FACULTY OF SCIENCES AND SCIENCE EDUCATION
FEDERAL UNIVERSITY OF EDUCATION, ZARIA

2nd INTERNATIONAL

HYBRID CONFERENCE

2026

BOOK OF ABSTRACTS

CONFERENCE THEME

"Sustainable and Inclusive STEM Education and Research: Bridging Theory, Practice, and Educational Excellence"

- **S** — Science
- **T** — Technology
- **E** — Engineering
- **M** — Mathematics

CONFERENCE DATES: 10th – 14th August, 2026

VENUE: Dr Suleiman Balarabe Senate Chamber, FUE Zaria, Nigeria

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Abstracts

Effect of Technology-Supported School Garden Activities on Secondary School Students' Understanding of Ecosystem Services and Nutritional Literacy for Sustainable Living in Zamfara State, Nigeria

Suleiman Abdullahi SHEHU — Department of Educational Foundations, Federal University Gusau, Zamfara State (Shehusuleman78@gmail.com)

Akilu ISMA'IL — Department of Science Education, Federal University Gusau, Zamfara State (akilu@fugusau.edu.ng)

Abstract: This study examined the effect of Technology-Supported School Garden Learning on secondary school students' understanding of ecosystem services and nutritional literacy for sustainable living in Gusau Education Zone, Zamfara State. A quasi-experimental pretest-posttest non-equivalent control group design was adopted. The study involved 120 Senior Secondary School II Biology students from two public secondary schools in Gusau metropolis, selected using intact classes. Data were collected using the Ecosystem Services Understanding Test and Nutritional Literacy Scale, and analysed using mean, standard deviation, and Analysis of Covariance at a 0.05 level of significance. The findings revealed that students exposed to Technology-Supported School Garden Learning recorded significantly higher adjusted mean scores in understanding ecosystem services and nutritional literacy than those taught using Conventional Biology Instruction ($p < .05$). The study concluded that integrating digital tools with school garden experiences enhances students' engagement with ecological and nutrition-related concepts within Biology education. The study recommends the adoption of technology-supported experiential learning approaches to strengthen sustainability-oriented Biology instruction.

Keywords: *Technology-supported learning; school garden; ecosystem services; nutritional literacy; sustainable living.*

Exploring Women Lived Experiences of Telemedicine and Mobile Health Utilization for Antenatal Care in Kaduna State, North-West Nigeria: A Phenomenological Study

YUSUF, Abdulkabir Toriola (Ph.D.) — Corresponding Author — Department of Health Education, Federal University of Education Zaria, Kaduna State (y.toriola@yahoo.com, +234 816 347 1528; ORCID: 0009-0005-4358-4426)

AYABIOGBE, C. I. (Ph.D.) — Department of Health Education, Federal University of Education Zaria, Kaduna State

YAKUBU, Safiya — Department of Health Education, Federal University of Education Zaria, Kaduna State

Abstract: Telemedicine and mobile health (mHealth) are increasingly recognised as innovative approaches for improving access to antenatal care, particularly in resource-constrained settings. This study explored the lived experiences of women utilising telemedicine and mHealth for antenatal care in Kaduna State, Nigeria. Specifically, the study explored women's experiences, described the meanings they attached to these experiences and elicited suggestions for improving digital maternal healthcare services. A qualitative phenomenological research design was adopted. The study involved 50 pregnant women attending antenatal clinics at Kwata Primary Healthcare Facility and Barau Dikko Teaching Hospital, Tudun Wada, Zaria, who had utilised telemedicine or mHealth services during pregnancy. Participants were selected through homogeneous purposive sampling. Data were collected through 18 In-Depth Interviews (IDIs) and 4 Focus Group Discussions (FGDs) using semi-structured interview guides. Interviews were audio-recorded, transcribed verbatim, and analysed using Braun and Clarke's Reflexive Thematic Analysis with the aid of NVivo Version 14. Data collection continued until saturation was achieved. Four major themes emerged. Participants reported that telemedicine and mHealth improved access to antenatal information, communication with healthcare providers and appointment reminders, enhancing confidence in pregnancy care. Women perceived these services as convenient, supportive and time-saving. However, participants unanimously reported that poor network connectivity, limited digital literacy, language barriers, privacy concerns, inadequate smartphone ownership, and the high cost of internet access hindered the effective utilisation of telemedicine and mobile health services. Participants recommended increased awareness, digital literacy training, improved network infrastructure, affordable internet services and user-friendly applications in local languages. The study concludes that telemedicine and mHealth have significant potential to improve antenatal care utilisation and maternal health outcomes in Kaduna State. Strengthening digital infrastructure, improving digital literacy and expanding equitable access to affordable digital health services are recommended.

Keywords: *Antenatal care, lived experiences, maternal health, mobile health, phenomenology, telemedicine.*

Assessment of Gifted and Talented Children in STEM Education: Ensuring Inclusiveness and Educational Excellence in Nigeria

Dr. Garba Alhaji MUHAMMAD — Department of Psychology, Aminu Saleh College of Education, Azare, Bauchi State, Nigeria (naziabb93@gmail.com, +234 803 696 2442)

