effect of enhanced information literacy skills and increased use of electronic resources resulted in a notable increase in overall job performance among participants.

Umar and Danjuma (2020) investigated the relative effects of information literacy and digital resources on the job performance of lawyers in Northern Nigeria (Abuja, Niger, and Plateau). 300 legal professionals, including solicitors and barristers served as the population of the study. A comparative study using both quantitative and qualitative methods was adopted. The quantitative data was gathered using structured questionnaires distributed to 300 lawyers, while qualitative data was obtained through interviews with 20 senior lawyers to assess their views on the effect of information literacy and digital resources.

The findings of study revealed that both information literacy and the use of digital resources were positively correlated with job performance, but their individual effects varied. The

relative effect of information literacy on job performance was greater than the effect of digital resource utilization. However, the study emphasized that effective use of electronic resources was dependent on having strong information literacy skills. Lawyers who scored higher on information literacy were better able to utilize electronic resources to enhance their work, leading to faster and more accurate legal analysis and case preparation.

Research Methodology

This study adopted a survey research design. This is because survey research is effective and efficient in gathering relevant data. The study's population comprised of 2,150 legal practitioners across 20 Northern States, including the Federal Capital Territory (FCT), Abuja. These states are Abuja (FCT), Adamawa, Bauchi, Benue, Borno, Gombe, Jigawa, Kaduna, Kano, Katsina, Kebbi, Kogi, Kwara, Nasarawa, Niger, Plateau, Sokoto, Taraba, Yobe, and Zamfara.

A multi-stage sampling technique was employed to determine a sample size of 362 participants. Initially, a stratified sampling technique was used, dividing the population into mutually exclusive groups, or strata. After which simple random sampling through balloting was conducted to select three states from each of the three geo-political zones in Northern Nigeria. Finally, proportionate sampling was used to determine the sample size from each selected state, resulting in 362 participants. Data was collected via a structured questionnaire, and statistical analysis was conducted using multiple regression techniques to determine the composite and relative effect.

Results

Hypothesis

Ho_1 There is no significant composite effect of information literacy skills and utilisation of electronic information resources and job performance of legal practitioners in Northern Nigeria.

Table 1. ANOVA Regression Analysis on composite effect of information literacy skills and utilisation of electronic information resources and job performance of legal practitioners in Northern Nigeria

Source	DF	Sum of square	Mean Square
Regression	2	8654.334	4327.167
Residual	343	2264.128	6.601
F-statistics	655.536		
S-g F	.000[b]		
Std. Error of the Estimate	2.56923		

*The asterisks ** indicate significance* at *5%. The figures in parenthesis ( ) are standard errors. Source: Computed by the researcher using IBM SPSS version 20 (2023)*

The results from Table 1 indicated a composite effect of information literacy skills and the utilization of electronic information resources on the job performance of legal practitioners in Northern Nigeria ($F(4,343) = 655.536$, $p < 0.05$). The obtained p-value being less than 0.05 signifies statistical significance. This suggests a significant composite effect of information

literacy skills and the utilization of electronic information resources on the job performance of legal practitioners in Northern Nigeria.

Ho_2 There is no significant relative effect of information literacy skills and utilisation of electronic information resources and job performance of legal practitioners in Northern Nigeria.

Table 2 Multiple Regression Analysis on relative effect of information literacy skills and utilisation of electronic information resources and job performance of legal practitioners in Northern Nigeria

Variables	Coefficients	SE	t-values	P-Values
Information	.678	.042	16.324	.000
Utilization	.094	.017	5.413	.000
R Square	.793			
Adjusted R Square	.791			
Durbin-Watson	.085			

*The asterisks ** indicate significance* at *5%. The figures in parenthesis ( ) are standard errors. Source: Computed by the researcher using IBM SPSS version 20 (2023)*

Table 2 presents the results regarding the relative contributions of the independent variables (information literacy and utilization) to the dependent variable (job performance), expressed as beta weights using standardized regression coefficients to determine their relative impacts. The results reveal a coefficient of multiple correlations (R) of 0.890, a multiple R square of 0.793, and Adjusted R2=0.791. This suggests that 79% of the variance in job performance is explained by the independent variables (information literacy and utilization) when considered together.

Information literacy emerges as the primary contributor to job performance ($\beta = 0.678$, $t= 16.324$, $p < 0.05$). This indicates that information literacy skills significantly influence the job performance of legal practitioners in Northern Nigeria. Conversely, the utilization of electronic information resources demonstrates a lower contribution ($\beta = 0.094$, $t= 5.413$, $p < 0.05$), albeit still statistically significant. Thus, it can be inferred from the findings that while information literacy skills are the predominant factor affecting job performance among legal practitioners in Northern Nigeria, the utilization of electronic information resources also plays a noteworthy role in contributing to their job performance.

Discussions of the Findings

Hypothesis One: Composite effect of information literacy skills and utilisation of electronic information resources and job performance of legal practitioners in Northern Nigeria.

The finding of this study revealed that the joint contribution of information literacy skills and the utilization of electronic information resources to the job performance of legal practitioners in Northern Nigeria has a significant relationship, it's important to acknowledge contrasting perspectives from existing literature.

Studies such as Goodman & Houghton (2020) have consistently shown that the combined effect of information literacy and access to electronic resources leads to improved efficiency in legal research and case preparation. The integration of these skills enhances a legal practitioner's ability to retrieve relevant case law, analyze legal precedents, and manage information effectively, thereby contributing to better job performance. Similarly, Ibrahim & Ali (2021) concluded that legal professionals who utilized electronic resources alongside strong information literacy skills were better equipped to handle complex legal matters, and their overall productivity was significantly higher.

In this study, both variables together created a synergy, enabling practitioners to maximize the utility of available resources, reduce time spent on legal research, and increase the accuracy of legal arguments. This outcome is consistent with findings from Alzahrani (2019), which noted that the intersection of information literacy and technological tools in professional environments directly enhances job outcomes.

Hypothesis Two: Relative effect of information literacy skills and utilisation of electronic information resources and job performance of legal practitioners in Northern Nigeria.
The finding revealed that there is relative effect to both information literacy skills and the utilization of electronic information resource contributing significantly to the job performance of legal practitioners in Northern Nigeria. The significant contributions of information literacy skills and electronic information utilization imply that legal practitioners benefit from possessing a diverse skill set encompassing both traditional information literacy competencies and proficiency in navigating electronic resources. While information literacy and electronic information utilisation are distinct constructs, they often interact synergistically to enhance job performance.

However, contrasting studies have presented an opposing view, suggesting that the relative effect of information literacy and electronic resources may not always be as significant in certain contexts. For instance, Jin & Walker (2020), in their study of legal practitioners in developing regions, argued that the impact of information literacy and electronic resources on job performance can be mitigated by external factors such as infrastructural challenges, lack of technical support, and unreliable access to the internet. In regions where these external barriers are prevalent, the potential positive effects of information literacy and electronic resource utilization are not fully realized.

Similarly, Ogunleye (2021) found that in some parts of Nigeria, legal practitioners who had access to electronic resources but lacked consistent electricity or internet access did not benefit as much from these tools. This suggests that while the joint contribution of information literacy and electronic resources is theoretically sound, practical limitations can dilute its effectiveness in certain environments.

Summary of the Findings

1. The independent variables (information literacy skills and utilization of electronic information resources) jointly contributed significantly to job performance of legal practitioners in Northern Nigeria.
2. There are relative contributions of the independent variables (information literacy skills and utilization of electronic information resources) to job performance of legal practitioners in Northern Nigeria.

Conclusion

The results of this study demonstrate that both information literacy skills and the utilization of electronic information resources play crucial roles in the job performance of legal practitioners in Northern Nigeria. The findings revealed that:

Joint Contribution: Information literacy skills and the utilization of electronic information resources collectively made a significant impact on the overall job performance of legal practitioners. This suggests that the integration of both these skills and resources into legal practice creates a positive synergy, enabling legal practitioners to be more effective and efficient in their professional duties, such as legal research, case management, and decision-making.

Relative Contribution: Each independent variable, information literacy skills and utilization of electronic information resources, made a unique contribution to job performance. Legal practitioners who demonstrated higher information literacy were more adept at locating, evaluating, and applying legal information, while those who made greater use of electronic resources improved their research speed and accuracy. The relative contributions of these variables highlight the importance of not only possessing strong information literacy skills but also being proficient in utilizing modern legal technologies and electronic databases.

In conclusion, enhancing both information literacy and access to electronic resources will result in improved job performance among legal practitioners in Northern Nigeria. Therefore, targeted interventions by the Government and Ministries of justice, such as training programs and improved access to electronic legal resources, should be prioritized to optimize the efficiency and effectiveness of legal professionals in this region.

Recommendations

Based on the results obtained in this research, which indicated that both information literacy skills and the utilization of electronic information resources significantly contribute to the job performance of legal practitioners in Northern Nigeria, here are some tailored recommendations:

1. Enhance Information Literacy Training

Workshops and Seminars: Ministries of justice should organize regular workshops and training sessions on improving information literacy skills for legal practitioners. These should focus on critical thinking, research skills, and the effective use of legal databases and digital tools.

Incorporate in Legal Education: Legal institutions in Northern Nigeria and Nigeria as a whole should incorporate information literacy training into their curricula to ensure that legal professionals are well-equipped to find, evaluate, and use relevant legal information.

2. Promote the Use of Electronic Information Resources

Subscription to Legal Databases: Government should encourage law firms and legal departments in the Nigeria to subscribe to well-regarded electronic legal databases such as Westlaw, LexisNexis, and HeinOnline. Providing easy access to these resources will improve legal research efficiency.

Awareness Campaigns: Government in collaboration with ministries of justice Northern Nigeria should conduct awareness campaigns to promote the benefits of using electronic

information resources in legal practice. Demonstrating how they improve job performance can encourage wider adoption.

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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON PERSONALIZED LEARNING: A CRITICAL REVIEW

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Abstract
This critical review explores the transformative role of artificial intelligence (AI) in enhancing personalized learning experiences within the education sector. As educational institutions grapple with the limitations of traditional teaching methods, which often fail to meet the diverse and evolving needs of learners, AI technologies have emerged as powerful tools capable of customizing and optimizing educational experiences on an individual level. Personalized learning, driven by AI, offers the possibility of tailoring instruction to align with each student's unique learning pace, style, and preferences, thereby fostering greater engagement and improving academic outcomes. This review synthesizes a broad range of current literature on the integration of AI in personalized learning environments, providing a comprehensive examination of its various applications, potential benefits, and inherent challenges. Furthermore, it offers evidence-based recommendations for the effective and responsible implementation of AI-driven educational tools in contemporary educational settings. The findings suggest that while AI holds significant promise for reshaping the future of education by delivering tailored learning experiences, careful attention must be paid to the ethical implications, including issues related to data privacy, algorithmic bias, and equitable access, to ensure that its full potential is realized in a manner that benefits all learners.

Keywords: Artificial Intelligence, Personalized Learning, Educational Technology, Learning Outcomes, Equity in Education.

Introduction
The educational landscape has undergone significant transformation due to advancements in technology, with artificial intelligence (AI) at the forefront of this evolution. Personalized learning, defined as tailoring education to meet the individual needs of students, has gained prominence as a viable approach to enhance student engagement and academic achievement (Walkington, 2013). The traditional educational model often adopts a standardized approach that does not cater to the varying abilities and learning styles of individual students, leading to disparities in academic performance and motivation. In contrast, personalized learning aims to provide customized educational experiences that align with each learner's unique strengths, preferences, and learning paces. Recent research has emphasized the need for personalized approaches, particularly in light of the COVID-19 pandemic, which highlighted the limitations of conventional teaching methods and the necessity for adaptable learning environments (Wong *et al*., 2022).

AI technologies play a crucial role in facilitating personalized learning through applications such as adaptive learning systems, intelligent tutoring systems, and robust data analytics. Adaptive learning systems, such as DreamBox and Knewton, adjust the difficulty and type of content presented to students based on real-time performance metrics, allowing learners to progress at their own pace (Holmes *et al*., 2022). Intelligent tutoring systems, like Carnegie Learning, provide individualized feedback and support, simulating a one-on-one tutoring experience that can help students navigate challenging concepts. Furthermore, the integration

of data analytics in educational settings enables educators to collect and analyze student performance data, providing valuable insights into learning patterns and potential areas for intervention. This data-driven approach empowers teachers to make informed instructional decisions and design targeted interventions to meet students' needs more effectively (García *et al*., 2023).

Despite the promising advancements AI offers in the realm of personalized learning, several challenges must be addressed to ensure its effective implementation. One major concern involves data privacy and security, as the extensive collection and analysis of student data raise ethical questions about consent and potential misuse (Selwyn, 2021). Additionally, there is a risk of algorithmic bias, where AI systems may inadvertently reinforce existing inequalities if they are not carefully designed and monitored (O'Neil, 2016). Furthermore, the disparity in access to technology among different socioeconomic groups can hinder the equitable implementation of AI-driven personalized learning initiatives, potentially widening the educational gap (Reich & Ruipérez-Valiente, 2019). Addressing these challenges requires a collaborative effort among educators, policymakers, and technology developers to create secure, fair, and inclusive AI-enhanced learning environments that prioritize student well-being and academic success.

AI Applications in Personalized Learning

AI applications in personalized learning have rapidly evolved, significantly enhancing the educational experience by adapting to individual learner needs in real-time. Adaptive learning platforms, such as DreamBox and Knewton, use sophisticated algorithms to continuously assess a student's progress and knowledge level, allowing the system to provide tailored instructional materials suited to their unique learning pace (Holmes *et al*., 2022). These systems adjust content difficulty and format based on the learner's performance, ensuring that students neither move too quickly through material they haven't mastered nor become bored with content they have already learned. The integration of AI into adaptive learning platforms reflects the growing trend towards more flexible and student-centered education, shifting away from traditional, one-size-fits-all approaches.

Intelligent tutoring systems (ITS) represent another key application of AI in personalized learning. These systems offer one-on-one tutoring experiences that are comparable to human tutors, guiding students through complex problem-solving tasks with individualized feedback. For instance, Carnegie Learning's ITS is designed to help students understand difficult math concepts by providing step-by-step explanations, feedback on errors, and targeted hints to aid comprehension (García *et al*., 2023). The ability of AI-driven tutoring systems to offer real-time support ensures that learners receive immediate feedback, which is critical for fostering deeper understanding and enhancing retention. Moreover, ITS platforms are designed to adapt not only to students' cognitive abilities but also to their emotional states, offering encouragement and motivation when learners face challenges, a feature that has been linked to improved learning outcomes (Luckin *et al*., 2021).

AI-powered data analytics also play a pivotal role in advancing personalized learning by enabling educators to make data-driven decisions regarding instructional strategies. Through the analysis of vast amounts of student data, such as performance metrics, engagement patterns, and behavior in virtual learning environments, AI systems can identify learning gaps and predict future performance (Zawacki-Richter *et al*., 2022). These insights allow educators to intervene early, providing targeted support where necessary and personalizing instructional approaches to meet the diverse needs of their students. Additionally, predictive analytics can

inform curriculum design and instructional delivery methods, optimizing the learning experience for individuals and improving overall academic achievement. The growing use of AI in data analytics illustrates its potential to revolutionize education by creating a more responsive and adaptive learning environment that caters to each student's specific needs.

Challenges and Ethical Considerations

Despite the promising potential of AI in personalized learning, several challenges must be carefully addressed to ensure its responsible and equitable implementation. One of the foremost concerns is the issue of data privacy and security. AI technologies rely on the collection and analysis of vast amounts of student data to personalize learning experiences. However, this raises critical ethical questions regarding student consent, data ownership, and the risk of data breaches (Selwyn, 2021). Educational institutions and technology providers must ensure robust security protocols and transparent data policies to safeguard sensitive information. Moreover, students and parents must be fully informed about how their data is collected, stored, and used to prevent potential misuse, ensuring compliance with data protection laws like the General Data Protection Regulation (GDPR) or similar local regulations.

Another pressing challenge lies in the potential reinforcement of biases through AI algorithms. AI systems are only as unbiased as the data they are trained on, and if the training datasets reflect existing societal inequalities, these biases may be perpetuated or even amplified in educational settings (O'Neil, 2016). For instance, algorithms that are designed without considering diverse learning styles, backgrounds, or cultural contexts may fail to provide truly personalized experiences for all students. Recent research highlights the need for continual monitoring and auditing of AI systems to identify and mitigate algorithmic biases (Lobato *et al*., 2023). Developers must prioritize inclusive design, ensuring that AI-driven personalized learning tools are capable of adapting to the needs of students from diverse demographic and socio-economic backgrounds.

Equity in access to AI-powered personalized learning is another critical issue that cannot be overlooked. Disparities in technological infrastructure, internet connectivity, and financial resources between regions, particularly in lower-income communities, may exacerbate the digital divide (Reich & Ruipérez-Valiente, 2021). While AI has the potential to enhance learning for many students, those in under-resourced schools or rural areas may be left behind if they do not have equal access to the necessary tools. Governments and educational institutions must work together to ensure that the deployment of AI technologies in education is inclusive, providing equitable opportunities for all students regardless of their socio-economic status. This could involve policies aimed at expanding access to affordable technology and internet services, as well as investing in teacher training to effectively integrate AI into diverse classroom environments.

Future Directions and Recommendations

To fully harness the potential of AI in personalized learning, several future directions and recommendations must be considered. First, there is a critical need for more in-depth, longitudinal research to evaluate the long-term impact of AI on learning outcomes and student engagement. While initial studies have shown positive effects, such as improved student motivation and tailored instructional support (Schmid *et al*., 2021), there is limited understanding of how AI influences learning over extended periods. Future research should focus on measuring the sustained effects of AI-driven personalized learning, including its impact on students' academic performance, cognitive development, and emotional well-being. Additionally, research should examine the adaptability of AI systems across different

educational contexts, including diverse learner populations and varied subject areas, to ensure that these technologies are effective for all students.

Collaboration among educators, technologists, and policymakers is essential to establish ethical guidelines and standards for AI use in education. As AI continues to shape the future of personalized learning, it is imperative to address issues such as data privacy, algorithmic transparency, and fairness. Without proper regulations, AI systems risk perpetuating biases or misusing student data (Selwyn, 2021). A collaborative approach will ensure that stakeholders develop comprehensive policies to mitigate these risks and promote the responsible integration of AI into classrooms. Policymakers can work with educational institutions to craft ethical frameworks that prioritize student safety and equity, while technologists can focus on creating AI systems that are transparent, accountable, and adaptable to diverse learning environments. Educators, being at the forefront of implementation, play a crucial role in identifying potential challenges and contributing to the development of practical guidelines for AI in education.

Lastly, professional development opportunities for educators are essential to maximize the benefits of AI-powered personalized learning. Many teachers may feel unprepared to integrate AI technologies into their instructional practices, and without proper training, the potential of these tools may remain untapped. Professional development programs should equip educators with the necessary knowledge and skills to effectively use AI in the classroom (Weller, 2021). These programs should cover not only the technical aspects of AI but also pedagogical strategies for leveraging AI to create more engaging, personalized learning experiences for students. Furthermore, efforts must be made to ensure equitable access to AI-powered educational tools. Governments and institutions should invest in infrastructure and resources, particularly in underserved areas, to bridge the digital divide and guarantee that all students, regardless of their socio-economic background, can benefit from personalized learning opportunities (Reich & Ruipérez-Valiente, 2021).

Conclusion

In conclusion, artificial intelligence (AI) has the potential to transform personalized learning by offering tailored educational experiences that align with the unique needs, abilities, and learning styles of individual students. Through technologies like adaptive learning platforms and intelligent tutoring systems, AI has demonstrated its capacity to enhance student engagement, motivation, and academic performance. Research shows that personalized learning environments driven by AI can lead to more meaningful learning experiences by allowing learners to progress at their own pace and receive immediate, targeted feedback (Zawacki-Richter et al., 2021). These benefits reflect the growing promise of AI to create an educational ecosystem where each student's potential can be maximized. However, the realization of this potential requires overcoming significant hurdles that may arise along the way.

While the benefits of AI in personalized learning are promising, challenges related to ethics, equity, and data privacy present substantial obstacles that must be addressed. Ethical concerns include the potential misuse of student data, biased algorithms, and the lack of transparency in AI decision-making processes (Selwyn, 2021). Without proper regulation, AI systems could unintentionally reinforce societal biases, thus perpetuating inequalities in educational opportunities. Moreover, there are growing concerns about data privacy, as AI-driven personalized learning systems often rely on extensive data collection and analysis to function effectively. Questions around who owns this data and how it is used have implications for both student rights and the ethical use of technology in education. Ensuring that AI operates in a

fair, unbiased, and transparent manner is essential for it to be a valuable tool in improving educational outcomes for all learners.

As the educational landscape continues to evolve, it is crucial for educators, technologists, and policymakers to collaborate in addressing these challenges to harness AI's full potential in creating a more personalized and equitable education system. Stakeholders must work together to develop clear guidelines and policies that prioritize student well-being, protect data privacy, and ensure equitable access to AI technologies, particularly for underserved populations (Schmid *et al*., 2021). Collaborative efforts should also focus on supporting educators through professional development opportunities, equipping them with the skills needed to integrate AI tools effectively into their classrooms. By navigating these challenges with foresight and responsibility, AI can play a transformative role in shaping the future of education, making it more inclusive, responsive, and aligned with the needs of individual learners.

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ASSESSMENT OF CHEMISTRY TEACHERS' PROFESSIONAL DEVELOPMENT ON THE USE OF EMERGING TECHNOLOGIES IN MINNA METRIOPOLIS, NIGER STATE.

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Abstract

This work assessed chemistry teachers' professional development on the use of emerging technology in Minna Metropolis, Niger State. Three objectives were formulated to guide the study which were translated to research questions. Descriptive research design was adopted for this research. The population for the study was 112 chemistry teachers in Minna Metropolis. The research instrument was researchers' developed questionnaires which was validated by two experts from departments of Science Education and Educational Technology. The reliability of the instrument was determined using Richard Kuderson which yielded 0.82 and was used to collect data from respondents. The data gathered was analyzed using descriptive statistic. The research questions were answered using mean and standard deviation. The results of analysis show that most of the chemistry teachers are not institutionally trained but professionally trained on the use of emerging technology. It was therefore recommended that chemistry teachers should be trained institutionally as well on the use of emerging technology so as to improve teaching and learning effectiveness and efficiency.

Keywords: Emerging Technologies, Chemistry, Professional Development, Teachers, Teaching and Learning

Background to the Study

The 21st century presents itself with technological challenges (emerging technologies), and opportunities for the students, and it is important for the teachers to reach them with the tools that speak to the students especially when teachers engage in professional development regularly. Professional development is a platform that can specifically educate teachers regarding the efficacy of emerging technologies that can be woven into instruction to make it more interesting, interactive and collaborative for students. There is a need to emphasize the need for effective training of teachers on the use of emerging technologies that can significantly improve teacher-student communication in the diverse educational environment preparing and supporting both face-to-face and online teachers to meet the diverse student needs is vital for the success of learning. In this process of learning, teachers are trying to adapt their teaching practice to a technologically mediated medium, by making use of the technological tools that enhance the quality of instruction. Teachers need to use other means of reaching out and communicating with their students and one aspect of technology that can be harnessed is emerging technologies. One cannot undermine the role of technology in the 21st century and the need for trained professionals that will serve as facilitators in diverse educational settings. Okan (2020) views emerging technologies as, 'tools, concepts, innovations, and advancements utilized in diverse educational settings to serve varied education related purposes.

When educators discover new teaching strategies through professional development, they are able to go back to the classroom and make changes to their lecture styles and curricula to better suit the needs of their students. However, these changes are hard to evaluate because they are typically implemented gradually. Professional development for teachers makes them more efficient in their presentations and course evaluations by exposing educators to new delivery methods, evaluation styles and record-keeping strategies. In the words of Chris, (2021) Professional Development (PD) refers to the continued education or training of a person in order to advance and maintain his/her career. The study also reported that professional development is often collaborative and more intensive than casual learning. Acker *et al.* (2023) conceived PD as an on-going, planned learning development process which enables teachers' expansion of teaching potentials; contribute to work-based and professional development. It aids teachers' maintenance and enhancement of knowledge expertise and competence of teachers throughout their job careers. Chemistry teachers' professional development on the use of emerging technologies is the key to the realization of meaningful teaching and learning process. Kari (2023) stated that teacher professional learning is of increasing interest as one of the ways to support the increasingly complex skills students need to learn in preparation for further education and work in the 21st Century. As a result of this, sophisticated forms of teaching are needed to develop students' competencies such as deep mastery of challenging content, critical thinking, complex problem-solving, effective communication, collaboration and self-direction. Effective professional development is needed to help teachers learn and refine the pedagogies required to teach these skills. Professional development is conceived in two perspectives, Institutional Professional Development (IPD) and Self-Professional Development (SPD).

Institutional Professional Development is the act of institutional governing bodies such as the Ministries of Education (MOE), Parent Teachers Association (PTA), Universal Basic Education Commission (UBEC) among other agencies sponsoring teachers on professional development. Ligami (2021) affirmed that Institutional Professional Development cannot be treated as an individual responsibility and that dedicated institutional support is essential. This further placed a clarion call on educational governing bodies to stand up to the responsibility of developing teachers' skill in order to prepare and develop learners who can compete favourably in a competence-based work environment.

Self-Professional Development (SPD) is referred to as the state of self-willingness, self-motivation and self-readiness among Chemistry teachers to train themselves on the use of emerging technologies to teach. This is a situation where the concerned teachers did not receive any incentive from the governing bodies of the school or the school management. Michael (2020) argued that SPD reduces the mismatch between the IPD and individual teachers' needs. This implies that the institutional sponsored professional development might not address the immediate classroom needs of the teacher. Hence, the needs for individual teachers to identify their individual needs based on their classroom and subject dynamics and self-develop towards it. Michael (2020) further argued that individualized professional development gives teachers responsibility, choice and involvement in the planning of their learning experiences. Micube (2022) identified 21st century classroom management, communication, information, creative and innovative skills and media awareness as the possible factors that may affect Professional Development and advocated for SPD being induced by governing institutions at all levels of education especially for Chemsitry teachers.

Chemistry is a branch of science that studies the properties, composition, and behaviour of matter. It explores how substances interact with each other, how matters change during

chemical reactions, and the principles that govern these processes. Chemistry examines different forms of matter, which include solids, liquids, gases, and plasma. It investigates the structure and properties of atoms and molecules, which are the building blocks of matter. It studies how substances combine or break apart to form new substances. This involves understanding reactants, products, reaction mechanisms, and energy changes associated with these processes (Ababio, 2024)

Chemistry plays a critical role in various industries, influencing numerous aspects of production, product development, and environmental management. Its applications span across different sectors, including pharmaceuticals, agriculture, food processing, manufacturing, energy, and environmental science (Adesoji, 202I)

The importance of chemistry in industries cannot be overstated. It underpins innovation, enhances product quality, ensures safety, and promotes sustainability across various sectors. As industries continue to evolve and face new challenges, the role of chemistry will remain central to addressing these issues and driving progress. For this importance to come to stay, the instructional content should be delivered with the use of modern 21st Century technologies. This will make the students to be abreast of technologies they can use to function well on their various job. Twenty-first Century technologies are electronic devices that can be used for instructional delivery within and outside the classroom for the teaching of Chemistry**.**

When teachers, particularly Chemistry teachers are well professionally developed with 21st century techno-pedagogies, their level of awareness rises especially in the area of technological tools for teaching and learning processes. Awareness is the state of being conscious of professional development on the use of emerging technologies. Awareness is the ability to directly know and perceive the utilization of emerging technologies. It is a fundamental experience by teachers (Guertin, 2019). Ligami (2021) reported that IPD provides an opportunity to promote resource-based learning approaches, has the potential to offer quality courses, promotes information literacy skills among students, and allows assessment for and of learning. Education being the tool of change needs to be modernized.

However, it cannot achieve its aims unless the institutional staff is professionally developed. Education undergoes many socioeconomic changes; educational institutions including teachers need to change as well. Thus, the employees/professionals need training and professional development that matches the sophisticated changes within their environment, society, culture in general and education system in particular. Therefore, it is always recommended to learn and get training in the form of simulation or workshop (Khan, 2021).

When teachers are fully aware of the existence of emerging technologies, then, the utilization is questioned. Utilization is the actual use of emerging technologies within the classroom or outside the classroom for effective teaching. Utilization is the use of emerging technologies such as social media, social networking, learning management system to achieve professional development (Garwood, 2023).

Statement of the Research Problem

Chemistry is a subject enshrined in the senior secondary school education curriculum and also provides foundation knowledge for students who may further their studies in since related courses in tertiary institution. Over the years, Chemistry teachers have not embrace emerging technologies to boost their professional development and instructional delivery**.**

Micube (2023) asserted that "our students have changed radically. Today's students are no longer the people our educational system was designed to teach''. The teachers do not believe that the present generation of learners can learn from digital technologies, because they did not learn by that means. This has become a big challenge to the teachers. Field observation revealed that Chemistry teacher's instructional delivery is laden with the conventional methods. This is not in tandem with the 21st century needs of the learners and instructional delivery specifications of an ICT driven society. Therefore, this work aimed at assessing Chemistry teachers' professional development on the use of emerging technology studies in Minna metropolis

Aim and Objectives of the Study

The aim of the study is to assess Chemistry teachers' professional development on the use of emerging technologies in Minna metropolis, Niger State. Specifically, the objectives of the study are to:

9. Assess Chemistry teachers' institutional professional development on the use of emerging technologies in Minna metropolis.
10. Examine Chemistry teachers' self-professional development on the use of emerging technologies in Minna metropolis.
11. Find out Chemistry teacher's use of emerging technologies for teaching in Minna metropolis.

Research Questions

Based on the above objectives, the study raised the following research questions:

4. What is Chemistry teachers' institutional professional development on the use of emerging technologies in Minna metropolis?
5. Do Chemistry teachers' self-professional development on the use of emerging technologies in Minna, Metropolis?
6. Do Chemistry teachers' use of emerging technologies for teaching in Minna metropolis?

Methodology

Research Design

This study adopted descriptive survey research design. A descriptive survey research design is aimed at finding, describing and reporting events without manipulation. The study tries to find out the views of respondents through the use of questionnaire. This study involves the gathering of quantitative data using questionnaire for teachers in selected secondary schools in Minna Metropolis on the assessment of Chemistry teachers' professional development on the use of emerging technologies.

Population of the Study

The population of the study comprised of Chemistry teachers in Minna metropolis. A total of 112 Chemistry teachers in secondary schools in Minna Metropolis comprising of Bosso and Chanchaga Local Government Areas

Sample and Sampling Technique

The sample size for this study was 112 Chemistry teachers from 25 secondary schools in Minna metropolis of Niger State. a random sampling technique was employed to carefully select participants in the study, Assessment Chemistry Teachers' professional development on the use of emerging technologies in Minna metropolis. The sample is in conformity with Krejcie and Morgan (1970) sample determination table which address the need for a representative

statistical sample in empirical research. It is an effective method of determining sample size for a given population for easy reference.

Research Instrument

The instrument that was used for data collection in this study was a researcher designed questionnaire titled, Chemistry Teachers' Professional Development on the Use of Emerging Technologies (CHEMTUT). Section A comprised the demographic information. The respondents are to tick where it is appropriate. Section B comprises of awareness of emerging technologies among Chemistry teachers for teaching. Section B will be responded to using Highly Aware =4, Fully Aware =3**, Aware=2**and Not Aware **(1)**. Section C will measure use of emerging technologies for teaching among Chemistry teachers using 4- point rated scale of Strongly Agree =4Agree =3, Disagree =2 and Strongly Disagree =1. Section D will also measure means of professional development acquisition. It will be responded to using Self-Professional Development (self-sponsored) =4, Self-Development and Free Online =3, Institutional Professional Development =2 and Institutional-Professional Development (Not sponsored) =4.

Validation of the Research Instrument

The instruments titled Chemistry Teachers' Professional Development on the Use of Emerging Technologies (CHEMTUT) was used for data collection was validated by two experts, one from Department of Educational Technology and Science Education Department, Federal University of Technology, Minna.

Reliability of the Research Instrument

The reliability coefficient obtained was 0.82 which indicate that the instrument was adjudged to be reliable for the purpose of this study. The result indicate strong reliability and validity of the measurement instruments used in the study.

Method of Data Collection

Orientation was given to the respondents on the aim and objectives of the study and how to fill the questionnaire, to ascertain that the appropriate data was collected. The researcher then administered the questionnaire to the respondents and retrieved them immediately. 86 questionnaires were printed for the study. The study lasted for six (6) weeks.

Method of Data Analysis

The data collected was and analyzed using simple descriptive statistics. The research questions were answered using mean and standard deviation. The decision mean for the descriptive statistics will be 2.5 because the questionnaire is a four-point rated scale with the use of Statistical Package for Social Sciences (SPSS) Version 23.

Data Analysis and Results

Research Question One

What is Chemistry teachers' institutional professional development on the use of emerging technologies in Minna metropolis?

To determine whether Chemistry teachers' institutional professional development on the use of emerging technology in Minna Metropolis, analysis of mean and Standard deviation was carries out as shown in table 4.1

Table 4.1: Analysis of Mean and Standard Deviation of Chemistry Teachers' Institutional Professional Development on the Use of Emerging Technology in Minna Metropolis

S/N	Emerging Technologies	Mean	STD	Decision
1	Microsoft PowerPoint	3.44	0.61	Institutionally Developed
2	Microsoft Excel	3.36	0.52	Institutionally Developed
3	Multimedia Projector	3.28	0.68	Institutionally Developed
4	Digital Camera	3.35	0.55	Institutionally Developed
5	Electronic Whiteboard	3.41	0.58	Institutionally Developed
6	Interactive Response System	3.22	0.69	Institutionally Developed
7	Laptop	3.36	0.53	Institutionally Developed
8	Media Player/MP3	3.35	0.63	Institutionally Developed
9	Digital Podium	3.47	0.61	Institutionally Developed
10	Smart Devices	3.37	0.65	Institutionally Developed
11	Audio Books	3.36	0.59	Institutionally Developed
12	Google Meet	3.29	0.72	Institutionally Developed
13	Zoom	3.40	0.56	Institutionally Developed
14	Smart TV	3.45	0.52	Institutionally Developed
15	Microsoft Word	3.47	0.50	Institutionally Developed
16	Facebook	3.45	0.56	Institutionally Developed
17	WhatsApp	3.40	0.52	Institutionally Developed
18	Electronic Mail	3.45	0.67	Institutionally Developed
19	Twitter	3.36	0.64	Institutionally Developed
20	TikTok	3.44	0.62	Institutionally Developed
21	Grand Total	3.38	0.60	Institutionally Developed

The result in the table 4.1 shows the Chemistry teachers' institutional professional development on the use of emerging technology in Minna Metropolis response shows that all the item 1 to

20 reveal that most Business studies teachers are developed institutionally. Item 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 and 20 with their mean greater than 2.5 0 with grand mean total of 3.38. There is no disparity in their standard deviation since the standard deviation follow the same pattern with grand total of 0.60

Research Question Two

What is Chemistry teachers' self-professional development on the use of emerging technologies in Minna, Metropolis?

To determine whether Chemistry teachers' self-professional development on the use of emerging technologies in Minna, Metropolis? Analysis of mean and standard deviation was carried out as shown in the table 4.3

Table 4.3: Analysis of Mean and Standard Deviation of Chemistry Teachers' Self-professional Development on the Use of Emerging Technologies in Minna Metropolis

S/N	Emerging Technologies	Mean	STD	DECISION
1	Microsoft PowerPoint	**3.36**	**0.53**	**Highly Developed**
2	Microsoft Excel	**3.37**	**0.62**	**Highly Developed**
3	Multimedia Projector	**3.38**	**0.63**	**Highly Developed**
4	Digital Camera	**3.30**	**0.61**	**Highly Developed**
5	Electronic Whiteboard	**3.35**	**0.67**	**Highly Developed**
6	Interactive Response System	**3.35**	**0.57**	**Highly Developed**
7	Laptop	**3.37**	**0.66**	**Highly Developed**
8	Media Player/MP3	**3.40**	**0.58**	**Highly Developed**
9	Digital Podium	**3.33**	**0.60**	**Highly Developed**
10	Smart Devices	**3.28**	**0.66**	**Highly Developed**
11	Audio Books	**3.24**	**0.70**	**Highly Developed**
12	Google Meet	**3.34**	**0.58**	**Highly Developed**
13	Zoom	**3.27**	**o.77**	**Highly Developed**
14	Smart TV	**3.37**	**0.70**	**Highly Developed**
H	Ighly	**3.42**	**0.58**	**Highly Developed**
16	Facebook	**3.43**	**0.56**	**Highly Developed**

17	WhatsApp	**3.44**	**0.56**	**Highly Developed**
18	Electronic Mail	**3.34**	**0.61**	**Highly Developed**
19	Twitter	**3.34**	**0.63**	**Highly Developed**
20	TikTok	**3.42**	**0.81**	**Highly Developed**
21	**Grand Total**	**3.01**	**0.53**	**Highly Developed**

Table 4.3 shows the results of self-professional development of Chemistry Teachers'. The results show that most of Chemistry teachers develop themselves after institutions have spent resource on them by putting the knowledge into practice while teaching in the classrooms. All the items in Table 4.3 shows it means to be greater than 2.50 . Item 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 and 20 have their mean greater than 2.50 with grand total of 3.01. The standard deviation did not show any desi parity since the follow the same pattern with their grand total 0.53

Research Question Three

What is chemistry teachers' use of emerging technologies for teaching in Minna metropolis?