Abstract: The growing global emphasis on Science, Technology, Engineering, and Mathematics (STEM) education has increased the need for effective identification and assessment of gifted and talented children to promote innovation, national development, and educational excellence. In Nigeria, however, several challenges hinder the proper assessment and inclusion of gifted learners within STEM education programmes. These challenges include inadequate assessment tools, limited professional expertise, unequal access to quality educational opportunities, socioeconomic disparities, and insufficient policy implementation. This paper examines the assessment of gifted and talented children in STEM education with particular focus on ensuring inclusiveness and educational excellence in Nigeria. The study adopts a conceptual and analytical approach through review of relevant literature on gifted education, educational assessment, inclusiveness, and STEM practices. The paper discusses the importance of early identification of gifted learners, appropriate assessment strategies, and equitable educational practices that can support the intellectual and creative potentials of learners across diverse backgrounds. Findings indicate that inclusive and reliable assessment mechanisms are essential for reducing educational inequality and promoting academic excellence among gifted learners in STEM-related disciplines. The paper concludes that sustainable educational development in Nigeria requires policies and practices that support fair identification, continuous assessment, teacher training, and inclusive instructional approaches for gifted and talented learners. It recommends improved assessment frameworks, specialized teacher preparation, integration of technology-driven assessment methods, and increased government commitment toward inclusive STEM education.

Keywords: *Gifted and Talented Children, STEM Education, Educational Assessment, Inclusiveness, Educational Excellence, Equal Educational Opportunities.*

Enhancing Digital Skills through Computer Education for Sustainable National Development

Abubakar Bello Lawal — Department of Computer Science Education / School of Sciences, Yusuf Bala Usman College of Education and Legal Studies, Daura, Katsina State (Bellolawal1982@gmail.com)

Abstract: Computer education has become a vital tool for developing digital competencies necessary for sustainable national development in the 21st century. The increasing use of information and communication technologies (ICT) across education, business, healthcare, governance, and industry has created a strong demand for digitally skilled individuals capable of adapting to technological changes and contributing to economic growth. This paper examines the role of computer education in promoting digital skills acquisition and supporting sustainable development. The study highlights how computer education equips learners with practical skills such as computer operations, programming, digital communication, information management, internet usage, and cyber security awareness. These competencies improve employability, encourage innovation and entrepreneurship, and enhance access to information and learning opportunities. The paper further identifies major challenges affecting effective computer education, including inadequate ICT infrastructure, unstable internet connectivity, insufficient funding, and shortage of qualified instructors. The paper concludes that computer education is essential for building digitally competent citizens capable of driving sustainable socio-economic development.

Keywords: *Digital Literacy, Sustainable Development, ICT Skills, Digital Economy, Innovation.*

Integrating Artificial Intelligence Tools into Mathematics Education among Undergraduate Students in Sokoto State, Nigeria

GALADIMA, Usman — Department of Science Education, Sokoto State University, Sokoto, Nigeria (usman.galadima@ssu.edu.ng, +234 803 244 1317)

AMINU, Kabiru — Department of Computer Science Education, Sokoto State University, Sokoto, Nigeria (aminukabiru2011@gmail.com, +234 813 120 7078)

Abstract: This study investigated the integration of Artificial Intelligence (AI) tools into Mathematics education among undergraduate students in Sokoto State, Nigeria. Specifically, the study evaluated the academic performance of undergraduate students using AI tools in Mathematics education and identified the challenges associated with integrating AI tools into Mathematics education. A descriptive survey research design was adopted for the study. The population comprised undergraduate Mathematics students from three universities in Sokoto State. A sample of 320 respondents was selected using a stratified random sampling technique. Data were collected using a questionnaire titled Artificial Intelligence Tools Integration in Mathematics Education Questionnaire (AITIMEQ). The instrument was validated by experts in Mathematics Education, Educational Technology, and Measurement and Evaluation. The reliability was established through a pilot study using Cronbach's Alpha, yielding coefficients of 0.81 and 0.79 for the two constructs. Data were analyzed using frequency counts, percentages, mean, and standard deviation. The findings revealed that the integration of AI tools had a positive influence on the academic performance of undergraduate Mathematics students. The study also found that unstable electricity supply, poor internet connectivity, high internet data costs, inadequate digital literacy, limited access to digital devices, lack of institutional guidelines, and concerns about the reliability of AI-generated information were the major challenges affecting effective AI integration. The study concluded that AI tools have considerable potential to improve Mathematics education among undergraduate students, provided that the identified infrastructural, financial, and institutional barriers are adequately addressed. The study recommended increased institutional support for AI integration and improved digital infrastructure to facilitate the effective use of AI tools in Mathematics education.

Keywords: *Artificial Intelligence, Academic Performance, Undergraduate Mathematics Students, AI tools.*

Bridging Theory and Practice in Integrated Science Education through the Integrated Professional Pedagogical Framework: Evidence from Teacher Capacity-Building Programmes in Nigeria

Dr. Zainab MUHAMMAD SHUAIBU — Head, Research and Development Division, Academic Services Department, National Teachers' Institute (NTI), Kaduna, Nigeria (zeelamee@gmail.com, +234 806 563 9331)

Professor Binta Asabe MUHAMMAD — Head, Department of Chemistry, Federal University of Education, Zaria, Kaduna State, Nigeria (amirabintafce@gmail.com, +234 802 843 4843)