Table 4.4: Analysis of Mean and Standard Deviation of Chemistry Teachers' use of Emerging Technologies in Minna Metropolis

S/N	Emerging Technologies	Mean	STD	DECISION
1	Microsoft PowerPoint	**3.34**	**0.63**	**Highly Use**
2	Microsoft Excel	**3.42**	**0.81**	**Highly Use**
3	Multimedia Projector	**3.36**	**0.53**	**Highly Use**
4	Digital Camera	**3.37**	**0.62**	**Highly Use**
5	Electronic Whiteboard	**3.38**	**0.63**	**Highly Use**
6	Interactive Response System	**3.30**	**0.61**	**Highly Use**
7	Laptop	**3.35**	**0.67**	**Highly Use**
8	Media Player/MP3	**3.35**	**0.57**	**Highly Use**
9	Digital Podium	**3.37**	**0.66**	**Highly Use**
10	Smart Devices	**3.40**	**0.58**	**Highly Use**
11	Audio Books	**3.33**	**0.60**	**Highly Use**
12	Google Meet	**3.28**	**0.66**	**Highly Use**
13	Zoom	**3.24**	**0.70**	**Highly Use**
14	Smart TV	**3.34**	**0.58**	**Highly Use**

15	Microsoft Word	**3.27**	**o.77**	**Highly Use**
16	Facebook	**3.37**	**0.70**	**Highly Use**
17	WhatsApp	**3.42**	**0.58**	**Highly Use**
18	Electronic Mail	**3.43**	**0.56**	**Highly Use**
19	Twitter	**3.44**	**0.56**	**Highly Use**
20	TikTok	**3.34**	**0.61**	**Highly Use**
21	**Grand Total**	**3.52**	**0.52**	**Highly Use**

Table 4.4 reveal the analysis of mean and standard deviation of the use of emerging technologies in teaching of Chemistry. The results reveal that Chemistry teachers use emerging for teaching and learning with value of mean of 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 1nd 20 greater 2.50 with the grand total of 3.52. The standard deviation shows that there is no disparity in the result since the standard deviation following the same pattern.

Findings on the Emerging Technologies for Teaching and Learning of Chemistry By Chemistry Teachers

Analysis of mean and standard deviation has shown that Most Chemistry teachers have been developed institutional on the use of emerging technologies, Chemistry teachers are fully aware of emerging technologies, Most Chemistry teachers compliment the effort of institution by improving on the development given to them by institutions and Most chemistry teachers make use of emerging technologies during teaching and learning processes. These findings support the findings of Jeffrey et al 2020, who says most teachers are been trained by Kenya Government for effective performance in the class also the work of SyvieI saw *et al., 2020*, support these findings which says most South Africa teachers were trained to use emerging technologies for effective performance in class during teaching and learning. The institution of each were asked to nominate teachers for training every term of academic session which help the government. The government effort is supported by every teacher sponsored by putting into practice what they have learnt in the training sometimes consulting the expert for more explanation on the learnt software this finding supported findings of Syvie, *et al* 2020 most teachers in South Africa develop themselves after government sponsored them for academic training and go against the findings of Mathieu,(2021)and Philip (2022) who says Edo state teacher are the one responsible for their training and government did not sponsor most of the their teachers for technological development.

Conclusion

It has been asserted that students' performance in Chemistry is poor in spite of the importance of the subject towards technological and commercial development of dear our nation. The major cause of the performance is attributed to inappropriate of teachers to adopt, adapt, trained, support and availability of emerging technology in our nation. It is against this background that this study is to assess of Chemistry teachers' professional development on the use of emerging technologies in Minna Metropolis, Niger State.

Conclusion arising from the findings of this study indicates that emerging technologies which Chemistry teachers employ in teaching and learning chemistry determine the performance of

chemistry students in which institutions, Chemistry teachers have spent a lot of resource on for better performance. Both chemistry teachers and government have identified the emerging technologies as a teaching tools that improve students' performance. Emerging technologies are constructively interact freely to learn and consciously depend less their teachers' their achievement could improve in chemistry drastically.

Recommendations

Based on the major findings of this study, the following recommendations are proffered:

2. More teachers should be trained on emerging technologies which would reduce the boredom, increased retention and improve the performance of students
3. More teachers should be encouraged to use emerging technologies when teaching their subject
4. chemistry teachers and other teachers should be trained on how to use emerging technologies
5. The teacher education should gear towards preparation of chemistry teachers to acquire and maintain appropriate emerging technologies which believed strongly enhanced the performance
6. Curriculum developer should embrace and include emerging technologies that will bring about improvement in learning, acquisition of skills, social interaction and performance skill into student curriculum

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A SYSTEMATIC REVIEW OF INTELLIGENT TUTORING SYSTEMS (ITS) FOR ENHANCING LEARNING OUTCOMES IN ENGLISH LANGUAGE AMONG SMART JUNIOR SECONDARY SCHOOLS IN FCT, ABUJA

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Abstract
This paper presents a systematic review of the impact of Intelligent Tutoring Systems (ITS) on enhancing learning outcomes in English language education in smart junior secondary schools in the Federal Capital Territory (FCT), Abuja. The review synthesizes evidence from peer-reviewed articles, conference proceedings, and empirical studies published between 2010 and 2024. The study explores how ITS supports personalized learning, improves student engagement, and enhances learning outcomes in English language classrooms. Additionally, it identifies key challenges in implementing ITS in smart schools and provides recommendations for future research and practice. The findings suggest that ITS has significant potential in improving English language proficiency, though infrastructural challenges in Nigeria remain a concern.

Keywords: Intelligent Tutoring Systems (ITS), English Language, Learning Outcomes, Smart Schools, Personalized Learning, Junior Secondary Schools, Abuja

Introduction
The rapid growth of technology in education has led to the development of innovative instructional tools aimed at enhancing student learning outcomes. Among these innovations, Intelligent Tutoring Systems (ITSs) have a great potential to effectively transform teaching and learning (Wang *et al.,* 2023). ITSs can determine the learning path, select and recommend the learning content to students, provide scafoldings and help engage students in dialogue, and simulate one-to-one tutoring, among others (Zawacki-Richter *et al.,* 2019). They can also provide customized experiences for different students, teachers and tutors (Churi *et al.,* 2022). Thus, ITSs have enormous potentials to support teaching and learning, especially in large-scale distance teaching institutions where human one-to-one tutoring is very difficult (Luckin *et al.,* 2016). This systematic review focuses on the application of ITS in-teaching English language to students in smart junior secondary schools in FCT, Abuja.

In Nigeria, junior secondary schools, especially in urban centers like Abuja, are increasingly integrating technology to enhance the quality of education. However, English language proficiency remains a challenge for many students. As the lingua franca, English serves as a medium of instruction for most subjects, making its mastery essential for academic success. ITS offers a promising solution for personalized English language instruction, helping to address students' individual learning needs. In the digital age, the availability and accessibility of educational materials have transformed, significantly impacting English language proficiency by necessitating the development of adaptive learning technologies and intelligent tutoring systems (ITS) powered by artificial intelligence (AI). These technologies offer personalized learning experiences, enabling students to progress at their own pace and receive customized feedback (Mustafa, 2024). Furthermore, traditional teaching methods often fail to engage students or provide practical problem-solving skills, whereas adaptive learning technologies enhance engagement and outcomes. This paper seeks to systematically review

existing literature to evaluate the effectiveness of ITS in improving English language learning outcomes.

Methodology

This systematic review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Moher *et al.,* 2009). A comprehensive search of peer-reviewed journal articles, conference papers, and empirical studies was conducted using academic databases such as Google Scholar, ERIC, Scopus, and JSTOR. The search focused on studies published between 2010 and 2024 that examined the application of ITS in junior secondary schools, particularly in English language instruction.

Literature Review

Intelligent Tutoring Systems (ITS) in Education

ITS have been widely implemented across various subjects to provide individualized instruction and feedback. They rely on artificial intelligence algorithms to track student performance and adapt the learning experience accordingly (VanLehn, 2011). Studies have demonstrated that ITS can significantly improve learning outcomes, especially in subjects like mathematics and science (Koedinger et al., 2013). However, fewer studies focus on their application in language learning, particularly in the Nigerian context.

English Language Learning in Nigerian Junior Secondary Schools

English language learning in Nigeria is critical, as it is both a subject of study and the medium of instruction across the curriculum. Despite efforts to improve English proficiency, many students in junior secondary schools' struggle with reading comprehension, grammar, and writing skills. scant fund, shortage of professional English teacher, inadequate English language instructional materials, deficient English laboratory, poor capacity development of English language teachers and paltry motivation of English language teacher are the challenges affecting the effective administration of English language program in Abaji secondary Schools (Jacob, 2020).

Role of ITS in English Language Learning

Research has shown that ITS can enhance student engagement and motivation in language learning by providing interactive exercises, immediate feedback, and adaptive content (Murray *et al.,* 2004). For example, systems like Carnegie Learning and AutoTutor have been used successfully in language instruction. Studies have found that ITS helps students improve reading fluency, vocabulary acquisition, and comprehension skills by offering differentiated instruction based on individual student performance (Graesser *et al.,* 2012).

Findings and Discussion

Impact of ITS on-Learning Outcomes

The systematic review revealed that ITS significantly improves learning outcomes in English language education in junior secondary schools. Studies conducted in developed countries report improvements in student achievement, with ITS helping learners master complex language skills (Graesser et al., 2012). In particular, ITS was found to enhance reading comprehension, writing fluency, and grammar usage among junior secondary students (Koedinger *et al.,* 2013).

Challenges of ITS Implementation in FCT, Abuja

While the potential of ITS is well-documented, the review also highlights several challenges specific to the FCT, Abuja context. The poor performance of students in Abaji area council of

Federal Capital Territory (FCT), Abuja, Nigeria in the recent external examination and the called by stakeholder in the educational sector in the local government area council motivated the reason for this research and secondly research gap that exist in this aspect of English language program in Nigeria and in Abaji area council in particular (Jacob, 2020). Despite these challenges, the review indicates a growing interest in integrating ITS into Nigerian schools. In smart schools equipped with the necessary infrastructure, ITS has shown promising results in improving student engagement and academic performance (Aliyu *et al.*, 2021). Further investments in teacher training and infrastructure development are needed to fully realize the potential of ITS in Nigeria.

Conclusion and Recommendations

This systematic review underscores the potential of Intelligent Tutoring Systems to enhance English language learning outcomes in junior secondary schools in FCT, Abuja. While ITS has been proven effective in improving language skills, challenges such as infrastructural deficiencies and teacher preparedness must be addressed. To maximize the impact of ITS in Nigerian schools, the following recommendations are made:

Infrastructure development: The government and private sector should collaborate to improve technological infrastructure in public schools.

Teacher training: Professional development programs should be designed to equip teachers with the skills necessary to effectively implement ITS in the classroom.

Cost-effective solutions: Schools should explore low-cost ITS options or open-source platforms to make the technology more accessible.

Further research: More empirical studies are needed to evaluate the long-term impact of ITS on English language learning outcomes in Nigeria.

By addressing these challenges, ITS can play a pivotal role in transforming English language education in smart schools across Nigeria.

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A SYSTEMATIC REVIEW OF AUGMENTED AND VIRTUAL REALITY LEARNING MODES FOR ENHANCING LEARNING OUTCOMES IN BASIC PROGRAMMING IN NORTH CENTRAL NIGERIA

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Abstract
This paper presents a systematic review of augmented reality (AR) and virtual reality (VR) learning modes and their impact on basic programming education in North Central Nigeria. AR and VR have been recognized for their immersive capabilities, which can enhance engagement and understanding in technical subjects like programming. This review synthesizes findings from studies between 2010 and 2024, focusing on the role of AR/VR technologies in improving student achievement, engagement, and retention. The review also identifies challenges specific to the region, such as infrastructure limitations and the digital divide, while providing recommendations for integrating these technologies into secondary school programming curricula.

Keywords: Augmented Reality, Virtual Reality, Programming Education, Learning Outcomes, North Central Nigeria, Educational Technology

Introduction
The rapid growth of digital technologies has reshaped the landscape of education worldwide. Among these technologies, augmented reality (AR) and virtual reality (VR) are emerging as powerful tools for creating interactive, immersive learning experiences. The integration of technology into education has become paramount, with Augmented Reality (AR) and Virtual Reality (VR) emerging as innovative tools for enhancing learning experiences (Olaronke and Olusola, 2024). These technologies offer immersive environments where students can interact with both virtual and real-world objects, which helps in visualizing abstract concepts and making complex subjects more accessible (Sujarwo *et al.*, 2024).

In North Central Nigeria, programming education has faced significant challenges, including low student interest, inadequate instructional resources, and a lack of trained teachers In Nigeria, computer education most especially programming, at the secondary school level, has faced significant challenges due to traditional teaching methods that often fail to engage students effectively. The result is poor student performance in basic programming, a topic critical for equipping students with the skills needed in today's technology-driven world (Ahmed *et al.*, 2019). Therefore, to address these challenges, integrating AR and VR into teaching methodologies offers a solution. These tools provide students with interactive, hands-on experiences that can enhance comprehension and retention of programming concepts. AR overlays digital content onto the real world, while VR creates entirely new virtual environments for immersive learning (Olaronke and Olusola, 2024).

This systematic review aims to evaluate the effectiveness of AR and VR learning modes in enhancing learning outcomes in basic programming courses within North Central Nigeria. The review will focus on empirical studies that examine the impact of these technologies on student achievement, engagement, and retention in programming education.

Methodology

This systematic review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework (Moher *et al.,* 2009) to ensure transparency and thoroughness. A comprehensive literature search was conducted in databases such as Google Scholar, JSTOR, ERIC, and Scopus. Keywords used in the search included "augmented reality," "virtual reality," "basic programming," "learning outcomes," and "North Central Nigeria." The search spanned studies published between 2010 and 2024.

Literature Review

Augmented and Virtual Reality in Education

The phrase "Augmented Reality" was first used in 1990 to explain how the head-mounted displays that electricians utilized to put together intricate wiring harnesses operated. It was coined by researchers Thomas Caudell and David Mizell. The 1990s saw the end of the previous AR and VR technology frenzy. However, at that time, some barriers kept the general public from really adopting these technologies, like inadequate engineers and experts in the educational sector (Elmqaddem, 2019). These technologies have been applied in various fields, including medical education, engineering, and computer science, where practical skills are essential.

Programming Education Challenges in North Central Nigeria

In North Central Nigeria, programming education has struggled to gain momentum due to a range of factors. Many schools lack adequate infrastructure, such as computer labs and reliable internet access, which are critical for teaching programming (Hakim *et al.,* 2020). Additionally, the shortage of qualified programming teachers has further hindered students' ability to grasp key programming concepts. Traditional lecture-based teaching methods, which often dominate classrooms, fail to engage students in meaningful coding activities, leading to poor retention and low academic achievement.

Benefits of AR/VR in Programming Education

Augmented Reality Application (ARA) helps students retain what they have learned, and augmented reality learning environments are beneficial for active learning. As highlighted by Godoy (2020), blending electronic devices with a real-world setting, ARA offers potential advantages for improving learners' experiences and their comprehension of environmental context awareness and the educational framework. As a developing technology, ARA is rapidly being included in inclusive education, which adjusts learning via exploration and experience by everyone on an equal footing. These technologies allow students to practice coding in simulated environments that closely mimic real-world programming tasks. For example, It is believed that combining virtual and real environments to have in-time interaction can bring users a sense of engagement and immersion in the scenarios with the smartphone webcam (Chang & Hwang, 2018).

Findings and Discussion

Predictions of Using ARA in Teaching

Educational academics are identifying more and more of the new teaching and learning opportunities that ARA offers. In addition to experiencing phenomena that are not possible in the real world and developing critical practices that cannot be developed and implemented in other technology-enhanced learning environments, learners can visualise complex spatial relationships and abstract concepts when virtual objects and real environments coexist. ARA is expected to be one of the most important developing technologies for education in the next five years because of its educational benefits (Mekni & Lemieux, 2014). Exposure to AR

applications during teacher training can improve pre-service teachers' achievement, ability, confidence and competence in integrating technology into their future classrooms (Sánchez, Huertas, Pernas and Castaño, 2020).

These findings suggest that AR/VR technologies can make programming concepts more accessible and improve students' ability to apply what they have learned.

Challenges in Implementing AR/VR in North Central Nigeria

While the potential benefits of AR and VR in programming education are promising, there are several challenges to their implementation in North Central Nigeria. Infrastructure limitations, including inadequate access to computers and the internet, are significant barriers. Though AR and VR are a capable instructive tool for education, it is not without challenges and limitations. The author added that, one of the main challenges is the cost of obtaining the necessary equipment and software. AR and VR also needs a high level of practical expertise to advance and uphold, which can be a significant challenge for vocational institutions with limited resources. Another limitation is the potential for AR and VR to be too immersive, leading to disorientation or motion sickness among learners. Many schools in rural areas lack the resources to adopt AR and VR technologies, and even in urban settings, the cost of acquiring and maintaining these technologies can be prohibitive. Additionally, the lack of teacher training in AR/VR integration presents another hurdle, as teachers are often unfamiliar with how to incorporate these tools into their programming lessons.

Conclusion and Recommendations

The systematic review indicates that AR and VR learning modes have a positive impact on student achievement, engagement, and retention in programming education in North Central Nigeria. These technologies provide immersive, interactive experiences that can make abstract programming concepts more accessible to students, ultimately improving their learning outcomes. However, challenges such as infrastructure gaps, cost, and teacher readiness must be addressed to ensure the successful integration of AR/VR in secondary schools. The following recommendations are made:

Infrastructure development: Government and stakeholders should invest in the necessary technological infrastructure, such as computer labs and internet access, to enable the use of AR/VR in schools.

Teacher training programs: Professional development programs should be established to train teachers on the effective use of AR/VR technologies in programming education.

Policy support: Educational policymakers should create frameworks that support the adoption of AR/VR technologies, ensuring that schools have the resources and guidance to implement these tools effectively.

Future research should explore the long-term effects of AR/VR on programming education and investigate strategies to overcome the challenges identified in this review.

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EFFECT OF MACHINE LEARNING ON STUDENTS' ACHIEVEMENT AND INTEREST IN BASIC TECHNOLOGY

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Abstract
The study adopted quasi-experimental design. The study was carried out in Secondary Schools in Niger State. The population of the study consists of seven Secondary Schools in Niger State. The sample of study was two hundred and forty seven (247) JSS II, Basic technology students in Secondary Schools in Niger State. Basic technology Achievement Test (BTAT) and Basic technology Interest Scale (BTIS) were used as the instrument. The two instruments were validated by three experts from the Department of Industrial and Technology Education, Federal University of Technology, Minna. Pearson Product Moment Correlation Coefficient was used to compute results of the trial testing after test re-test instrument administration and the results indicated positive correlation coefficients of 0.85 and 0.88 for BTAT and BTIS respectively. The researcher administered the instrument with the help of two research assistants. Data for the study were collected through pre-test and post-test using the Basic technology Achievement Test (BTAT) and the Basic technology Interest Scale (BTIS). Data collected were analyzed using Mean and Standard Deviation to answer the two research questions while Analysis of Co-variance (ANCOVA) was used to test the two null hypotheses at 0.05 level of significance. From the findings, the study revealed that Machine learning enhances students' achievement in Basic technology in junior secondary schools more than the lecture method. The finding also revealed that Machine learning promotes students' interest in Basic technology in junior secondary schools more than the lecture method among others. The study therefore concluded that students' poor achievement and interest in Basic technology informed the need for the study on the effect of Machine learning on students' achievement and interest in Basic technology in Niger state.

Keywords: Machine learning, students, basic technology, achievement, interest

Introduction
Science is a field of study that involves a dynamic process of seeking for knowledge about nature through observation and experimentation (Anaekwe, *et al.,* 2009). Science education specifically is the training and acquisition of scientific knowledge through observations and analysis of events that helps an individual to integrate effectively into the society (Ifeakor & Okoli, 2011). Ukah (2013) sees science education as a social process and medium for acquisition of relevant knowledge, skills and attitudes for scientific literacy while Ellah (2014) described science education as the knowledge gained through understanding of scientific concepts and processes required for personal decision making, participating in realization that Nigeria and other nations of the world lay emphasis on science education at all levels including

secondary education level. According to the National Policy on Education (Federal Republic of Nigeria (FRN), 2014 p.17) the objectives of post-basic education among others are to provide trained manpower in the applied sciences, technology and commerce at sub-professional trades and entrepreneurial, technical and vocational job-specific skills for self-reliance and for agriculture, commercial and economic development.

The science subjects are very important in providing trained manpower in the applied sciences, technology and commerce at sub-professional trades and entrepreneurial, technical and vocational job-specific skills for self-reliance. Their importance in preparing professionals such as chemistry, biology and physics teachers, doctors, pharmacists, agricultural scientists, biologist, engineers and many other professions cannot be overemphasized. Raina (2011) posits that the study of these science subjects also equips its beneficiaries with necessary knowledge; skills and attitudes to enable them interact meaningfully with their environment, solve every day problems and live successfully in this day of advancing science and technology.

Furthermore, Raina observed that the current system of education in Nigeria which focuses on self-reliance and sustainable national development is built around science and technology with its activities centering on the science subjects (Chemistry, Physics and Biology among others). Furthermore, Agbi (2006) opines that the knowledge of science subjects is applied in manufacturing, processing and the development of materials for construction, building, pharmaceutical, water works, foodstuff, fertilizers, insecticides and herbicides. The government of Nigeria has demonstrated her concern towards the study of science civic cultural affairs and economic productivity for survival in a changing world. Science education involves various investigative processes and activities with regards to developing, acquiring and controlling knowledge, skills, increasing productive capacity and influencing peoples 'attitude about the natural factors of the environment. This is why one of the goals of science education is to provide knowledge and understanding of the complexity of the physical world, forms and conduct of good life (Federal Republic of Nigeria, 2014). It is well known world-wide that science and technology are central to the changing world because they supply man's basic needs such as food, clean water, shelter, energy, basic healthcare and education among others. It is in this subjects in concrete ways. For instance, the establishment of specialized universities of agriculture and technology, polytechnics and colleges of technology, the 60:40 ratio of university admission policy in favour of science candidates and the establishment of special science schools by some states of the federation are geared towards promoting science education. More importantly, the activities of professional bodies such as Science Teachers Association of Nigeria (STAN), Chemical Society of Nigeria (CSN), Nigerian Institute of Physics (NIP), Nigerian Society of Biochemistry and Molecular Biology (NSBMB) and many others are in line with the stakeholders' desire to encourage the effective teaching of these science subjects in the schools.

Basic technology curriculum adapted a spiral approach of teaching which expressed the fundamental unity of scientific thought. It is expected that by teaching Basic technology at this level, every Nigerian student would be given the basic knowledge and understanding of what science is all about and exposed to some of the innovations that are taking place around them. This assertion blends with the objectives of science teaching which are to produce individuals who will be able to live effectively in the modern age of science and technology and contribute to the development of the nation (Agogo & Ode, 2011).According to the National Curriculum for Junior Secondary School (FRN, 2012), basic technology is aimed at enabling students acquire specific science process skills such as: observing, organizing acquired information,

generalizing on the basis of acquired information, predicting as a result of generalization and designing experiment (including controls where necessary) to check predictions. Olusi (2008) earlier shown that concrete steps ought to be taken to get students groomed or trained in science and technology to enable them use scientific facts to interpret natural phenomena such as earthquake, volcanoes and other natural disasters. This may ultimately help them in solving environmental challenges. But the teaching of basic technology is faced with myriads of challenges. For instance, the subject is handled by teachers who are single subject specialist either in biology, chemistry, physics, integrated science or agricultural science, taught in an ill-equipped classroom, library and laboratory, without teaching aid. Some of these claims are verifiable because they might not have anything to do with disparity in achievement of students in BECE Basic technology as it relates to their performance in science at senior secondary education level.

The attainment of the Basic technology Education objectives and enhancement of students' achievement in Secondary Schools rely extensively on many factors. These include the failure of the Basic technology Education curriculum to satisfy the day-to-day exigencies, the comfort of the people and the technological development of the country (Akinpade, *et al*., 2020). Other challenges include inadequate qualified teachers, poor methods of instruction, and inadequate teaching facilities and equipment (Amaechi& Thomas, 2016). Regarding the quality and quantity of teachers, relevant literature reveals that there might be shortage of trained teachers to teach Basic technology Education in Secondary Schools in Nigeria. Apart from this, some pedagogical skills to impact the knowledge of the students are conspicuously lacking by many of these teachers, they might also be deficient in technical knowledge of the subject matter (Oviawe*et al.,*2017, & Bashir, 2018). Umar *et al.* (2020), opined that all technical college programmes should be run well to enhance the economic and environmental challenges of the professional tasks involved. These tasks positively influence the technological developments in the industries and have brought about changes and thus rendered analogue method of carrying out work inadequate in the industries or companies while creating the need for new and often sophisticated skills. Obviously, the industries and companies need the services of basic technology craftsmen who can adapt to the changes and challenges in technology.

The need for preparing Basic technology Education students for these change and challenges becomes paramount and has therefore necessitate a shift from instructional strategies that are based on the behavioral learning theories to those rooted in cognitive psychological learning theories for which Design-thinking learning strategy is one (Pusca& Northwood, 2018; DeGone, 2021). In agreement to the fact, William (2019) posited that the current educational system, regardless of decades of politically, the changing conditions and exponential growth of the world's technology constantly requires countries to transform their learning and teaching strategies so as to adapt to the changing world in this 21st century. Learning strategies employed by teacher is a strong determinant of students' learning outcome (Mohammed & Iredje, 2020). Design thinking is an emerging and instructional learning strategy used to assist students' in obtaining the thinking skills needed for 21st century learning and career development with a strong emphasis on problem solving. Pusca & Northwood (2018) stated that design-thinking was used as a human-centered, open-ended problem-based approach to transform the way teaching and learning is conducted in education, and to solve the different challenges that instructors and students are facing in the context of digital learning and of outcome-based curriculum. Design-thinking has been proven to be useful in tackling complex problems that are ill-defined or unknown (Fabiano, *et al*. 2021).

Machine Learning (ML) is a rapidly evolving field of technology that has the potential to greatly impact society in a variety of ways. ML is a form of Artificial Intelligence (AI) that allows machines to learn and improve from experience without being explicitly programmed. It is a data-driven approach that enables machines to automatically learn patterns and insights from data, and make predictions or decisions based on these patterns. With the increasing availability of big data, ML has become one of the most promising areas of research and development in recent years. According to a report by Markets and Markets, the global machine learning market is expected to grow from $1.4 billion in 2020 to $10.9 billion by 2025, at a CAGR of 44.1% during the forecast period (Markets and Markets, 2020). ML has already begun to revolutionize many industries such as healthcare, finance, transportation, and manufacturing. For example, in healthcare, ML is being used to improve the accuracy of medical diagnoses, predict patient outcomes, and personalize treatment plans. In finance, ML is being used to detect fraudulent transactions, predict credit risk, and optimize investment strategies. However, there are also concerns about the potential negative effects of ML on society, such as job displacement and privacy issues. These concerns have led to calls for more research on the impact of ML on society, in order to ensure that the benefits of this technology are maximized and the risks are minimized. The purpose of this research is to conduct a comprehensive analysis of the current and future impact of ML on society. The research will include a thorough literature review, case studies, and surveys to gather data on the economic impact of ML, ethical and privacy implications, and public perceptions of the technology. The findings of this research will provide a comprehensive understanding of the current trends and future implications of ML on society, which will be useful for policymakers, researchers, and practitioners in making informed decisions about the development and use of this technology. Additionally, this research will also inform the public about the potential benefits and risks of ML, and help to address any concerns they may have about the technology.

Student Academic achievement has to do with the successful accomplishment of goals, measured by the extent to which instructional objectives are achieved. According to Eze and Osuyi, (2018), academic achievement is a measure of the degree of success in performing specific tasks in a subject area or area of study by students after a learning experience. Whereas Ahmad and Ombuguhim, (2020) defined achievement as the scholastic standing of a student at a given moment in learning both theoretical and practical skills in Basic technology therefore, is essential to students' progress in the changing world of technology. In this regard, effective instructional approach must be developed to improve skills achievement and to maintain acquired skills at a functional level over a period of time. With adoption of design-thinking learning strategies, students' interest might increase. When students' interests are piqued, their performance improves.

Student interest according to Duru *et al.* (2021) is defined as a content-specific, person-object relationship that emerges from an individual's interaction with the environment. According to the authors, interest is an important variable in the school context, as it can influence students' level of participation in learning, Self-efficacy of their learning experience as well as their level of performance. The study therefore poised to find out the effect of Machine learning on students' achievement and interest in basic technology in Niger State.

Statement of the Problem

Basic technology is one of the trade programme offered at the Secondary Schools which is meant to prepare students with the requisite skills that can make them to be self-reliant after graduation. Such skills include but not limited to demonstration of basic knowledge in theory and practical skill content. It is an essential trade that covers setting out of buildings, form

block walls on the concrete foundation, be able to level the building and also possess skills in designing good roofing pattern.

The National Examinations Council (NECO) reports show the persistent records of the students' low performance in Basic technology and this has been attributed to teachers' inappropriate pedagogical approaches. Study Mbonyiryivuze, *et al.* (2019) had shown that students' poor academic achievement is as a result of teaching methods employed by teachers. Similarly, Researchers such as Duhu and Ibanga, (2020) and Lawal *et al.,* (2020) also identified several factors responsible for students' poor performance in subjects such as Basic technology to be specific, and they classified these factors as students-related factors, teacher related factors, society-related factors and government–related factors. Among other things that form the teacher-related factors is the teaching methods adopted by teacher like conventional teaching method. These learning methods adopted by teacher`s' in the Secondary Schools according Ayonmike, (2020) results to students' abseentism during lesson thereby paving way for students poor learning outcome.

Various methods of improving the poor performance of students have been neglected, hence there is the need to look for more proactive methods that will incorporate individual differences of learners and make them learn in a more profitable way. To search for more efficient methods that will improve students' academic performance call for the trial of another individualized approach such as design-thinking teaching methods. Therefore, the study, seeks to investigate effect of Machine learning on students' achievement and interest in basic technology in Niger State.

Research Questions

The following research questions guided the study:

1. What are the mean achievement scores of students taught Basic technology using Machine learning and those taught using lecture method in Niger State?
2. What are the mean interest scores of students taught Basic technology using Machine learning and those taught using lecture method in Niger State?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

Ho_1: There is no significant difference in the mean achievement scores of students taught Basic technology using Machine learning and those taught using lecture method in Niger State.

Ho_2: There is no significant difference in the mean interest scores of students taught Basic technology using Machine learning and those taught using lecture method in Niger State.

Methodology

The study adopted quasi-experimental design. The study was carried out in Secondary Schools in Niger State. The population of the study consists of seven Secondary Schools in Niger State. The sample of study was two hundred and forty-seven (247) JSS II, Basic technology students in Secondary Schools in Niger State. Basic technology Achievement Test (BTAT) and Basic technology Interest Scale (BTIS) were used as the instrument. The two instruments were validated by three experts from the Department of Science Education, Federal University of Technology, Minna. Pearson Product Moment Correlation Coefficient was used to compute results of the trial testing after test re-test instrument administration and the results indicated positive correlation coefficients of 0.85 and 0.88 for BTAT and BTIS respectively. The researcher administered the instrument with the help of two research assistants. Data for the study were collected through pre-test and post-test using the Basic technology Achievement

Test (BTAT) and the Basic technology Interest Scale (BTIS). After the pre-test, items of the BTAT were reshuffled before re-administration for post-test. The essence of reshuffling the items was to ensure that students do not memorise all the contents of the BTAT. Data collected from the two tests (pre-test and post-test) were used for data analysis. Data collected were analyzed using Mean and Standard Deviation to answer the two research questions while Analysis of Co-variance (ANCOVA) was used to test the two null hypotheses at 0.05 level of significance. The ANCOVA was preferred because of its power to take care of the initial lack of equivalence (differences) in the experimental and control groups since intact classes were used for the study. The pre-test served as covariate to the post-test and this justifies more the use of ANCOVA for testing the null hypotheses.

Results

Research Question 1: What are the mean achievement scores of students taught Basic technology using Machine learning and those taught using lecture method?

Table 1: Mean Achievement Scores of Students taught Basic technology using Machine learning and those taught using Lecture Method

Teaching Methods	N	Pre-test		Post-test		Mean Gain Score
		Mean	SD	Mean	SD	
Machine learning	126	33.28	10.32	79.08	8.80	42.80
Lecture Method	121	33.62	6.20	37.77	7.25	4.15
Total	**247**	**33.45**	**8.26**	**58.43**	**8.03**	**23.48**

Table 1 showed that students taught Basic technology in junior secondary schools using Machine learning had a mean and standard deviation achievement score of 33.28 (10.32) in pre-test while students taught with lecture method had pre-test mean and standard deviation achievement score of 33.62 (6.20) respectively. This suggests that at pre-test level students in both design thinking based and lecture methods almost had the same achievement. The post-test mean and standard deviation achievement of students taught Basic technology in junior secondary schools using the design thinking based and lecture methods are 79.08 (8.80) and 37.77 (7.25) respectively. This implies that students taught Basic technology in junior secondary schools with design thinking based had better achievement than their counterparts taught using the lecture method. Thus, the Machine learning enhances students' achievement in Basic technology in junior secondary schools more than the lecture method.

Research Question 2: What are the mean interest scores of students taught Basic technology using Machine learning and those taught using lecture method?

Table 2: Mean Interest Scores of students taught Basic technology using Machine learning and those taught using lecture method

Teaching Methods	N	Pre-test		Post-test		Mean Gain Score
		Mean	SD	Mean	SD	
Machine learning	126	1.69	0.80	3.39	0.68	1.70
Lecture Method	121	1.55	0.62	1.76	0.75	0.21
Total	**247**	**1.62**	**0.71**	**2.58**	**0.72**	**0.95**

Table 2 revealed that students taught Basic technology in junior secondary schools using Machine learning had a mean and standard deviation interest score of 1.69 (0.80) in pre-test

while students taught with lecture method had pre-test mean and standard deviation interest score of 1.55 (0.62) respectively. This suggests that at pre-test level students in both Machine learning and lecture method almost had the same interest level. The post-test mean and standard deviation interest of students taught Basic technology in junior secondary schools using the design thinking based and lecture methods are 3.39 (0.68) and 1.76 (0.75) respectively. This implies that students taught Basic technology in junior secondary schools with design thinking based had higher interest in Basic technology than their counterparts taught using the lecture method. Thus, the Machine learning promotes students' interest in Basic technology in junior secondary schools more than the lecture method.

Ho_1: There is no significant difference in the mean achievement scores of students taught Basic technology using Machine learning and those taught using lecture method.

Table 3: ANCOVA Summary Table of the difference in the mean (x) achievement scores of students taught Basic technology using Machine learning and those taught using lecture method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	109046.255[a]	2	54523.128	1081.545	.000
Intercept	28358.581	1	28358.581	562.534	.000
Pre-test	3708.140	1	3708.140	73.556	.000
Method	**106104.674**	**1**	**106104.674**	**2104.740**	**.000**
Error	12300.587	244	50.412		
Total	976558.000	247			
Corrected Total	121346.842	246			

Table 3 shows the F value as 2104.74 and the probability value as .000. The probability value of .000 of this finding is less than the alpha value of 0.05. Therefore, the null hypothesis is rejected and thus, there is significant difference in the mean achievement scores of students taught Basic technology using Machine learning and those taught using lecture method in favour of the Machine learning. This implies that students taught Basic technology with Machine learning had better achievement compared with their counterparts taught with the lecture strategy.

Ho_2: There is no significant difference in the mean interest scores of students taught Basic technology using Machine learning and those taught using lecture method.

Table 4: ANCOVA Summary Table of the difference in the mean (x) interest scores of students taught Basic technology using Machine learning and those taught using lecture method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	165.925[a]	2	82.963	163.546	.000
Intercept	313.734	1	313.734	618.469	.000
Pre-Interest	2.219	1	2.219	4.374	.038
Method	**165.854**	**1**	**165.854**	**326.950**	**.000**
Error	123.775	244	.507		
Total	1948.000	247			
Corrected Total	289.700	246			

Table 4 showed the F value as 326.95 and the probability value as .000. Since the probability value of .000 of this finding is less than the alpha value of 0.05. Therefore, the null hypothesis is rejected and thus, there is a significant difference in the mean interest scores of students taught Basic technology using Machine learning and those taught using lecture method in favour of the Machine learning. This suggests that students taught Basic technology with the Machine learning had higher interest in the subject compared to their counterparts taught with the lecture method.

Discussion of Results

The data presented in Table 1 and Table 3 revealed that students taught Basic technology in junior secondary schools with design thinking-based learning had better achievement than their counterparts taught using the lecture method. There is significant difference in the mean achievement scores of students taught Basic technology using Machine learning and those taught using lecture method. This implies that students taught Basic technology with Machine learning had better achievement compared with their counterparts taught with the lecture method. This finding is expected as students' direct involvement in the teaching and learning processes enhances students' achievement more than teacher-dominated instruction. The finding of this study is coherent with that of Fabiano*et al.* (2021) who found that Machine learning was very effective in promoting students' academic performance and retention in children.

The data presented in Table 2 answered research question 2 while the data presented in Table 4 answered hypothesis 2. The result of the analysis revealed that students taught Basic technology in junior secondary schools with Machine learning had higher interest in Basic technology than their counterparts taught using the lecture method. There is a significant difference in the mean interest scores of students taught Basic technology using Machine learning and those taught using lecture method in favour of the Machine learning. This suggests that students taught Basic technology with the Machine learning had higher interest in the subject compared to their counterparts taught with the lecture method. This finding is expected as students' active participation in teaching and learning process rekindles their interests and deactivates boredom and day dreaming. In line with the findings of this study Cereja*et al.* (2018) found out that students taught using design thinking exhibited higher interest in the subject Technical Drawing, than those taught by their teachers using the lecture method.