Abstract: Bridging the gap between educational theory and classroom practice remains a critical challenge in advancing sustainable and inclusive STEM education through Integrated Science in Nigeria. Although teacher professional development programmes have enhanced pedagogical knowledge, translating acquired competencies into effective classroom practice remains inconsistent. This study proposes the Integrated Professional Pedagogical Framework (IPPF), an evidence-informed framework that integrates competency-based STEM education, structured pedagogy, scripted lessons, context-responsive STEM pedagogy principles, and continuous teacher professional development to strengthen Integrated Science teaching. Guided by Experiential Learning Theory and Social Constructivism, the study adopts an explanatory sequential mixed-methods design involving 180 Integrated Science teachers selected through multistage sampling from public junior secondary schools in Kaduna, Kano, and Katsina States. Data will be collected using the STEM Pedagogical Competency Questionnaire, Classroom Observation Checklist, and Semi-Structured Interview Guide. Quantitative data will be analysed using descriptive and inferential statistics, while qualitative data will undergo thematic analysis. The study is expected to demonstrate that teachers exposed to sustained capacity-building programmes exhibit significantly stronger implementation of competency-based instruction, structured lesson delivery, inquiry-based learning, formative assessment, and learner engagement. Structured pedagogy and scripted lessons are anticipated to enhance instructional consistency and teacher confidence, while mentoring and reflective practice strengthen classroom implementation. The study concludes that the proposed IPPF offers a practical pathway for translating professional learning into effective classroom practice and recommends institutionalising integrated teacher professional development, and school-based mentoring.

Keywords: *Integrated Science Education; Integrated Professional Pedagogical Framework; Competency-Based STEM; Structured Pedagogy; Teacher Professional Development; Context-Responsive STEM Pedagogy.*

Effect of AI-Based Adaptive Learning Tools on the Academic Performance of Secondary School Chemistry Students in Oxidation-Reduction, Zaria Educational Zone, Kaduna State, Nigeria

Swafiyah BAWA — Department of Chemistry, Federal University of Education, Zaria (bawaswafiyah@gmail.com, 0806 920 0027)

Hadiza Muhammad Lawal — Department of Chemistry, Federal University of Education, Zaria (aminatu429@gmail.com)

Ismail AHMAD — Department of Chemistry, Federal University of Education, Zaria (ahmadismaila835@gmail.com)

Abstract: This study examined the effect of AI-based adaptive learning tools on the academic performance of secondary school Chemistry students in Oxidation-Reduction, Zaria Educational Zone, Kaduna State, Nigeria. A quasi-experimental, pretest-posttest, control group design was adopted. The population comprised 1,434 SS II Chemistry students drawn from 21 secondary schools, 14 co-educational and 6 single-sex, within the zone. A sample of 110 students was randomly selected after their equivalence had been established through a pretest, and assigned into a control group of 65 students and an experimental group of 45 students. Data were collected using the Oxidation-Reduction Performance Test (OPT), with a reliability coefficient of 0.78, determined using PPMC. One research question and its corresponding hypothesis guided the study. The research question was answered using mean and standard deviation, while the hypothesis was tested using t-test at a 0.05 level of significance. Findings revealed that students taught using AI-based adaptive learning tools performed significantly better than those taught using the conventional method. It was therefore recommended that workshops and seminars be organized for secondary school Chemistry teachers on integrating AI-based adaptive learning tools into chemistry instruction, to enhance seamless student learning.

Keywords: *Artificial Intelligence, Adaptive Learning, Oxidation-Reduction, Academic Performance.*

The Role of Mathematics in Real Life for Sustainable Development and Self-Reliance

Rabiu, Ahmed Tijjani — Corresponding Author — Department of Mathematics, Federal University of Education, Zaria (atrabiu64@gmail.com, +234 802 373 1035)

Muawiya, Haruna Usman — Department of Mathematics, Federal University of Education, Zaria

Ado, Muhammad Sirajo — Department of Mathematics, Federal University of Education, Zaria

Abstract: Mathematics is universally recognized as a fundamental tool for scientific advancement, technological innovation, economic growth and societal transformation. This paper examines the role of mathematics in real life with particular emphasis on sustainable development and self-reliance. The study highlights how mathematical knowledge contributes to everyday decision-making, entrepreneurship, industrial development, agriculture, health care, engineering and information technology. The paper further discusses the importance of mathematics in promoting self-employment, skill acquisition and national productivity. Challenges affecting the effective teaching and learning of mathematics, such as inadequate instructional materials, poor teaching methods, and negative attitudes toward the subject, are also examined. The paper concludes that mathematics remains indispensable for sustainable national development and recommends improved teaching strategies, adequate funding of education, teacher capacity building, and integration of technology into mathematics instruction.

Keywords: *Mathematics, Sustainable Development, Self-Reliance, Technology, Entrepreneurship, Education.*

Physics Education for Sustainable Technology and Inclusive Innovation

Ayodeji Jones IYE — Department of Physics, Kwara State College of Education, Oro, Kwara State (cyrusayodeji@gmail.com)

Abstract: As the world advances in knowledge, the global demand for sustainable technological solutions and equitable participation in scientific advancement has placed physics education at the centre of sustainable development. Physics provides foundational principles required for renewable energy systems, advanced materials, digital technologies and emerging innovations that address societal challenges. However, in order to accomplish sustainable technological development, physics education needs to be transformed from a content-oriented discipline to an innovation-driven, problem-solving-oriented field. Hence, this paper examines the role of physics education in promoting sustainable technology and inclusive innovation. Contemporary approaches such as technology-enhanced learning, computational modelling, inquiry-based learning, project-based learning, and inclusive pedagogical practices that can prepare learners to contribute meaningfully to sustainable technological development are discussed in this paper. The paper argues that physics education should not only promote conceptual understanding but also bring about creativity, ethical awareness, accessibility, and collaborative problem-solving. Recent literature indicates that integrating digital technologies, sustainable development goals (SDGs), and inclusive learning principles into physics education enhances students' capacity to develop solutions for real-world challenges. The paper also highlights implications for physics curriculum reform, teacher preparation, and educational policy, particularly in developing contexts, where sustainable innovation is needed to address energy, environmental, and technological challenges.