Conclusions

Students' poor achievement and interest in Basic technology informed the need for the study on the effect of Machine learning on students' achievement and interest in Basic technology in Secondary Schools in Niger state. The study indicated that Machine learning enhances students' achievement and interest in Basic technology more than the lecture method. Basically, there was significant difference in the mean achievement and interest scores of students taught Basic technology using Machine learning and those taught using lecture method in favour of the Machine learning. It was concluded that appropriate use of Machine learning in teaching Basic technology would facilitate students' achievement and interest in Basic technology.

Recommendations

Based on the findings of the study, the following recommendations were made.

1. Basic technology teachers should be encouraged by the government through its relevant ministries to adopt Machine learning in teaching and learning Basic technology for better academic achievement of the students in the subject.

2. The Government through its relevant ministries of education should organize seminars, workshops and symposia for the in-service teachers on the use of Machine learning for effective teaching and learning of Basic technology in junior secondary schools.

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REVIEW ON PRACTICAL REALIA AND IT'S RELEVANCE TO BIOLOGY STUDENTS

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Abstract
This paper presents review on practical realia and its relevance to biology students Practical realia is a real object, systematic, peer-mediated teaching strategy under the guidance of the teacher. It involves students learning from and with each other using real objects which are symbiotically beneficial and involves exchange of ideas, knowledge, experience and skills among participants. This review summarises significant research on the meaning of practical realia, importance of realia, benefit of practical realia, challenges of practical realia and key factors that contributed to enhance achievement of students in Biology were also identified in the study. The study concluded that the use of practical realia will aid students' better achievement in Biology. It will bring about responsiveness for Biology teachers about how the practical realia would help to enhance their job delivery, this will support them to adapt and adopt it in other concepts in Biology and use it for classroom instruction in order to avoid passive instruction and encourage active involvement of students and also reduce the stress of teachers. Hence, Government, organizations, agencies and non-governmental organisations (NGOs) should organise seminar, workshops to train teachers on practical realia.

Keywords: Practical Realia, Biology

Introduction

Practical realia refer to the use of real objects, materials, and experiences in the learning process to create a more engaging and authentic educational experience. In biology education, the use of realia has gained significant attention as it provides students with tangible, hands-on learning opportunities that help them grasp complex biological concepts more effectively. The teaching of biology often involves abstract and theoretical concepts that can be challenging for students to comprehend through traditional lecture methods alone. By incorporating realia, such as specimens, models, live plants, or animals, students can directly observe and manipulate the materials, fostering a deeper understanding of topics like anatomy, physiology, ecology, and genetics. This experiential learning approach helps students make connections between theory and practice, which is vital for mastering biological sciences.

The relevance of practical realia to biology education lies in its ability to enhance critical thinking, problem-solving skills, and retention of knowledge. Research suggests that students who engage in hands-on learning through realia tend to perform better academically and exhibit higher levels of engagement compared to those who rely solely on textbooks or digital simulations (Olayemi, 2021). Moreover, practical realia supports the development of scientific inquiry skills, such as observation, experimentation, and hypothesis testing, which are essential for biology students aiming to pursue careers in research, healthcare, or environmental sciences.

In addition to enhancing student performance, practical realia has been shown to positively impact student attitudes toward learning. A study by Ezeokoli and Ikediashi (2023) found that biology students who participated in practical sessions using realia demonstrated greater interest and enthusiasm for the subject. These findings align with educational theories that emphasize the importance of active learning, which engages students more deeply and helps in long-term knowledge retention.

Furthermore, the integration of practical realia is critical in addressing learning disparities, particularly in under-resourced schools where students may lack access to modern laboratory equipment. According to Adebola and Shokunbi (2022), the use of locally available materials and biological specimens as realia can bridge the gap between theory and practice, making biology education more inclusive and accessible, especially in low-income areas.

Importance of Practical Realia for Biology Students

Practical realia play a crucial role in biology education by transforming abstract concepts into tangible learning experiences. It refers to the use of real objects, materials, and real-world experiences that actively engage students, allowing them to observe, interact with, and manipulate biological materials. Here are several key reasons why practical realia is essential for biology students:

1. Enhances Understanding of Complex Concepts

Biology often deals with abstract topics like cell biology, genetics, and ecosystems, which can be challenging to visualize and understand through traditional lectures or textbooks alone. Practical realia, such as actual biological specimens, models, and live organisms, help students see and engage with the material firsthand. This promotes deeper understanding by bridging the gap between theory and reality, allowing students to visualize what they are learning and make sense of complicated biological systems (Olayemi, 2021).

2. Fosters Critical Thinking and Problem-Solving Skills

By interacting with real biological materials, students are encouraged to think critically and approach problem-solving from an experiential perspective. Hands-on activities, such as dissection or experimentation, require students to formulate hypotheses, make observations, and draw conclusions based on real-world data. This type of learning promotes scientific inquiry and critical thinking, which are core competencies for any biology student (Ezeokoli & Ikediashi, 2023).

3. Promotes Active Engagement and Motivation

Practical realia help engage students more actively in their learning process. Unlike passive learning from textbooks or lectures, the use of real objects and live materials makes learning dynamic and interactive. According to Adebola and Shokunbi (2022), this active engagement not only enhances knowledge retention but also makes the learning experience more enjoyable. When students are motivated and interested in what they are learning, they tend to have a more positive attitude toward the subject, leading to better academic performance.

4. Develops Scientific Inquiry Skills

Biology as a discipline relies heavily on the scientific method, which involves observing phenomena, testing hypotheses, and conducting experiments. Practical realia is essential for teaching these skills. For example, when students work with live plants, animals, or other real-life biological specimens, they get firsthand experience with observation, data collection, and

experimentation. These experiences are foundational for biology students, especially those pursuing careers in research, medicine, or environmental science (Olayemi, 2021).

5. Provides Real-World Applications

Biology is the study of living organisms and their interactions with the environment. Through practical realia, students can make meaningful connections between what they learn in the classroom and the world around them. For example, studying ecosystems by examining real plant species or observing animal behavior allows students to understand the relevance of biological concepts in real-world contexts. This approach cultivates a greater appreciation for biology as a practical science and demonstrates its applications to everyday life and broader societal challenges (Adebola & Shokunbi, 2022).

6. Addresses Learning Disparities

In regions where access to advanced laboratory equipment may be limited, practical realia provide an effective and inclusive solution. By using locally available materials and biological specimens, students can still engage in meaningful, hands-on learning without the need for costly technology. This is particularly important in under-resourced schools, where providing equal learning opportunities can be challenging. Practical realia, therefore, helps level the playing field and ensures that all students, regardless of resources, can benefit from experiential biology education (Adebola & Shokunbi, 2022).

The importance of practical realia in biology education cannot be overstated. It not only helps students better understand complex biological concepts but also fosters critical thinking, active engagement, and scientific inquiry skills. By providing real-world applications and addressing learning disparities, practical realia ensures that biology education is accessible, dynamic, and meaningful for students. These benefits collectively contribute to improved academic outcomes and a deeper appreciation for biology as a discipline.

Overview of Practical Realia for Biology Students

Practical realia refer to the use of real objects, materials, and real-life experiences in education to engage students and provide authentic learning experiences. In biology education, practical realia have become an effective instructional tool, offering students tangible, hands-on learning opportunities that facilitate a deeper understanding of biological concepts.

Key Elements of Practical Realia in Biology

1. **Use of Biological Specimens**: These include plant and animal specimens, either live or preserved, that allow students to study anatomy, physiology, and other biological processes firsthand.
2. **Models and Simulations**: Physical models of biological structures (e.g., the human heart, DNA molecules) enable students to visualize and manipulate complex systems.
3. **Fieldwork and Outdoor Activities**: Activities such as ecological studies in natural environments give students the opportunity to observe ecosystems, collect data, and learn about biodiversity.
4. **Laboratory Experiments**: Practical realia often involve laboratory work where students conduct experiments, test hypotheses, and engage in scientific inquiry.

Importance of Practical Realia for Biology Students

1. **Enhanced Understanding**: By working with real-life biological materials, students can move beyond theoretical knowledge, fostering a clearer understanding of complex biology topics.

2. **Skill Development**: Hands-on experiences cultivate critical thinking, problem-solving, and observation skills, which are essential for scientific inquiry.

3. **Increased Engagement**: Interactive learning through practical realia stimulates interest and enthusiasm for biology, making lessons more engaging and enjoyable.

4. **Improved Retention**: Studies show that students retain information better when they engage in experiential learning, as practical realia connect abstract concepts to real-world examples (Ezeokoli & Ikediashi, 2023).

5. **Scientific Literacy**: Practical realia encourage students to develop key scientific skills such as experimentation, data collection, and hypothesis testing, which are foundational to understanding biological sciences (Olayemi, 2021).

6. **Inclusive Learning**: Practical realia can be adapted for use in under-resourced schools by incorporating locally available materials, making it an inclusive teaching method that addresses educational inequalities (Adebola & Shokunbi, 2022).

Challenges and Considerations

While practical realia provides numerous benefits, it also presents some challenges. For example, maintaining and accessing biological specimens may be expensive or logistically difficult in some schools. Additionally, educators must ensure that the use of realia aligns with educational goals and learning outcomes to maximize its effectiveness.

Practical realia is a highly effective tool in biology education that allows students to engage directly with the subject matter. It transforms the learning experience by offering a dynamic and interactive approach that enhances understanding, fosters skill development, and promotes active engagement. When integrated thoughtfully, practical realia can significantly enhance the educational experience of biology students and prepare them for further studies or careers in scientific fields.

Benefits of Practical Realia for Biology Students

Practical realia, or the use of real objects and materials in the learning process, offers numerous benefits for biology students. These advantages not only enhance the educational experience but also contribute to deeper understanding and skill development. Here are some key benefits:

1. Enhanced Understanding of Concepts

Practical realia help students visualize and comprehend complex biological concepts that can be abstract when taught through traditional methods. By interacting with real specimens, models, and other materials, students can see biological processes in action, making it easier to grasp difficult topics such as cellular structures, ecological interactions, and physiological functions.

2. Development of Critical Thinking Skills

Engaging with practical realia encourages students to think critically and analytically. When students work with real-world materials, they are prompted to ask questions, formulate hypotheses, and test their ideas through experimentation. This process cultivates a mindset of inquiry that is essential for scientific learning.

3. Active Engagement and Motivation
Hands-on learning through practical realia actively involves students in their education, making lessons more engaging and stimulating. This increased interaction leads to higher levels of motivation and enthusiasm for the subject matter, which can result in improved academic performance and a positive attitude toward biology.

4. Improved Retention of Knowledge
Research indicates that students who learn through experiential methods, including the use of realia, tend to retain information more effectively. The combination of seeing, touching, and manipulating biological materials reinforces learning and helps students remember concepts long after the lesson is over (Ezeokoli & Ikediashi, 2023).

5. Development of Practical Skills
Working with realia allows students to develop essential laboratory and research skills, including observation, measurement, data collection, and analysis. These practical skills are crucial for students pursuing careers in science, healthcare, or environmental studies and prepare them for hands-on work in laboratories or field settings.

6. Promotion of Scientific Literacy
Practical realia foster a deeper understanding of the scientific method and promotes scientific literacy. Students learn how to formulate research questions, conduct experiments, analyze results, and communicate their findings, which are vital skills in both academic and real-world contexts.

7. Encouragement of Collaborative Learning
Many practical realia activities are designed for group work, encouraging collaboration and teamwork among students. This social aspect of learning enhances communication skills and allows students to learn from one another's perspectives, fostering a collaborative learning environment.

8. Bridging the Gap between Theory and Practice
Practical realia serve to bridge the gap between theoretical knowledge and real-world applications. Students can see the relevance of what they are learning, connecting classroom concepts to everyday life and current scientific issues, which increases the perceived value of their education.

9. Inclusivity and Accessibility
In regions where access to advanced laboratory equipment may be limited, practical realia can utilize locally available materials and specimens. This approach makes biology education more inclusive and accessible, ensuring that all students can engage with the subject matter effectively (Adebola & Shokunbi, 2022).

The benefits of practical realia in biology education are manifold, ranging from enhanced understanding and critical thinking skills to increased engagement and retention of knowledge. By providing students with hands-on, experiential learning opportunities, practical realia not only enrich their educational experience but also prepares them for future studies and careers in biological sciences.

Conclusion

Practical Realia have been found to be a rewarding instructional process capable of helping students to learn and develop their skills and improve their performance more than conventional teaching method. additionally, Practical Realia offers high degree of independence needed as students are required to learn how to communicate effectively and help their fellow students to comprehend abstract concepts through the regulatory role of their teachers using real object while learning. Thus, Practical Realia is considered to be an effective teaching and learning strategy to improve Biology student's performance and should be embraced by Biology teachers in Nigerian secondary schools.

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EFFECTS OF COMPETITIVE LEARNING STRATEGY ON STUDENTS' ACHIEVEMENT IN GEOMETRY AMONG SENIOR SECONDARY SCHOOL STUDENTS IN ABUJA NIGERIA

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Abstract
This study investigated the Effects of Competitive Learning Strategy on Students' Achievement in Geometry among Senior Secondary School students in FCT Abuja. The study employed a quasi – experimental design using pre-test posttest and non-equivalent control group. The population of the study consist of Forty-Five Thousand Two Hundred and Eight Seven (45,287) students. A sample of 261 SSII students, comprising of One Hundred and forty -one (141) males and One Hundred twenty (120) females were used for the study. A multi stage sampling techniques were used for the study. Instrument for data collection was Students' Geometry Achievement Test (SGAT). The instruments were validated by five experts in mathematics education, three Senior Lectures from Department of Science Education Federal University of Technology, Minna, two Principal Lectures from FCT – COE, Zuba as well as two teachers of mathematics from FCT-Secondary Education Board. The reliability coefficient of the instrument using PPMMC was 0.89, for SGAT. Two research questions were raised and two null hypotheses were tested at 0.05 level of significant. Mean and standard deviation were used to answered research questions and Z test was statistical tools used for testing null hypotheses. The results revealed that the use of competitive learning strategy enhance students' achievement in geometry. Among other recommendations is that, mathematics teachers should be encouraged to adopt these strategies in the classroom.

***Keywords**; Competitive, learning strategy, Students and Achievement*

Introduction
Attainment of any nation's visions is based principally on the successful attainment of educational objectives, especially those of Sciences, Technology, and Mathematics at all levels (Bashir, 2018).

It has been established that, no nation rises above the knowledge of its citizens in Sciences and Technology, remarkably mathematics is the bedrock of science, and technology. Mathematics is an intellectually stimulated subject that affects every talent activity such as politics, economics, sciences and technology (Hassan *et al*, 2017). Mathematics is an important subject not only for getting academic qualification at college but is also a subject that prepares the students for the future. Due to the importance of mathematics to everyday life, mathematics is made compulsory (core) at both primary and secondary school levels in Nigeria.

Akanni (2015) viewed Mathematics as an essential tool in developing science-based knowledge such as technology, industry, and even for the sound analytical of unfolding issues

in a modern society such as Nigeria. In light of this, all over the globe, much effort and time are being expended by Mathematics educators and practitioners in enhancing effective teaching and learning of Mathematics. Because of its application in daily life and academic progression, it has been declared that Mathematics is used to procure solutions to problems, answers to questions that arise in everyday life as human being strives to satisfy the needs and importance of Mathematics in all enterprises (Etok *et al*, 2018).

However, the WAEC (2020) Chief examiners' report revealed that, students avoided questions drawn from geometry concepts like plane geometry, trigonometry, circle theorem, construction, bearings and distance. Those students who attempt question drawn from these concepts scored relatively low mark when compared with performance in the same paper on questions drawn from other areas. Also, Etok *et al*, 2018 equally identified geometry as one of the concepts perceived as difficult by the students and teachers. This meant that, there are some challenges affecting the learning of geometry concepts by the students which needs to be urgently addressed.

Geometry is the branch of mathematics which deals with the relationship of lines, angle and surfaces, it is also a concept of enjoyment and excitement, which offers students opportunities for creative work and moment of enlightenment and joy (Usman and Umar 2019). When ideas are discovered and insight gained, students are spurred to pursue mathematics beyond classroom walls, since practical approach is being used as teaching method. Poor instructional learning strategies employed by the teachers have been identified as one of the factors that are attributed to low achievement in geometry and mathematics in general (Udousoro, 2015). Thus major challenge is implementing appropriate learning strategies in Mathematics classrooms that will enhance Mathematics learning especially geometry concepts.

Successful teaching depends on the strategy the teachers adopt. Dike and Adebayo (2017) opined that the mathematics curriculum recommends guided-discovery, laboratory approach, demonstration, discussion, cooperative learning strategies, and others for teaching mathematics effectively in secondary schools in Nigeria. They further stressed that teachers use rote learning rather than demonstration or other learning strategies that are student-centered, and by this, students embarked on memorization without questioning. Thus, Mathematics becomes difficult for the students to learn because once the formula is forgotten the students will be left stranded in any mathematical task.

Therefore, mathematics teachers need to employ other learning strategies that will develop students' problem–solving abilities that is helpful in making learners exercise their reasoning power or imagination in the classroom rather than the conventional method that emphasizes knowledge and ignoring higher thinking abilities, where students sit and listen to the teacher as he/she dishes out the contents of a day's lesson. Students are allowed to ask few questions where necessary and answer questions from the teacher. Uninspiring method that teachers employ could make the attainment of the learning objectives illusive (Umar, 2015). As children differ in appearance; so also the way they learn. For instance, some learn by memorization, others by hands-on, peer or individual learning, problem-solving or work sheet method. Therefore, the teacher must discern the learning strategy that will guide the learners to develop interest and achieve the stated objectives. From the primary through Secondary to the Tertiary level of Education, competitive learning always exists, because one sees students either with friends debating (Competitive) when learning a concept (Olayede *et al*, 2016).

Competitive learning strategy is a social process that occurs when rewards are given to individuals based on how their performances are compared with the version of others, doing the same task or participating in the same event (Costin *et al*, 2016). Students engage in the win-lose struggle to determine who emerged as the best in a competitively structured classroom. In competitive classroom students perceive that they can obtain their goal only if other students in the class fail to get their own goal. Chinwe and Charles (2014) believe that, competition exist where there is a scarcity of desired learning outcome students are positioned to vie for the attainment of that outcomes. Introducing competitive learning strategy into classroom brings a shift in students' attitudes, it gives students an air of importance and motivate them to perform better especially when rewards are attached to it.

Learning under competitive strategy could be learning between individuals in a class setting or between groups. In competitive learning, the goal of class members is structured to perform faster and more accurately than other classmates. The level of interaction pattern in competition may be focused on the group (by seeking to be the best student in the group), the class (seeking to be the best student in the class), and the school (seeking to be the best student in the school). Students obstruct each other's success. Students work alone, refuse to assist others and may interfere in seeking to turn down others efforts to learn (Gambari *et al*, 2016).