Keywords: *Physics education, sustainable technology, inclusive innovation, sustainable development goals, technology-enhanced learning.*

Bridging the Gap: The Synergistic Impact of Inclusive Computer Education Driving Technical Advancement in Nigeria’s Emerging Economy

Ahmad Bello Usman — Department of Business Education, School of Vocational Education, Federal College of Education (Technical), Yauri, Kebbi State (ahmadbellousman@gmail.com, +234 806 606 0142)

Abstract: In Nigeria's rapidly evolving economic landscape, digital transformation presents a pivotal opportunity for sustainable development. However, realizing this potential requires overcoming significant disparities in technological literacy and infrastructure. This paper examines the synergistic impact of inclusive computer education as a primary driver of technical education and its subsequent macroeconomic benefits within Nigeria. Historically, unequal access to digital tools has marginalized rural and underserved demographics, widening the socioeconomic divide. By implementing inclusive computer literacy initiatives — which prioritize gender equity, rural accessibility, and adaptive learning for individuals with disabilities — Nigeria can fundamentally transform its technical education framework from an exclusive privilege into a nationwide engine for innovation. Leveraging qualitative and quantitative analyses of recent digital literacy interventions, this study illustrates how widespread computer proficiency accelerates technical training in advanced fields like software engineering, data analytics, and digital manufacturing. The research demonstrates a direct correlation between inclusive digital skills acquisition and localized economic growth, characterized by heightened youth employability, a surge in grassroots tech entrepreneurship, and reduced regional economic disparities. Ultimately, this paper argues that inclusivity in foundational computer education is not merely a social imperative, but a core strategic driver necessary to bridge the digital divide. By equipping a diverse workforce with essential technical capabilities, Nigeria can foster a resilient, self-sustaining digital economy capable of competing on the global stage.

Keywords: *Inclusive Education, Computer Literacy, Technical Education, Nigeria, Economic Development, Digital Divide, Innovation Ecosystems.*

Bridging the Digital Divide through Inclusive Computer Science Education for Sustainable Digital Skills Development in Nigeria

Abubakar ALIYU — Corresponding Author — Department of Computer Science, Federal University of Education, Zaria (FUEZ) (abubakarualiyu9@gmail.com, WhatsApp: 0806 382 6696)

Bello Zainab Abike — Department of Computer Science, Federal University of Education, Zaria (FUEZ) (zainabbelloabike14@gmail.com)

Abstract: The digital divide remains a major challenge to equitable access to technology and digital skills development in Nigeria. This study examined the role of inclusive Computer Science education in bridging the digital divide and promoting sustainable digital skills development among students of Federal University of Education, Zaria. A mixed-methods case study design was adopted, involving questionnaires administered to students and interviews conducted with lecturers and ICT personnel. The study investigated students' access to digital resources, the contribution of Computer Science education to digital competency development, challenges affecting digital inclusion, and strategies for improving digital skills acquisition. Findings indicated that inclusive Computer Science education enhances digital literacy, programming skills, computational thinking, and problem-solving abilities. However, inadequate digital infrastructure, limited access to devices, unstable internet connectivity, and insufficient exposure to emerging technologies remain significant barriers. The study recommends increased investment in ICT infrastructure, curriculum enhancement, lecturer training, and stronger institutional support to promote sustainable digital inclusion in Nigeria.

Keywords: *Digital divide, Computer Science education, digital skills, inclusion, Nigeria.*

Inclusive Computer Education for Digital Skills and Sustainable Innovation

Asiya Rabe Abdullahi — Grand Khadi Muhammad Usman Library, Yusuf Bala Usman College of Education and Legal Studies, Daura (asiyarabe89@gmail.com, 0806 323 2674)

Abstract: This paper examines inclusive computer education as a pathway for enhancing digital literacy and innovation in the digital age. As digital technologies become crucial to economic development, governance, and social participation, the exclusion of disadvantaged groups from computer education risks deepening inequality and limiting the potential for innovation. The paper draws on evidence from peer-reviewed literature and identifies several benefits of inclusive computer education. It enhances digital literacy and employability among women, persons with disabilities, rural populations, and low-income learners, thereby contributing to poverty reduction and economic participation. Notwithstanding these advantages, major challenges continue. Systemic obstacles include high costs of devices, inadequate infrastructure and internet access, and a shortage of trained educators in inclusive methods. Socio-cultural factors such as language barriers, gender norms and closed-mindedness further restrict participation. The paper also recommends policy and practice interventions: governments and institutions should invest in affordable infrastructure, subsidize access, and adopt universal design standards for digital learning resources. Teacher training programmes must incorporate inclusive education and digital equity frameworks. Public-private partnerships and community-based initiatives can expand outreach to underserved groups. The paper concludes that inclusive computer education is no longer optional; it is essential for the continued growth and relevance of sustainable innovation.