Students' academic achievement is an important pre- requisite for individual and societal developmental outcomes because of its association with economic prosperity. Students' academic achievement represents the performance outcomes that indicates the extent in which a person has accomplished specific goals that were the focus of the activities in instructional environment (Nwosu, 2018). Students' academic achievement is the measure of students' overall academic achievement and learning over a particular period of time, specifically schools, colleges and university. It is the extent in which a learner has attained their short- or long-term educational goals. According to Anyor and Iji (2014), achievement is attaining a goal, when a goal is attained, it implies something has been accomplished. Thus, when a student's obtain credit pass in Mathematics at Senior Secondary Certificate Examination (SSCE) either WAEC or NECO they have achieved a goal of learning mathematics. Okechukwu and Oyekunle (2019) defined achievement as success obtained in school work by an individual in a particular learning exercise.

Anakor (2015) described achievement as the tendency to strive for success and participate in activities in which success depends on a person's effort and ability. Mathematics achievement could be in the form of good grades, marks, scores of descriptive commentaries, behavioral outputs, and mastery of skills and strategies that could be used to solve mathematical problems. It is long-term ability of the learners to retain mathematical concepts over time. The low academic achievement could be attributed to number factors, including the relationship with teachers, peer-group influence, poor home background, inadequate staffing, job satisfaction among mathematics teacher, non-utilization of appropriate instructional strategies, inadequate time, teachers' competency and lack of interest. Each of these factors can lead to stress and strain on the child and the consequence is underachievement (Danjuma 2015).

However, there is a disparity in the performances of male and female students in science which is been studied over the years Gender has remained an issue in the front burner of academic discourse in various levels of education in Nigeria especially in FCT. Iman and Dada (2014) described gender as a social role, responsibility and behaviour created in our families, societies and culture. Similarly, Augustine (2015) sees gender as a cultural difference based on a biological division between males and females.

Some studies revealed that, girls performed poorly when compared to boys at all levels of science education in Nigeria (Ekeh, 2015). Trumper (2016) identified gender as one of the factors affecting students' achievement and interest. He stressed that most female students lose interest in science even when they perform well or are better than their male counterparts. Fabiyi (2017) observed that, there was significant difference between male and female students in their mean scores, favour female students. In the vein Omoroh *et al*, (2019) observed that, there was significant interaction effect of concept mapping instructional approach and sex on students' achievement in geometry. Also, Chika *et al* (2019) revealed that, there was significant difference in the mean achievement scores between male and female students taught Mathematics using cooperative learning strategy.

Onyeizugbo (2015) pointed out that, in Nigeria, gender differences are emphasized, it is common to see gender stereotypes manifesting in day-to-day life of the average Nigerian. Specific profession or vocation has been regarded as men's (Engineering and Architecture) and others are women (Catering and Typing). Typically, parent call boys to wash cars, fix bulb, cut grasses or climb ladder in other hand washing dish, cooking, cleaning are reserved for girls. Complex and difficult tasks are located to boys while simple and less demanding tasks are expected to be handled by girls. The society term girls as weaker sex, consequently, an average Nigerian girl grows and goes to school with such a fixed stereotype.

Gambari *et al.* (2016) revealed that, there was significant difference between male and female students taught geometry using Video Based competitive instructional strategy in favour of the male students. Kolawale (2017) also revealed that, there was significant difference between male and female students taught Mathematics using competitive learning strategy, males performed better than their female counterparts.

Danjuma (2015) equally observed that, males performed better than female students when taught Basic Science using a competitive learning strategy. Onouha *et al*, (2016) observed that, there was no significant difference in the mean achievement scores between male and female students taught social studies using Jigsaw as a teaching strategy. Nwanakwo and Okigbo (2021) also observed that, there was no significant difference in the mean achievement scores between male and female students taught chemistry using Jigsaw teaching strategy. Sunday, *et al* (2014) revealed that, there was no significant difference in the academic achievement of based on gender when taught geometry construction using target- task mode of teaching.

Statement of the Research Problem

Student's poor achievement was attributed to poor instructional strategy employed by the teachers. It is noted that, students have difficulties in comprehending concepts, skills and generalization in mathematics. This becomes a thing of serious concern to the stakeholders in academic industry including parents, teachers, government, the examination bodies and even the students themselves. Poor achievement in mathematics as a subject has implications on university admission where credit is required before entry. This problem could be attributed to Instructional strategies employed by the teachers.

The studies reviewed have also proffered recommendations such as the use of Inquiry, Cooperative, Guided- Discovery, Discussion, and Problem-Solving Instructional Strategies among others, as the way forward (Dike and Adebayo, 2017). To improve students' achievement in mathematics, students must be more active in the classroom and must creatively acquire knowledge, especially in understanding and solving mathematical problems. Students need the opportunity to develop, interact and share with friends through cooperative learning

activities. In spite, the report that competitive and collaborative learning strategies has be found to facilitates teaching and learning in many subjects such as Basic Science (Danjuma, 2015). Mathematics teachers have not made much effort towards exploring these strategies in complementing secondary school mathematics instruction in FCT. Responding to recommendations that, similar studies should be carried out in other subject areas and other locations. Hence, this study is design to determine the effects of competitive learning strategy on students' achievement in Geometry among senior secondary school students in Federal Capital Territory (FCT), Abuja Nigeria.

Aim and Objectives

The aim of the study is to find out the effects of competitive learning strategy on students' achievement in Geometry among senior secondary school students In Abuja Nigeria

1. What is the difference in the mean achievement scores of senior secondary school students taught Geometry using Competitive learning strategy in Abuja?
2. What is the difference in the mean achievement scores of male and female students taught Geometry using the Competitive learning strategy

Research Questions

The following research questions were raised to guide the researcher.

1 What is the difference in the mean achievement scores of senior secondary school students taught Geometry using Competitive learning strategy in FCT?

2 What is the difference in the mean achievement scores of male and female students taught Geometry using the Competitive learning strategy

Research Hypotheses

The following null hypotheses were formulated and will be tested at 0.05 alpha levels

HO_1: There is no significant difference in the mean achievement scores of senior secondary School students taught Geometry using Competitive learning strategy.

HO_2: There is no significant difference in the mean achievement scores of male and female students taught Geometry using the Competitive learning strategy.

Significance of the Study

This research finding will contribute to the upliftment of knowledge and method of teaching mathematics in secondary schools. The study would greatly benefit students, teachers, policy makers, Government and educational researchers. The study would help students develop and adopt competitive or collaborative learning strategies in studying mathematics concepts. This will assist them in developing interest and equally improve their performance by enabling them to discover their hidden abilities and potentials, building confidence, recognising their personalities and motivations about mathematics creativity.

Methodology

The research design for the study was quasi-experimental using pretest, posttest and non-equivalent control group. Intact class as were randomly assigned to experimental and control group. The population consisted of forty five thousand two hundred and eighty seven secondary school students, comprising of twenty thousand two hundred and seven male and twenty five thousand and eighty (25,080) females from seventy seven senior secondary schools in federal capital territory (FCT) Abuja Nigeria as at 2023/2024 Academic calendar of the schools. A sample of two hundred and sixty one (261) SS II students consisting of One Hundred and Twenty (120) females and One Hundred and Forty One (141) males were used for the study. A sampling procedure was a multi-stage sampling technique. The first stage was cluster

sampling technique was used to divide Senior Secondary Schools in FCT in six (6) Area Councils. The Simple random sampling technique to select one school from each of the Area Councils. Purposive sampling technique was used to select three (3) schools from sampled schools each of the group, control group and experimental group. Finally, the researcher further employed Simple random sampling technique to select the arms of class for the control and experimental groups in the sampled schools.

Instrument for data collection was Student Geometry Achievement Test (SGAT). The instrument was designed by the researcher following his years of teaching experience as a mathematics teacher and WAEC Examiner. SGAT consisted of two (2) sections. Section A deals with the students Biography information such as: Name of school, gender and age. Section B consist of fifty (50) multiple choice. Objective test items with five options (A-E). The measure of validity of the instrument used for the study were based on face, content and construct validity. Experts in the field of Mathematics and Mathematics Education carried out the validity of the instrument. The experts were three senior Lecturers; one from the department of science education Federal University of Technology, Minna, and Principal Lecturers from the department of mathematics FCT College of Education Zuba as well as two senior teachers of mathematics from Senior Secondary Schools in FCT with a minimum qualification of first degree with at least 10 years teaching experience. The observations, corrections, suggestions and comments on the appropriateness, clarity and simplicity as well as suitability of the instrument were taken into considerations.

The reliability of the instrument was carried out using test-retest method and was calculated using Pearson Product Moment Correlative Coefficient (PPMCC) and the reliability coefficient of SGAT was 0.89 which is considered reliable enough to be used for the study. The sampled schools were visited before the commencement of field work to seek permission from the school authorities. The researcher established a rapport with teachers in the sampled schools who served as research assistant. The research assistants were trained on the objectives and operational guided for competitive learning strategy. The entire group (experimental and control) were subjected to SGAT as pre-test to determine the level of students achievement on the content of the study before experiment. The groups were exposed to treatment. The process of data collection lasted for Eight (8) weeks.

Descriptive statistics (Mean and Standard Deviation) were used to answer research questions and Z-test was used for analysis to test the stated Null hypothesis at 0.05 levels of significance for Social Science using statistical package for (SPSS) Version 23.00.

Results

The descriptive statistics of mean and Statistical Deviation were used to answer the research questions while the hypothesis were tested at 0.05 levels of significant using Z-test

Research Question One: What is the difference in the mean achievement scores of senior secondary school students taught Geometry using Competitive, learning strategy in FCT?

Table 1: Mean and Standard Deviation of students' Achievement Scores Taught Geometry using Competitive Learning Strategy and Conventional method

Groups	N	Pre-test		Post-test		Mean Difference
		$\bar{x}$	SD	$\bar{x}$	SD	
Exp.Group1	124	17.87	2.036	39.56	4.471	21.69
Control Group	137	18.02	2.024	24.01	2.771	5.99

Table 1 shows that the experimental group I (Competitive) had a mean score of 17.87 and standard deviation of 5.36 in the Pre-test and a mean score of 39.56 and standard deviation of 4.471 in the Post-test having a mean difference of 21.69. The control group had a mean score of 18.02 and a standard deviation of 2.024 in the pre-test and a post-test mean score of 24.01 and a standard deviation of 2.771 with a mean difference of 5.99. With this result, the students in the experimental group (competitive) performed better in the achievement test than the students in the control group.

Research question Two: What is the difference in the mean achievement scores of male and female students taught Geometry using the Competitive learning strategy?

Table 2 Mean and Standard Deviation of Male and Female Students' Achievement Scores Taught Geometry using Competitive learning strategy

Groups	N	Pre-test		Post-test		Mean Difference
		$\bar{x}$	SD	$\bar{x}$	SD	
Male	65	17.83	1.948	39.49	4.649	21.66
Female	59	17.94	2.187	39.67	4.219	21.73

Analysis in table 4.4 shows that, in competitive learning strategy male had a mean score of 17.83 and standard deviation of 1.948 in the pre-test and a mean score of 39.49 and standard deviation of 4.649 in the post-test having mean difference of 21.66. In female category, a mean score of 17.94 and standard deviation of 2.187 in the pre-test and a mean score of 39.67 and standard deviation of 4.219 in the post-test having mean difference of 21.73. The results show that there is a difference between the mean achievement scores of the Male and Female students when exposed to Competitive learning strategy in favour of the Female students.

HO_1: There is no significant difference in the mean achievement scores of senior secondary school students taught Geometry using Competitive learning strategy and conventional method. To test this formulated hypothesis, Z-test was used and result presented in table 3

Table 3: Summary of Z-test of Male and Female Students' Mean Achievement Scores taught Geometry using Competitive Learning Strategy

Group	No	Df	Mean	SD	Z	P-value
Experimental	124	259	39.56	4.47	1.45	0.02
Control	137		24.01	2.78		

Significant at 0.05 level

Table 3, presents the z-test comparison between the mean achievement scores of students taught geometry using competitive learning strategy and conventional method. The mean score and standard deviation of students taught geometry using competitive learning strategy are 39.56 and 4.47 respectively while students taught using conventional method were 24.01 and 2.78. this result shows that there is a significant difference in the mean achievement score of students taught geometry using competitive learning strategy and conventional method ($z=1.45$, $df= 259$, $p<0.05$). Hence the null hypothesis stated above that, there is no significant difference in the mean achievement scores of senior secondary school students taught Geometry using Competitive learning strategy and conventional method was rejected.

HO2: There is no significant difference in the mean achievement scores of male and female students taught Geometry using Competitive learning strategy in FCT. To test this formulated hypothesis, z-test was used and result presented in table 4

Table 4: Summary of Z-test of Male and Female Students' Mean Achievement Scores taught Geometry using Competitive Learning Strategy

Group	No	Df	Mean	SD	Z	P-value
Male	65	122	39.49	4.65	1.34	0.25
Female	59		39.67	4.22		

Significant at 0.05 level

Table 4, presents the z-test comparison between the mean achievement scores of male and female students taught geometry using competitive learning strategy. The mean score and standard deviation of the male students are 39.49 and 4.65 respectively while the female students were 39.67 and 4.22. this result shows that there is a significant difference in the mean achievement score of male and female students taught geometry using competitive learning strategy ($z=1.34$, $df=122$, $p>0.05$). Hence the null hypothesis stated above that there is no significant difference in the mean achievement scores of male and female students taught geometry using competitive learning strategy was retained.

Findings

1. There was significant difference in the mean achievement scores of students taught geometry using competitive learning strategy and control method, implies that, competitive learning strategy as instructional strategy had significant effect on students' achievement over conventional method.
2. There was significant difference in the mean achievement scores of male and female students taught geometry taught mathematics using competitive learning strategy. The strategies tend to favour female students

Discussion

The outcome of the analysis revealed that, there was difference in the mean achievement scores of students taught geometry using competitive learning strategy. Also indicated that, those taught using competitive outperformed those taught using conventional method. This is in agreement with Kolawele (2017) that, competitive learning strategy is more effective than conventional method, also in line with Danjuma (2015) that, students taught using competitive and collaborative learning strategies performed better than those taught using conventional method. The result of the study also agreed with Olayede *et al* (2016) and Sunday *et al* (2021) that, students taught mathematics using competitive learning strategy had higher achievement score than those taught mathematics using conventional method.

Also, analysis result revealed that, there was no significant difference in the mean achievement scores of male and female students taught geometry using competitive learning strategy. This is in lined with Omoroh *et al* (2019) revealed that, there was no significant gender interactive difference of concept mopping on students' achievement in Geometry.

Conclusion

The study "Effect of competitive and Jigsaw collaborative learning strategies on learning outcomes mathematics among senior secondary schools' students in FCT" has provided

empirical evidence that the use of competitive and collaborative learning strategies facilitates learning, thereby enhances students' achievement, interest and retention in mathematics.

Recommendations

From the findings of the study the following recommendations were made:

i. Since the study revealed that, competitive learning strategy enhances students' achievement in mathematics, mathematics teachers should be encouraged to incorporate this strategy in teaching and learning of mathematics.
ii. Mathematics teachers should re-assess their classroom instructional practices because there is need for a shift from instructions practices that makes learner's passive listener to the practice that engages learners actively during instructional process.
iii. Findings from the study revealed that, most research assistants who are all mathematics teachers do not have full knowledge on how to employ competitive learning strategy, it is recommended that, workshops and seminars should be organized by government for training mathematics teachers on how this strategy are employed

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A SYSTEMATIC REVIEW OF INTELLIGENT TUTORING SYSTEMS (ITS) LEARNING MODES FOR ENHANCING ACADEMIC ACHIEVEMENT AMONG BIOLOGY STUDENTS IN FCT, ABUJA, NIGERIA

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Abstract
This paper presents a systematic review of the effectiveness of Intelligent Tutoring Systems (ITS) in enhancing academic achievement among biology students in the Federal Capital Territory (FCT), Abuja, Nigeria. Intelligent Tutoring Systems leverage artificial intelligence to provide personalized, adaptive learning experiences, thus enhancing students' understanding and retention of complex concepts in subjects like biology. The review synthesizes empirical studies conducted between 2010 and 2024, focusing on the impact of ITS on academic achievement, motivation, and engagement among secondary school biology students. The review also discusses the potential challenges to ITS implementation in FCT Abuja, including infrastructural and resource constraints, and proposes recommendations for overcoming these obstacles.

Keywords: Intelligent Tutoring Systems, Academic Achievement, Biology Education, FCT Abuja, Educational Technology

Introduction
The era of 21st century is characterized with the integration of innovative technology. Globally, technology plays an important role in educational activities as its impact is obvious. Technological advancement has resulted to paradigm shift in education. The existence of technologies in education offer ways to increase the usefulness and efficiency of knowledge transmission (Anwar *et al.*, 2021). With each passing day new software or gadget are been developed to improve lives in one way or another. There is continuous research and development going on in introducing advanced technologies to make education easier, enjoyable and accessible (Budhwar, 2017).

Intelligent Tutoring System (ITS) is a computer-based educational software program that has independent database, or knowledge base for educational content in addition to teaching strategies and try to use conclusions about the learner's ability to understand topics and identify his weaknesses and strengths so that they can adapt the learning process dynamically. Intelligent Tutoring System is an educational software program aimed at adapting teaching to student's ability, personalizing instruction and provide immediate feedback to learners (Alkhatlan and Kalita, 2018).

In Nigeria, biology is a core science subject at the secondary school level, and it plays a critical role in preparing students for careers in medical sciences, environmental science, and biotechnology. Biology provides insights into the processes of evolution and adaptation, helping us understand the origins and diversity of life on Earth. This knowledge informs research in fields such as paleontology, anthropology, and evolutionary biology. Biology informs personal health decisions, such as nutrition, exercise, and disease prevention. It empowers individuals to make choices that promote their well-being and longevity. The

relevance of Biology is evident in healthcare, food production, environmental conservation, technology, and many other areas that impact society with all these relevancies. There are still lapses in the learning of Biology which according to Lim and Khine (2021) have been attributed to the quality of the teaching, teaching process and lack of ICT instructions. To remediates this situation, this study intends to develop AI software for the learning of Biology.

This systematic review aims to evaluate the effectiveness of ITS learning modes in enhancing academic achievement among biology students in the Federal Capital Territory (FCT), Abuja. Specifically, the review will examine how ITS improves student outcomes by providing personalized instruction, feedback, and engagement.

Methodology

This systematic review adhered to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Moher *et al.,* 2009) to ensure a comprehensive and transparent review process. A literature search was conducted across multiple databases, including Google Scholar, ERIC, JSTOR, and Scopus, covering studies published between 2010 and 2024. The search terms used included "Intelligent Tutoring Systems," "biology education," "academic achievement," and "FCT Abuja."

Literature Review

Intelligent Tutoring Systems in Education

Intelligent Tutoring System is also seen as an intelligent education program that aims to provide immediate and customized instruction and feedback to learners using human-like interaction and conversation style dialogues (Goksel and Bozkurt, 2019). According to Karaci, (2018), students who utilized intelligent tutoring systems performed better academically than students who did not use the system and instead relied on conventional education. ITS dynamically models the learner over various issues or scenarios. The system's pedagogical judgments concerning tutorial technique, case selection, and curriculum sequencing may be influenced by the student state assessment (Mosa, *et al,* 2018).

Biology Education in Nigeria

The relevance of Biology is evident in healthcare, food production, environmental conservation, technology, and many other areas that impact society with all these relevancies. There are still lapses in the learning of Biology which according to Lim and Khine (2021) have been attributed to the quality of the teaching, teaching process and lack of ICT instructions. To remediates this situation, this study intends to develop AI software for the learning of Biology. Onyenma *et al.* (2024) also noted that teacher needs to apply two or more teaching and learning strategies so as to have a better and significant learning results since there is no particular teaching-learning style that is totally the best. Based on this assertion, the developed AI software will be used for adaptive, personalized and collaborative settings to improve students' achievement.

Impact Personalized learning on Biology Learning Outcomes

Personalized learning enables students to learn on their own, and prove their knowledge individually at their own pace. In personalized learning approach, biology students master concepts of a lesson by learning at their own pace, proceeding to the next concept only after accomplishment a prescribed degree of mastery over the earlier concept. The personalized learning approach focus on individual learners and best respond to their needs, accommodating their choices and goals (Abedi *et al.,* 2021). Personalize learning enable biology students to move to another concept or module when they successfully complete one concept or module.

Findings and Discussion

Findings on Personalized Learning Effectiveness

Numerous success stories and research studies highlight the effectiveness of personalized learning environments in improving student outcomes. For instance, a study conducted in a high school setting found that personalized learning interventions led to higher student achievement, increased motivation, and reduced dropout rates (Gülmez, *et al.,* 2021). In another example, Kaya, S. (2023), stated that a university implemented AI-driven adaptive learning modules in a computer science course. The personalized modules allowed students to learn at their own pace, receive targeted feedback, and access additional resources based on their individual needs. As a result, student satisfaction and course completion rates improved significantly. Furthermore, research on personalized learning platforms like Duolingo, which uses AI to adapt language lessons to each user's proficiency level, demonstrates substantial gains in language learning outcomes compared to traditional instruction methods.

Retention of Biological Concepts

Retention refers to how well students are able to remember learnt concepts after a period of time. Retention is the ability to reproduce a learned concept when the need arises after a period of time. Poor retention is one of the prevalent problems among Nigerian students. This poor retention of learned materials can be attributed to teachers' non-use of instructional technologies to support their teaching (Lim and Khine, 2021). The retention of students can also be influence by their gender. Gender is one of the factors that have considerable effects on students' academic achievement especially in science subjects like Biology.

Conclusion and Recommendations

The findings of this systematic review demonstrate that ITS can significantly enhance academic achievement, engagement, and retention in biology education in FCT Abuja. By providing personalized, adaptive learning experiences, ITS has the potential to address many of the challenges faced by traditional teaching methods, particularly in complex subjects like biology. However, the successful implementation of ITS in FCT Abuja requires overcoming challenges related to infrastructure, cost, and teacher readiness.

To address these challenges, the following recommendations are proposed:
Infrastructure Development: Investment in educational technology infrastructure, including computers and internet connectivity, is critical for enabling ITS adoption in FCT Abuja schools.

Teacher Training: Professional development programs should be implemented to equip biology teachers with the skills needed to integrate ITS into their classrooms.
Government and Private Sector Support: Collaboration between the government and private sector stakeholders is necessary to fund and support ITS initiatives in secondary schools.
Future research should explore long-term ITS implementation strategies and investigate the scalability of these systems in other subject areas beyond biology.

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Performance Analysis in Reliability, Availability, Maintainability and Dependability (RAMD ANALYSIS) of Subsystems

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Abstract

This study aimed to increase textile manufacturing system dependability, reliability, maintainability, availability, and metrics like MTBF and MTTF by boosting RAMD. The textile system under investigation is a serial system consisting of five subsystems, which are; subsystem A is weaving section, subsystem B is the dry clean section, subsystem C is the cross cut section, subsystem D is the side seam section and subsystem E is the cleaning section. Each of the subsystem consist of main unit, warm standby unit and cold standby unit. For design and prediction, the Markovian birth-death method is employed to assemble the system governing the differential difference equation from the state-to-state transition diagram. The rates of repair and failure of each subsystem are exponentially distributed and statistically independent. For several subsystems of the system, the findings for RAMD, all of which are crucial to system performance, have been acquired and shown in figures and tables. Furthermore, the results of this study reveal that the highest system performance and dependability may be achieved when the overall system failure rate is low. The findings of this research are thought to be valuable for analyzing performance and determining the best system design and feasible maintenance strategies that may be used in the future to improve system performance, strength, effectiveness, production output as well as revenue mobilization.

Keywords: Availability; Failure Rate, Lindley; Repair Rate; Reliability; Textile

Introduction

Series-parallel systems are systems consisting of subsystems that are configured in series. Some of the subsystems have units arranged in parallel, k-out-of-n, cold standby, hot standby or warm standby. The entire system is said to be up and running whenever all subsystems are up and running. Failure of such systems can be partial due to failure of unit or total due to failure of all units in subsystem. This failure will not stop the system from operating; rather, the system will continue to operate at full or reduced capacity depending on how the components are arranged. When any of the subsystems fails, the system's operation ceases, resulting in the system's total failure. The majority of industrial and manufacturing systems are set up in a series-parallel configuration. Because of their widespread use in industrial and manufacturing settings, determining the reliability, availability, and profitability of series-parallel systems as industrial and manufacturing systems has become an increasingly important issue.

RAMD is a logistical technique for assessing the strength, effectiveness, and performance of equipment at various levels. It ensures system safety and operation problems and identifies which of the system's units, components, or subsystems require adequate maintenance. RAMD (reliability, availability, maintainability, and dependability) management is critical to a company's success. These four measures of system strength, effectiveness, and performance can be used to forecast system speed, product quality, and volume production output.

Literature review

The Lindley distribution was first introduced as a one scale parameter distribution by Lindley (1958).In the recent years, researchers have given Lindley distribution a special attention for its importance in modelling complex real lifetime data. Some researchers went in the track of studying the Lindley distribution and its properties in more details. Ghitany et al. (2008) studied some properties of the one parameter Lindley distribution, and in the application part, they showed that it is more flexible and works better in modelling lifetime data than the known exponential distribution. Other researchers have introduced more flexible generalizations of Lindley by compounding Lindley with other well-known distributions. A two parameters extension of Lindley distribution was investigated by Ghitany et al. (2011) , Shankar et al.(2013) and More recently, another two-parameter Lindley distribution was introduced by Dye et al(2019), which provides a better fit to skewed real data than the inverse Lindley distribution introduced by Sharma et al (2015). With comparison to Weibull distribution, Arslan et al (2017) proposed the use of Generalized Lindley distribution introduced by Nadarajah et al. (2011) as an alternative to the Weibull distribution when modeling wind speed data. Many three-parameter generalizations have been defined, analyzed and presented as a competitive model to well-known distributions (From these three-parameter generalization; the one proposed by Zakerzadeh and Dolati (2009), Elbatal et al. (2013), and another three-parameter Lindley was introduced by Ashour and Elterhiwy (2015), which was extended by the exponentiation of Lindley distribution.

Aim and Objectives

i. The aims of this research is to formulated models of RAMD analysis of textile manufacturing system considering models; main, warm and cold standby units.
ii. To utilize the Warm standby unit in a multitude of settings when the active main unit fails and the standby unit resumes work with minimal service interruption.
iii. To developing the explicit expressions for the reliability, availability, maintainability, mean time to failure and dependability for each subsystem.
iv. To see the performance of the system through RAMD models under Lindley

Methodology

Subsystem A

Any machine that weaves yarn into fabric is referred to as a weaving machine. They are used to render upholstery fabric, silk, and ornate carpets. They come in shuttle, circular, and narrow fabric options.

Subsystem B

A dry-cleaning machine is any sanitizing device that uses a solvent other than water to tidy clothing and textiles. Although liquid is still used in dry cleaning, clothes are submerged in a water-free liquid solvent and other detergent, which is the most commonly used solvent.

Subsystem C

A cross-cutter machine is an equipment that cuts both hard and soft wood.

Subsystem D

A seam is a method of joining a number of pieces of garment, typically with thread to form stitches. Seams can be hand-stitched or machine-stitched. A seam is a line that connects pieces of fabric and other materials in a garment.

Subsystem E

Cleaning is the mechanical removal of loosely bound fibers, such as brushing, or grinding.

Machine/Subsystem	Primary Unit	Warm Standby Unit	Cold Standby Unit	Total
Weaving (A)	4	1	1	6
Dry Clean (B)	5	2	1	8
Cross Cut (C)	2	2	2	6
Side Seam (D)	3	2	1	6
Cleaning (E)	4	2	1	7

Table 1: **System Configuration**

$$A(t) = limA(T) = \frac{MTBF}{MTBF+MTTR}. \quad (2)$$

Maintainability

$$M(t) = P(T \leq t) = 1 - e^{\left(\frac{-t}{MTTR}\right)} = 1 - e^{-\mu t}. \quad (3)$$

Where μ is system repair rate.

Dependability

Dependability is a metric given by

$$D_{min} = 1 - \left(\frac{1}{d-1}\right)\left(e^{-log(d)/d-1} - e^{-dlog(d)/d-1}\right). \quad (4)$$

Where $$d = \frac{\mu}{\theta} = \frac{MTBF}{MTTR}. \quad (5)$$

MTBF

The average time between the failures is known as MTBF. It's usually expressed in hours. As the MTBF increases, so does the system's reliability. The MTBF is given by

$$MTBF = \int_0^\infty R(t)\,dt = \int_0^\infty e^{-\theta t}\,dt = \frac{1}{\theta}. \quad (6)$$

MTTR

The reciprocal of the system repair rate is specified as MTTR given by

$$MTTR = \mu^{-1} \quad (7)$$

Where μ is the system's repair rate?

RAMD Analysis for Subsystem A

This section consist of four primary operation unit (main unit), one warm standby unit and one cold standby unit. When one of the primary units failed, the warm standby unit switch to operation as primary unit and the cold standby unit switch to the position of warm standby unit. Through Table 4 below, the Chapman-Kolmogorov differential difference equations (11)-(14) are derived using Markovian birth-death process.

	S_0	S_1	S_2	S_3
S_0	0	$4\lambda_1 + \alpha_1$	0	0
S_1	μ_1	0	$4\lambda_1 + \alpha_1$	0
S_2	0	$2\mu_1$	0	$4\lambda_1$
S_3	0	0	$3\mu_1$	0

Table2: Transition rate table for Subsystem A

$$\frac{d}{dt}\vartheta_0(t) = -(4\lambda_1 + \alpha_1)\vartheta_0(t) + \mu_1\vartheta_1(t) \quad (8)$$

$$\frac{d}{dt}\vartheta_1(t) = -(4\lambda_1 + \alpha_1 + \mu_1)\vartheta_1(t) + (4\lambda_1 + \alpha_1)\vartheta_0 + 2\mu_1\vartheta_2(t) \quad (9)$$

$$\frac{d}{dt}\vartheta_2(t) = -(4\lambda_1 + 2\mu_1)\vartheta_1(t) + (4\lambda_1 + \alpha_1)\vartheta_1 + 3\mu_1\vartheta_3(t) \quad (10)$$

$$\frac{d}{dt}\vartheta_3(t) = -3\vartheta_3(t) + 4\lambda_1\vartheta_2(t) \quad (11)$$

The normalizing condition for this problem is

$$\vartheta_0(t) + \vartheta_1(t) + \vartheta_2(t) + \vartheta_3(t) = 1 \quad (12)$$

Availability of subsystem A is

$$A_{S1} = \vartheta_0(t) + \vartheta_1(t) + \vartheta_2(t) \quad (13)$$

Setting (8) to (12) to zero as $t \to \infty$ in steady state, availability of subsystem A in (16) is now

$$A_{S1}(\infty) = \frac{1 + m_1 + \frac{m_1^2}{2}}{1 + m_1 + \frac{m_1^2}{2} + \frac{2\lambda_1 m_1^2}{3\mu_1}} \quad (14)$$

Where $m_1 = \left(\frac{4\lambda_1 + \alpha_1}{\mu_1}\right)$

The Corresponding reliability, maintainability, dependability and MTBF, MTTR for main and warm standby unit of subsystem A are

$$R_{S1}(t) = \exp^{-\lambda_1 t} \quad (15)$$

$$R_{S1}(t) = \exp^{-\alpha_1 t} \quad (16)$$

$$M_{S1} = 1 - \exp^{-\mu_1 t} \quad (17)$$

Mean time between failure (MTBF) = $\lambda_1^{-1} = 66.6667\,h$ for main unit

Mean time between failure (MTBF) = $\alpha_1^{-1} = 66.6667\,h$ for warm standby unit

Mean time to repair (MTTR) = $\mu_1^{-1} = 2.8571h$

Dependability ratio d= $\frac{\mu_1}{\lambda_1} = 23.3345$ for main unit

Dependability ratio d= $\frac{\mu_1}{\alpha_1} = 23.3345$ for warm standby unit

$D_{\min}(s_1) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.9595$ for main and warm standby unit **RAMD Analysis for Subsystem B**

This section consist of five primary unit, two warm standby and one cold standby unit. Similar to the method subsystem A, the differential difference equations are derived using Markovian birth-death process.

Table 3: Transition rate table for Subsystem B

S_0	S_1	S_2	S_3	S_4

S_0	0	$5\lambda_2+2\alpha_2$	0	0	0
S_1	μ_2	0	$5\lambda_2+2\alpha_2$	0	0
S_2	0	$2\mu_2$	0	$5\lambda_2+\alpha_2$	0
S_3	0	0	$3\mu_1$	0	$5\lambda_2$
S_4	0	0	0	$4\mu_2$	0

$$\frac{d}{dt}\vartheta_0(t)=-(5\lambda_2+\alpha_2)\vartheta_0(t)+\mu_2\vartheta_1(t) \tag{18}$$

$$\frac{d}{dt}\vartheta_1(t)=-(5\lambda_2+2\alpha_2+\mu_2)\vartheta_1(t)+(5\lambda_2+2\alpha_2)\vartheta_0+2\mu_2\vartheta_2(t) \tag{19}$$

$$\frac{d}{dt}\vartheta_2(t)=-(5\lambda_2+\alpha_2+2\mu_2)\vartheta_2(t)+(5\lambda_2+2\alpha_2)\vartheta_1+3\mu_2\vartheta_3(t) \tag{20}$$

$$\frac{d}{dt}\vartheta_3(t)=-(5\lambda_2+3\mu_2)\vartheta_3(t)+(5\lambda_2+\alpha_2)\vartheta_2(t)+4\mu_2\vartheta_4(t) \tag{21}$$

$$\frac{d}{dt}\vartheta_4(t)=-4\mu_2\vartheta_4(t)+5\lambda_2\vartheta_3(t) \tag{22}$$

The normalizing condition for this problem is

$$\vartheta_0(t)+\vartheta_1(t)+\vartheta_2(t)+\vartheta_3(t)+\vartheta_4(t)=1 \tag{23}$$

Availability of subsystem B is

Mean time between failure (MTBF)= $\lambda_2^{-1}=40h$ for main unit

Mean time between failure (MTBF)= $\alpha_2^{-1}=62.5h$ for warm standby unit

Mean time to repair (MTTR)= $\mu_2^{-1}=5h$

Dependability ratio d= $\frac{\mu_2}{\lambda_2}=8$ for main unit

$$D_{\min}(s_2)=1-\left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}}-\exp^{\frac{d\ln d}{d-1}}\right)=0.8877 \text{ for main unit}$$

Dependability ratio d= $\frac{\mu_2}{\alpha_2}=12.5$ for warm standby unit

$$A_{S2}=\vartheta_0(t)+\vartheta_1(t)+\vartheta_2(t)+\vartheta_3(t) \tag{24}$$

Setting (21) to (25) to zero as $t\to\infty$ in steady state, availability of subsystem B in (27) is now

$$A_{S2}=\frac{1+m_2+\frac{m_2^2}{2}+\frac{(5\lambda_2+\alpha_2)m_2^2}{6\mu_2}}{1+m_2+\frac{m_2^2}{2}+\frac{(5\lambda_2+\alpha_2)m_2^2}{6\mu_2}+\frac{5\lambda_2(5\lambda_2+\alpha_2)m_2^2}{24\mu_2^2}} \tag{25}$$

Where $m_2=\left(\frac{5\lambda_2+2\alpha_2}{\mu_2}\right)$ The Corresponding reliability, maintainability, dependability and MTBF, MTTR for main and warm standby unit of subsystem B are

$$R_{S2}(t) = \exp^{-\lambda_2 t} \quad (26)$$

$$R_{S2}(t) = \exp^{-\alpha_2 t} \quad (27)$$

$$M_{S2} = 1 - \exp^{-\mu_2 t} \quad (28)$$

$$D_{\min}(s_2) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.9357 \text{ for main and warm standby unit}$$

RAMD Analysis for Subsystem C

The cross-cut section consists of two primary operation unit, two warm standby unit and two cold standby unit. Using the method described A and B above, the Chapman-Kolmogorov differential difference equations (32)-(37) are derived using Markovian birth-death process from Table 6 below:

Table 4: Transition Rate Table for Subsystem C

	S_0	S_1	S_2	S_3	S_4	S_5
S_0	0	$2\lambda_3 + 2\alpha_3$	0	0	0	0
S_1	μ_3	0	$2\lambda_3 + 2\alpha_3$	0	0	0
S_2	0	$2\mu_3$	0	$2\lambda_3 + 2\alpha_3$	0	0
S_3	0	0	$3\mu_3$	0	$2\lambda_3 + \alpha_3$	0
S_4	0	0	0	$4\mu_3$	0	$2\lambda_3$
S_5	0	0	0	0	$5\mu_3$	0

$$\frac{d}{dt}\vartheta_0(t) = -(2\lambda_3 + 2\alpha_3)\vartheta_0(t) + \mu_3\vartheta_1(t) \quad (29)$$

$$\frac{d}{dt}\vartheta_1(t) = -(2\lambda_3 + 2\alpha_3 + \mu_3)\vartheta_1(t) + (2\lambda_3 + 2\alpha_3)\vartheta_0 + 2\mu_3\vartheta_2(t) \quad (30)$$

$$\frac{d}{dt}\vartheta_2(t) = -(2\lambda_3 + 2\alpha_3 + 2\mu_3)\vartheta_2(t) + (2\lambda_3 + 2\alpha_3)\vartheta_1 + 3\mu_3\vartheta_3(t) \quad (31)$$

$$\frac{d}{dt}\vartheta_3(t) = -(2\lambda_3 + \alpha_3 + 3\mu_3)\vartheta_3(t) + (2\lambda_3 + 2\alpha_3)\vartheta_2(t) + 4\mu_3\vartheta_4(t) \quad (32)$$

$$\frac{d}{dt}\vartheta_4(t) = -(2\mu_3 + 4\mu_3)\vartheta_4(t) + (2\lambda_3 + \alpha_3)\vartheta_3(t) + 5\mu_3\vartheta_5(t) \quad (33)$$

$$\frac{d}{dt}\vartheta_5(t) = -5\mu_3\vartheta_5(t) + 2\lambda_3\vartheta_4(t) \quad (34)$$

The normalizing condition for this problem is

$$\vartheta_0(t) + \vartheta_1(t) + \vartheta_2(t) + \vartheta_3(t) + \vartheta_4(t) + \vartheta_5(t) = 1 \quad (35)$$

Availability of subsystem C is

$$A_{S3} = \vartheta_0(t) + \vartheta_1(t) + \vartheta_2(t) + \vartheta_3(t) + \vartheta_4(t) \quad (36)$$

Setting (29) to (34) to zero as $t \to \infty$ in steady state, availability of subsystem C is now

$$A_{S3}=\frac{1+\frac{m_3}{\mu_3}+\frac{m_3^{\,2}}{2\mu_3^2}\vartheta+\frac{m_3^{\,3}}{6\mu_3^3}+\frac{(2\lambda_3+\alpha_3)m_3^{\,3}}{24\mu_3^4}}{1+\frac{m_3}{\mu_3}+\frac{m_3^{\,2}}{2\mu_3^2}+\frac{m_3^{\,3}}{6\mu_3^3}+\frac{(2\lambda_3+\alpha_3)m_3^{\,3}}{24\mu_3^4}+\frac{2\lambda_3(2\lambda_3+\alpha_3)m_3^{\,3}}{120\mu_3^5}} \quad (37)$$

Where $m_3=(2\lambda_3+2\alpha_3)$

The Corresponding reliability, maintainability, dependability and MTBF, MTTR for main and warm standby unit of subsystem C are

$$R_{S3}(t)=\exp^{-\lambda_3 t} \quad (38)$$

$$R_{S3}(t)=\exp^{-\alpha_3 t} \quad (39)$$

(40)

Mean time between failure (MTBF)= $\lambda_3^{-1}=100h$ for main unit

Mean time between failure (MTBF)= $\alpha_3^{-1}=71.4286h$ for warm standby unit

Mean time to repair (MTTR)= $\mu_3^{-1}=5h$

Dependability ratio d= $\frac{\mu_3}{\lambda_3}=14.9999$ for main unit

$$D_{\min}(s_3)=1-\left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}}-\exp^{\frac{d\ln d}{d-1}}\right)=0.9451$$ for main unit

Dependability ratio d= $\frac{\mu_3}{\alpha_3}=14.2857$ for warm standby unit

$$D_{\min}(s_3)=1-\left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}}-\exp^{\frac{d\ln d}{d-1}}\right)=0.9427$$ for main and warm standby unit

RAMD Analysis for Subsystem D

The side seam section consists of three primary operation unit, two warm standby unit and one cold standby unit.