Keywords: *Inclusive education, computer education, digital skills, sustainable innovation, digital equity.*

The Impact of Green Chemistry on Public Health and Environmental Quality

YUSUF Rukayya Ubandoma — Department of Chemistry, Federal College of Education (Technical), Yauri (yusufrukayya90@gmail.com, 0703 833 8544)

Abstract: Green chemistry has emerged as a sustainable approach to chemical production and utilization, focusing on the design of products and processes that reduce or eliminate the use and generation of hazardous substances. This study examines the impact of green chemistry on public health and environmental quality by exploring its principles, applications, benefits, and challenges. Traditional chemical manufacturing processes often contribute to environmental pollution, resource depletion, and adverse health effects through the release of toxic substances into air, water, and soil. In contrast, green chemistry promotes the use of safer chemicals, renewable feedstocks, energy-efficient processes, and waste minimization strategies, thereby reducing environmental and health risks. The study highlights how the implementation of green chemistry practices contributes to improved public health by minimizing human exposure to toxic chemicals associated with respiratory diseases, cancers, skin disorders, and other health complications. Furthermore, it demonstrates the role of green chemistry in enhancing environmental quality through the reduction of greenhouse gas emissions, hazardous waste generation, water contamination, and ecosystem degradation. The adoption of environmentally friendly technologies and sustainable industrial practices also supports biodiversity conservation and the efficient use of natural resources. Despite its numerous benefits, the study identifies challenges such as high implementation costs, limited awareness, technological barriers, and regulatory constraints that may hinder widespread adoption. Nevertheless, increasing government support, industrial innovation, and public awareness continue to drive the integration of green chemistry into various sectors, including pharmaceuticals, agriculture, manufacturing, and energy production. The study concludes that green chemistry is a vital tool for achieving sustainable development goals, protecting public health, and preserving environmental quality for present and future generations. Therefore, greater investment in research, education, policy development, and industrial implementation is recommended to maximize its positive impacts on society and the environment.

Keywords: *Green Chemistry, Renewable, Toxic Substance.*

Impact of Round-Robin Brainstorming Strategy on Students' Motivation towards Sustainable Biology Education among Secondary School Students in Kaduna State

MUHAMMAD Maimuna Madaki — Corresponding Author — Department of Biology, Federal University of Education Zaria (ummuahlaam83@gmail.com, 0803 662 7732)

JIBRIL Jamila — Department of Biology, Federal University of Education Zaria

Hauwa RABIU Musa — Department of Biology, Federal University of Education Zaria

Abstract: This study investigated the impact of the Round Robin Brainstorming Strategy (RRBS) on students' motivation toward sustainable Biology education among secondary school students in Kaduna State. The study compared the motivation levels of students taught ecology concepts using RRBS with those taught using the conventional method, and examined gender differences in motivation among students exposed to RRBS. A quasi-experimental control group design with pretest and post-test was used. The population comprised 3,869 Senior Secondary School Two (SSII) Biology students from 19 public coeducational senior secondary schools in Zaria Education Zone, Kaduna State, Nigeria. A total of 310 students from two schools participated and were assigned to an experimental group (taught using RRBS) and a control group (taught using conventional methods). Data were collected using the Ecology Motivation Scale Questionnaire (EMSQ), which had a reliability coefficient of 0.79. Two research questions were analyzed using mean-rank statistics, and two null hypotheses were tested using the Mann–Whitney U test. Results revealed that the Round Robin Brainstorming Strategy significantly improved students' motivation for sustainable Biology education compared with the conventional method. Additionally, gender did not significantly influence students' motivation using RRBS. It was concluded that RRBS is an effective, gender-inclusive classroom intervention that significantly enhances student motivation and collaborative engagement in sustainable biology topics. The study recommends that school administrators promote sustainable Biology education by training biology teachers to implement RRBS when teaching ecology concepts to enhance student motivation, participation, and long-term interest in Biology.

Keywords: *Round-Robin-Brainstorming strategy, Motivation, Sustainable Education, Biology and Secondary School.*

Fostering Student Engagement and Learning Outcomes in Simultaneous Equations: A Cooperative Learning Approach with GeoGebra-Based Pedagogy

Aliyu Jaafaru — Department of Mathematics, Faculty of Science and Science Education, Federal University of Education, Zaria, Nigeria (aliyujfr@gmail.com)

Osman Sharifah — Department of Mathematics, School of Education, Universiti Teknologi Johor Bahru, Malaysia (Sharifah.o.@utm.my)

Abstract: The 2018 outcomes of simultaneous equations involving indices (SEII) reveal less than 50% attainment due to learners' difficulties in connecting mathematical structures linking symbols and terms from SEII taught through traditional, teacher-centered instruction. This study aimed to develop and evaluate the effectiveness of a learning strategy that promotes student engagement in SEII through a cooperative learning strategy (CLS) and GeoGebra-based pedagogy. Using cooperative learning (CL), students work in small groups to achieve a shared objective while benefiting from each other's unique experiences and viewpoints. Despite growing interest in CL, few studies have considered the effectiveness of such a strategy when blended with mathematical tools for student-perceived engagement and mathematics achievement. Hence, by incorporating GeoGebra (GG), an interactive mathematics software, this study compares the effectiveness of a learning strategy (LS) developed based on three approaches — CL+GG, GG, and CL. Through the administration of the Mathematical Achievement Test (MAT Test 1 and MAT Test 2), both prior to and following the implementation of the LS, along with an interview, a purposive sample of 83 students was evaluated. Post-test analysis reveals significantly higher performance among participants in the experimental CL+GG group. The learning strategy serves as a catalyst for pedagogical transformation, addresses learning impediments, enriches instructional content, and augments lesson planning. Its implementation fosters improvement in algebraic comprehension, logical reasoning skills, and adeptness with educational technology. Consequently, this research contributes to the advancement of effective teaching techniques, nurturing enhanced learning experiences and outcomes.