S_0	S_0	S_1	S_2	S_3	S_4
	0	$3\lambda_4+2\alpha_4$	0	0	0
S_1	μ_4	0	$3\lambda_4+2\alpha_4$	0	0
S_2	0	$2\mu_4$	0	$3\lambda_4+\alpha_4$	0
S_3	0	0	$3\mu_4$	0	$3\lambda_4$
S_4	0	0	0	$4\mu_4$	0

Table 5: Transition rate table for Subsystem D

$$\frac{d}{dt}\vartheta_0(t)=-(3\lambda_4+2\alpha_4)\vartheta_0(t)+\mu_4\vartheta_1(t) \quad (41)$$

$$\frac{d}{dt}\vartheta_1(t)=-(3\lambda_4+2\alpha_4+\mu_4)\vartheta_1(t)+(3\lambda_4+2\alpha_4)\vartheta_0+2\mu_4\vartheta_2(t) \quad (42)$$

$$\frac{d}{dt}\vartheta_2(t) = -(3\lambda_4 + \alpha_4 + 2\mu_4)\vartheta_2(t) + (3\lambda_4 + 2\alpha_4)\vartheta_1 + 3\mu_4\vartheta_3(t) \quad (43)$$

$$\frac{d}{dt}\vartheta_3(t) = -(3\lambda_4 + 3\mu_4)\vartheta_3(t) + (3\lambda_4 + \alpha_4)\vartheta_2(t) + 4\mu_4\vartheta_4(t) \quad (44)$$

$$\frac{d}{dt}\vartheta_4(t) = -4\mu_4\vartheta_4(t) + 3\lambda_4\vartheta_3(t) \quad (45)$$

The normalizing condition for this problem is

$$\vartheta_0(t) + \vartheta_1(t) + \vartheta_2(t) + \vartheta_3(t) + \vartheta_4(t) = 1 \quad (46)$$

Availability of subsystem D is

$$A_{S4} = \vartheta_0(t) + \vartheta_1(t) + \vartheta_2(t) + \vartheta_3(t) \quad (47)$$

Setting (44) to (48) to zero as $t \to \infty$ in steady state, availability of subsystem D is now

$$A_{S4} = \frac{1 + \frac{(2\lambda_2 + 2\alpha_2)}{\mu_2} + \frac{m_4^2}{2\mu_2^2} + \frac{(3\lambda_4 + \alpha_4)m_4^2}{6\mu_2^3}}{1 + \frac{(2\lambda_2 + 2\alpha_2)}{\mu_2} + \frac{m_4^2}{2\mu_2^2} + \frac{(3\lambda_4 + \alpha_4)m_4^2}{6\mu_2^3} + \frac{3\lambda_4(3\lambda_4 + \alpha_4)m_4^2}{24\mu_2^4}} \quad (48)$$

$$m_4 = (3\lambda_4 + 2\alpha_4)$$

The Corresponding reliability, maintainability, dependability and MTBF, MTTR for main and warm standby unit of subsystem D are

$$R_{S4}(t) = \exp^{-\lambda_4 t} \quad (49)$$

$$R_{S4}(t) = \exp^{-\alpha 4 t} \quad (50)$$

$$M_{S4} = 1 - \exp^{-\mu_4 t} \quad (51)$$

Mean time between failure (MTBF) = $\lambda_4^{-1} = 28.5714h$ for main unit

Mean time between failure (MTBF) = $\alpha_4^{-1} = 58.8235h$ for warm standby unit

Mean time to repair (MTTR) = $\mu_4^{-1} = 2.5h$

Dependability ratio d= $\frac{\mu_4}{\lambda_4} = 11.4286$ for main unit

$$D_{\min}(s_4) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.9307 \text{ for main unit}$$

Dependability ratio d= $\frac{\mu_4}{\alpha_4} = 23.5294$ for warm standby unit

$$D_{\min}(s_4) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.9630 \text{ for main and warm standby unit}$$

RAMD Analysis for Subsystem E

The cleaning section consists of four primary operation unit, two warm standby unit and one cold standby unit. Using the method described in section 4.1 above, the Chapman-Kolmogorov differential difference equations are derived using Markovian birth-death process from the Table below.

	S_0	S_1	S_2	S_3	S_4
S_0	0	$4\lambda_5 + 2\alpha_5$	0	0	0

S_1	μ_5	0	$4\lambda_5+2\alpha_5$	0	0
S_2	0	$2\mu_5$	0	$4\lambda_5+\alpha_5$	0
S_3	0	0	$3\mu_5$	0	$4\lambda_5$
S_4	0	0	0	$4\mu_5$	0

Table 6: Transition rate table for Subsystem E

$$\frac{d}{dt}\vartheta_0(t) = -(4\lambda_5+2\alpha_5)\vartheta_0(t)+\mu_5\vartheta_1(t) \quad (52)$$

$$\frac{d}{dt}\vartheta_1(t) = -(4\lambda_5+2\alpha_5+\mu_5)\vartheta_1(t)+(4\lambda_5+2\alpha_5)\vartheta_0+2\mu_5\vartheta_2(t)$$

(53)

$$\frac{d}{dt}\vartheta_2(t) = -(4\lambda_5+\alpha_5+2\mu_5)\vartheta_2(t)+(4\lambda_5+2\alpha_5)\vartheta_1+3\mu_5\vartheta_3(t)$$

(54)

$$\frac{d}{dt}\vartheta_3(t) = -(4\lambda_5+3\mu_5)\vartheta_3(t)+(4\lambda_5+\alpha_5)\vartheta_2(t)+4\mu_5\vartheta_4(t)$$

(55)

$$\frac{d}{dt}\vartheta_4(t) = -4\mu_5\vartheta_4(t)+4\lambda_5\vartheta_3(t)$$

(56)

The normalizing condition for this problem is

$$\vartheta_0(t)+\vartheta_1(t)+\vartheta_2(t)+\vartheta_3(t)+\vartheta_4(t)=1 \quad (57)$$

Availability of subsystem E is

$$A_{S5} = \vartheta_0(t)+\vartheta_1(t)+\vartheta_2(t)+\vartheta_3(t) \quad (58)$$

Setting (55) to (59) to zero as $t \to \infty$ in steady state, the availability of subsystem E in (61) is now

$$A_{S5} = \frac{1+\frac{m_5}{\mu_5}+\frac{m_5^2}{2\mu_5^2}+\frac{(4\lambda_5+\alpha_5)m_5^2}{6\mu_5^3}}{1+\frac{m_5}{\mu_5}+\frac{m_5^2}{2\mu_5^2}+\frac{(4\lambda_5+\alpha_5)m_5^2}{6\mu_5^3}+\frac{\lambda_5(4\lambda_5+\alpha_5)m_5^2}{24\mu_5^4}}$$

$$m_5 = (4\lambda_5+2\alpha_5)$$

The Corresponding reliability, maintainability, dependability and MTBF, MTTR for main and warm standby unit of subsystem D are

$$R_{S4}(t) = \exp^{-\lambda_5 t} \quad (59)$$

$$R_{S4}(t) = \exp^{-\alpha 5 t} \quad (60)$$

$$M_{S5} = 1-\exp^{-\mu_5 t} \quad (61)$$

Mean time between failure (MTBF) = $\lambda_5^{-1} = 20h$ for main unit

Mean time between failure (MTBF) = $\alpha_5^{-1} = 76.9230h$ for warm standby unit

Mean time to repair (MTTR) = $\mu_5^{-1} = 1.8182h$

Dependability ratio d= $\frac{\mu_5}{\lambda_5} = 10.9285$ for main unit

$$D_{\min}(s_5) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.9285$$ for main unit

Dependability ratio d= $\frac{\mu_5}{\alpha_5} = 42.3072$ for warm standby unit

$$D_{\min}(s_5) = 1 - \left(\frac{1}{d-1}\right)\left(\exp^{-\frac{\ln d}{d-1}} - \exp^{\frac{d\ln d}{d-1}}\right) = 0.9784$$ for main and warm standby unit

Numerical Simulation and Discussion

Numerical simulations of reliability, availability, maintainability, and dependability are discussed in this section.

	Availability					
	Subsystem	**Subsystem**	**Subsystem**	**Subsystem**	**Subsystem**	System
Failure rate	**A**	**B**	**C**	**D**	**E**	
0.00	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.02	1.0000	1.0000	0.9998	1.0000	1.0000	0.9998
0.04	0.9999	0.9999	0.9994	1.0000	0.9999	0.9991
0.06	0.9998	0.9998	0.9989	1.0000	0.9999	0.9984
0.08	0.9997	0.9996	0.9982	0.9999	0.9998	0.9972

Table 7: Variation in Availability of system due to with respect to availability of individual subsystem

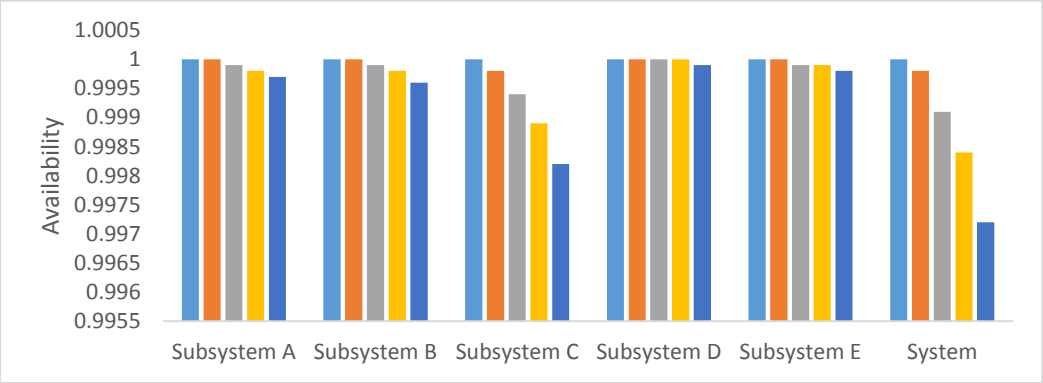

Figure 1: Availability of the system and individual subsystems

Reliability Using Lindley Distribution

Table 8: Variation in reliability of system due to changes in Lindley failure rate of subsystems for main unit

Time	**Reliability of Subsystem A**	**Reliability of Subsystem B**	**Reliability of Subsystem C**	**Reliability of Subsystem D**	**Reliability of Subsystem E**	**System Reliability**
	$\boldsymbol{\lambda_1 = 0.015}$	$\boldsymbol{\lambda_2 = 0.025}$	$\boldsymbol{\lambda_3 = 0.010}$	$\boldsymbol{\lambda_4 = 0.035}$	$\boldsymbol{\lambda_5 = 0.050}$	
0	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.0000000
20	0.95977927	0.90239927	0.98085565	0.83244010	0.71824081	0.14697050

40	0.87323231	0.72678621	0.93579333	0.58015807	0.39311677	0.00590089
60	0.76707478	0.54966210	0.87483835	0.37091875	0.19203583	0.00014415
80	0.65728589	0.39940413	0.80523309	0.22532037	0.08808950	0.00000267
100	0.55287917	0.28229231	0.73211651	0.13231414	0.03882340	0.0000004

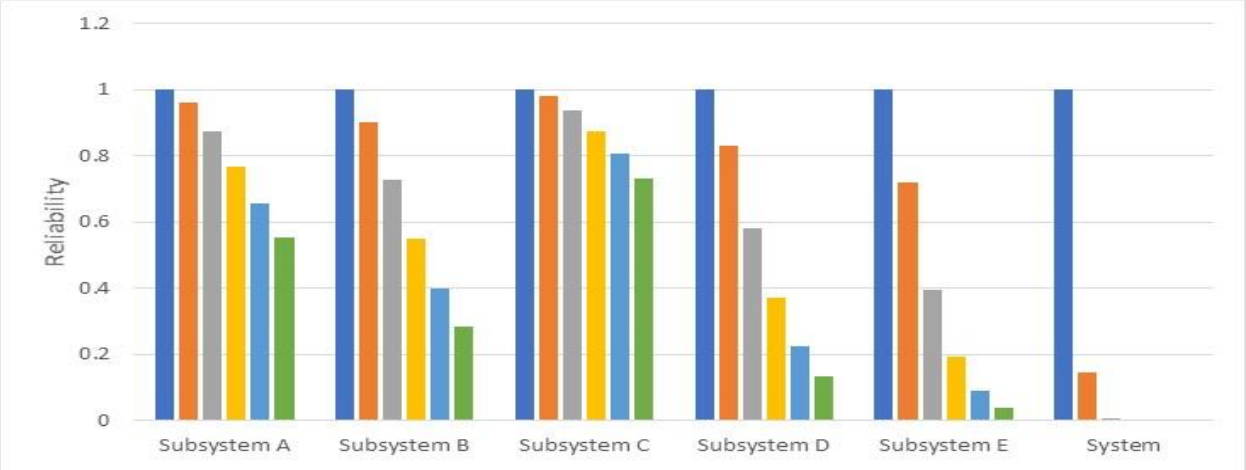

Figure 2: Variation in reliability of system due to changes in Lindley failure rate of subsystems for main unit

Table 9: Variation in reliability of system due to changes in Lindley failure rate of subsystems for Warm standby Unit

Time	**Reliability of Subsystem A** $\alpha_1 = 0.015$	**Reliability of Subsystem B** $\alpha_2 = 0.016$	**Reliability of Subsystem C** $\alpha_3 = 0.014$	**Reliability of Subsystem D** $\alpha_4 = 0.017$	**Reliability of Subsystem E** $\alpha_5 = 0.013$	**System Reliability**
0	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000	1.00000000
20	0.95977927	0.95485739	0.96448142	0.94972696	0.96895228	0.50827697
40	0.87323231	0.85944513	0.88666969	0.84535795	0.89970384	0.03210535
60	0.76707478	0.74468143	0.78934054	0.72225358	0.81137411	0.00096330
80	0.65728589	0.62832051	0.68666773	0.59988462	0.71633017	0.00002017
100	0.55287917	0.51984379	0.58706614	0.48805421	0.62227644	0.0000004

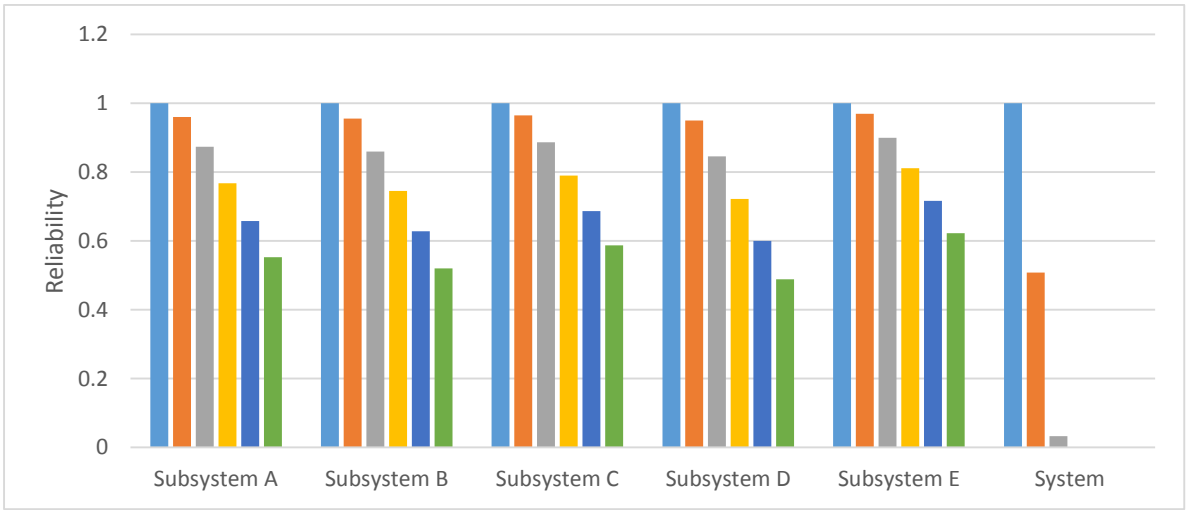

Figure 3: Variation in reliability of system due to changes in Lindley failure rate of subsystems for warm standby unit

Conclusion

From Table 7 Figure 1 and Table 8 and Figure 2 for reliability analysis of the individual subsystems and the system when the failure rate of the main and warm standby unit obeys Lindley distribution. It is observed from the tables and figures that reliability decreases slightly with passage of time from 0 to 100 in which reliability of the system is less than the reliability of each subsystem. It is evident from the tables and figures that subsystem E has the least reliability among the subsystems when the failure rate of the main obeys Lindley distribution and subsystem D for warm standby unit obeys Lindley distribution.

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