Keywords: *Cooperative learning, GeoGebra, Learning strategy, Simultaneous equation involving indices, Student engagement.*

Level and Readiness of University Library Staff towards Digitisation of Serial Publications in North-Eastern Nigeria

Idris Alh. Dano — PhD Student, Corresponding Author — Department of Library and Information Technology, Federal University of Technology, Minna, Niger State (idrisdano@gmail.com)

E. C. Madu — Department of Library and Information Technology, Federal University of Technology, Minna, Niger State

A. M. Obaje — Department of Library and Information Technology, Federal University of Technology, Minna, Niger State

M. A. Salubuyi — Department of Library and Information Technology, Federal University of Technology, Minna, Niger State

Abstract: This study examined the level of digitisation of serial publications and the readiness of university library staff towards it in North-Eastern Nigeria. A quantitative survey design was adopted. The population comprised 123 academic librarians drawn from the main libraries of fifteen tertiary institutions, from whom 110 valid responses were analysed using a self-designed instrument, the Academic Librarians' Attitude and Readiness Questionnaire (APARQ). The study addressed three objectives: to determine the level of digitisation of serial publications, to assess staff readiness towards digitisation, and to identify the challenges associated with digitisation of serial publications in the libraries studied. Item and average weighted means were computed as decision criteria. Findings showed that the level of digitisation of serial publications was high (mean = 3.09), and staff readiness was correspondingly high (mean = 3.17). The most pressing challenges were insufficient funding (3.65), inadequate technology and infrastructure (3.50), and unstable power supply (3.47), while limited management concern and technological obsolescence were less pronounced. The study concludes that digitisation of serial publications in the university libraries studied is well advanced and that staff are largely ready to sustain it, and it recommends increased funding, alternative power supply, and stronger ICT infrastructure to consolidate these gains.

Keywords: *Digitisation; level; readiness; serial publications; university library staff.*

Impact of Blended Learning Approach on Students' Academic Achievement in Biology among Senior Secondary School Students in Kebbi State, Nigeria

KASIMU, Haruna Ubah — Faculty of Life Science, Department of Biology Education, Federal College of Education (Technical), Yauri (Kaseembch2022@gmail.com)

Abstract: This study determined the difference in the mean achievement scores of students taught Biology using the blended learning approach and those taught using the traditional method, and also determined the difference in the mean achievement scores of male and female students taught Biology using the blended learning approach and the traditional method. A quasi-experimental design with a pre-test, post-test structure was employed, involving two groups: an experimental group exposed to the blended learning approach, and a control group taught using the conventional teaching method. Both groups were administered a pre-test before the commencement of treatment to determine their initial level of academic achievement in Biology. After the treatment period, a post-test was administered to both groups to assess the effect of the blended learning approach on students' academic achievement. The findings revealed that students taught Biology using the Blended Learning Approach (BLA) performed significantly better than those taught using the traditional method. The experimental group recorded a higher post-test mean score (68.67) and mean gain score (38.19) compared to the control group, which obtained a post-test mean score of 60.84 and a mean gain score of 30.35. Based on the findings, it was concluded that the Blended Learning Approach is an effective instructional strategy for improving students' academic achievement in Biology among Senior Secondary School students in Kebbi State.

Students' Use of Artificial Intelligence Applications and Learning Outcomes in Biology among Zaria Secondary School Students

Salau, O. A. — Department of Biology/Science Education, Federal University of Education, Zaria, Kaduna State (olaitanaisha7@gmail.com, 0803 696 0603)

Isah, A. Y. — Department of Biology/Science Education, Federal University of Education, Zaria, Kaduna State

Nuhu, B. T. — Department of Biology/Science Education, Federal University of Education, Zaria, Kaduna State

Abstract: This study examined the relationship between secondary school students' utilization of Artificial Intelligence (AI) applications and their academic learning outcomes in Biology within Zaria, Kaduna State. A descriptive correlational survey design was used. The study evaluated a population of 1,384 Senior Secondary II Biology students across 18 public secondary schools. A sample of 302 students was selected utilizing proportionate stratified random sampling. Data collection utilized the Students' AI-Application Usage and Learning Outcomes Questionnaire (SAULOQ) with a reliability coefficient of 0.83, paired with verified terminal continuous assessment and examination records. Data analysis utilized mean scores, standard deviation, Pearson Product Moment Correlation (PPMC), and independent samples t-tests. The findings revealed a high extent of informal AI application usage among students (grand mean = 2.85, SD = 0.73), dominated by interactive chatbots to clarify complex biological concepts. A moderate, statistically significant positive relationship exists between AI tool engagement and Biology learning outcomes ($r = 0.58$, $p < 0.05$). No significant gender-based variance was established regarding usage frequency ($t = 0.52$, $p = 0.604$). Major structural constraints included deficient smartphone access, high data costs, and restrictive mobile device policies. The study recommends formal integration of vetted AI software into the curriculum alongside enhanced digital infrastructure.

Keywords: *Zaria, Artificial Intelligence Applications, Learning Outcomes, Biology Education, Secondary School Students.*

Influence of Digital and Practical-Based Instruction on Students' Academic Achievement in Technical and Biology Education in Technical Secondary Schools of Katsina State, Nigeria

Nuraddeen Yusuf Galadanchi (Ph.D) — Department of Early Childhood Care and Education (ygaladanchi2015@gmail.com, 0803 212 8756; ORCID: 0009-0006-8383-1193)

Jamilu Haruna

Abstract: This study examined the impact of digital and practical-based instruction on students' academic achievement in Technical and Biology Education among Technical Secondary School students in Katsina State, Nigeria. The study was guided by four objectives and corresponding research questions and hypotheses. A survey research design was adopted. The population comprised 1,666 respondents, from which a sample size of 313 respondents was selected, including 80 female students. Data were collected using a structured questionnaire titled the Digital and Practical-Based Instruction and Students' Achievement Questionnaire (DPBI-SAAQ), designed on a five-point Likert scale. The instrument was validated by experts, while its reliability was established using Cronbach's Alpha, yielding a coefficient of 0.742. Data were analyzed using Pearson Product Moment Correlation (PPMC), multiple regression analysis, and independent samples t-test at a 0.05 level of significance. The findings revealed that digital instructional methods had a significant positive relationship with students' academic achievement ($r = 0.486$, $p < 0.05$). Practical-based instruction also showed a significant positive effect on students' academic achievement ($r = 0.590$, $p < 0.05$). The combined effect of digital and practical-based instruction significantly predicted students' academic achievement, with practical-based instruction having a stronger predictive influence. The study further revealed that gender significantly influenced students' academic achievement. The study concluded that the integration of digital and practical-based instructional strategies enhances students' academic performance and recommended improved digital infrastructure, adequate practical facilities, and teacher training programmes in technical secondary schools.

Keywords: *Digital instruction, practical-based instruction, technical education, biology education.*

Sustainable and Inclusive STEM Education and Research as Mechanisms for Bridging the Gap Between Theory and Practice in Technical Education for Educational Excellence in Technical Schools in Katsina State, Nigeria

Jamilu Haruna — Department of Education, Yusuf Bala Usman College of Education and Legal Studies, Daura, Katsina State (hjamilu99@gmail.com, 0803 283 2924)

Nuraddeen Yusuf Galadanchi — Department of Early Childhood Care Education, Yusuf Bala Usman College of Education and Legal Studies, Daura, Katsina State (ygaladanchi2015@gmail.com, 0806 888 5692)

Abstract: This study investigated sustainable and inclusive STEM education and research as mechanisms for bridging the gap between theory and practice in technical education for educational excellence in technical schools in Katsina State, Nigeria. Specifically, the study examined the influence of sustainable STEM education, inclusive STEM education, and STEM research practices on bridging the gap between theory and practice. A quantitative survey research design was adopted. The population comprised 3,244 teachers and students in public technical schools in Katsina State, from which a sample of 383 respondents was selected using the Krejcie and Morgan sample size table and a multistage sampling technique. Data were collected using a researcher-developed questionnaire validated by experts, while a pilot study yielded a Cronbach's Alpha reliability coefficient of 0.83. Descriptive statistics (mean and standard deviation) were used to answer the research questions, whereas simple linear regression analysis was employed to test the hypotheses at the 0.05 level of significance using SPSS version 29.0. The findings revealed that sustainable STEM education had no statistically significant influence on bridging the gap between theory and practice ($R = .000$, $R^2 = .000$, $F = .000$, $p = .993$). Similarly, inclusive STEM education did not significantly influence bridging the gap between theory and practice ($R = .005$, $R^2 = .000$, $F = .010$, $p = .921$). Furthermore, STEM research practices showed no statistically significant influence on bridging the gap between theory and practice ($R = .037$, $R^2 = .001$, $F = .528$, $p = .468$). The study concluded that the current implementation of STEM initiatives has not significantly enhanced the integration of theory and practice in technical schools in Katsina State. It recommended increased investment in STEM facilities, continuous teacher professional development, stronger school–industry partnerships, and improved implementation of STEM policies to promote educational excellence.

Effects of Nutritional Health Education Intervention on Nutritional Status of Children Under 5 Years among Internally Displaced Mothers in Borno State, Nigeria

Biddin ABUBAKAR — Corresponding Author — Department of Human Kinetics and Health Education, Faculty of Education, Ahmadu Bello University, Zaria, Nigeria (biddinabubakar00@gmail.com, 0808 385 3169)

Abstract: Child under-nutrition remains severe in conflict-affected communities, where displacement disrupts food access, health services, sanitation, and infant feeding practices. This study assessed changes in nutritional status of under-five children during a 16-week nutrition education and guided complementary-feeding programme for internally displaced mothers in Muna El-Miskin Camp, Maiduguri, Borno State. An uncontrolled before-and-after design followed 30 mother-child dyads through twice-weekly sessions on breastfeeding, complementary feeding, dietary diversity, hygiene, and growth monitoring. MUAC, HAZ, WHZ and WAZ were measured at baseline and at Weeks 4, 8, 12 and 16, and analysed using descriptive statistics, repeated-measures ANOVA, Bonferroni comparisons, paired t-tests, and exploratory regression. All anthropometric indicators improved significantly ($p < .001$); maternal education, occupation, income and session attendance explained 62% of the variation in improvement. The study concludes that integrated caregiver education, food security, screening and referral strategies are needed, and recommends larger controlled trials to isolate education effects from other forms of assistance.

Keywords: *Nutrition education; Internally displaced persons; Under-five children; Anthropometry; Child malnutrition.*

Integrating Emerging ICT Tools and Curriculum Innovation for Sustainable Learning in Nigerian Secondary Schools

Tukur, Habiba Mohammed, PhD — Department of Curriculum and Instruction, Faculty of General Education, Federal University of Education, Zaria, Kaduna State, Nigeria

Abstract: The integration of emerging ICT tools into curriculum innovation is essential for promoting sustainability learning in Nigerian secondary schools. Technologies such as mobile learning platforms, VR/AR, artificial intelligence, the Internet of Things, cloud-based collaboration tools and adaptive learning systems can transform teacher-centred instruction into interactive, learner-centred, competency-based education, supporting critical thinking, digital literacy and environmental responsibility in line with SDG 4. Despite support from TETFund, UNESCO and the World Bank, integration remains constrained by inadequate ICT infrastructure, poor connectivity, unreliable electricity, weak teacher capacity, and limited funding, compounded by outdated instructional practices and overloaded curricula. The paper recommends sustained investment in digital infrastructure, continuous teacher professional development, curriculum reform, and stronger collaboration among government, institutions and development partners to strengthen students' engagement, learning outcomes and sustainability competencies.

Keywords: *Emerging Technologies, Curriculum Innovation, Pedagogies, Secondary School and Sustainable Learning.*

Mathematical Proficiency: Effect of Tally-Division-Strategy on Interest and Performance in Division Concepts among Upper Primary School Pupils in Zaria, Kaduna State, Nigeria

Muawiya, H. U. (PhD) — Department of Mathematics, Faculty of Science and Science Education, Federal University of Education, Zaria (muawiyya2013@gmail.com, 0803 158 6305)

Sirajo, A. (PhD) — Department of Mathematics, Federal University of Education, Zaria (adosirajo@gmail.com, 0802 360 6933)

Ohimege, I. U. (PhD) — Department of Mathematics, Federal University of Education, Zaria (umarohimege@fuez.edu.ng, 0802 063 3069)

Abstract: This study investigated the effect of the Tally-Division-Strategy on performance and interest in division concepts among upper-primary pupils in Zaria, Kaduna State, guided by four research questions and hypotheses tested at 0.05. A quasi-experimental pretest-posttest non-equivalent control group design was used. The population comprised Basic 4 pupils in public primary schools in Zaria LGA, from which 120 pupils were selected from two schools using multi-stage sampling, with one intact class as the experimental group and one as control. Data were collected using the Division Performance Test (reliability = 0.82) and Division Interest Scale (reliability = 0.79), and analysed using mean, standard deviation, ANCOVA and independent t-test. Pupils taught using the Tally-Division-Strategy recorded significantly higher interest and performance than those taught conventionally, with no significant gender difference in either measure. The study recommends that Mathematics teachers adopt the strategy, with government training support and its incorporation into the primary Mathematics curriculum.

Keywords: *Tally-Division-Strategy, Interest, Performance, Division Concepts, Upper-Primary Pupils, Zaria.*

Assessment of STEM-Based Instructional Strategies, Science Process Skills, and Health Literacy among Secondary School Students in Zaria Education Zone, Kaduna State

Hurera Mouktar MACCIDO, PhD — Corresponding Author — Department of Health Education, Federal University of Education, Zaria (hureramouktar@gmail.com, 0803 702 4013)

Erahu Hope ODIN — Department of Health Education, Federal University of Education, Zaria (erahuhopeodin@gmail.com, 0703 376 1150)

Fanty Mela Tal — Department of Health Education, Federal University of Education, Zaria (fwailerg@gmail.com, 0803 656 5637)

Abstract: This study assessed STEM-based instructional strategies, science process skills, and health literacy among secondary school students in Zaria Education Zone, Kaduna State, in line with the conference theme of bridging theory, practice and educational excellence. A cross-sectional design was adopted, drawing a sample of 380 SS1–SS3 students from an estimated population of 21,460 using multi-stage stratified and convenience sampling. Data were collected with a researcher-developed questionnaire; research questions were analysed using mean and standard deviation against a decision mean of 2.50, and hypotheses tested using a one-sample t-test at 0.05. STEM-based instructional strategies, science process skills, and health literacy were all found to be significant ($p = .000$). The study concluded that students are exposed to a moderate-to-good level of STEM instruction with reasonable process skills and adequate health literacy, and recommends institutionalising inquiry-based STEM approaches, integrating health science content into STEM curricula, and continuous teacher professional development.

Keywords: *STEM Education, Instructional Strategies, Science Process Skills, Health Literacy, Zaria Education Zone.*

Assessment of Teaching Methods, Workshop Tools and Equipment for the Effective Implementation of Fabrication and Welding Trade Programme in Technical Colleges in Bauchi State, Nigeria

Baba Yakubu — Technical Education Department, School of Secondary Education (Vocational and Technical Education), Aminu Saleh College of Education, Azare, Bauchi State (bbyakubu4@gmail.com, +234 703 165 2555)

Abstract: This study assessed teaching methods and the adequacy of tools and equipment for implementing the Fabrication and Welding Trade programme in technical colleges in Bauchi State, guided by two research questions. A descriptive survey design was used with an 82-item questionnaire, validated by three experts, achieving a Cronbach alpha reliability of 0.86. Data were collected from 47 respondents (23 teachers and 24 administrators) and analysed using mean and standard deviation. Findings showed that teachers adopted all 17 identified teaching methods (grand mean = 4.14) and that tools and equipment were largely adequate (grand mean = 3.88). The study recommends that government, the Industrial Training Fund, the National Directorate of Employment, and NGOs such as UNESCO-UNEVOC and UNDP provide better funding to support facilities for effective implementation of the programme.

Keywords: *Technical Colleges, Tools and Equipment, Fabrication and Welding Trade Programme, Assessment, Teaching Methods.*

Effects of Video-Enriched Teaching Strategy on Interest and Performance in Nuclear Chemistry among Secondary School Students of Varied Ability in Zaria, Kaduna State, Nigeria

Rabiu Ibrahim — Department of Chemistry, Federal University of Education, Zaria (ibradiyat@gmail.com)
Madaki Saadatu Muhammad — Department of Chemistry, Federal University of Education, Zaria
Abubakar Suwaida — Department of Chemistry, Federal University of Education, Zaria

Abstract: This study investigated the effect of a Video-Enriched Teaching Strategy on the performance and interest of students of varied ability in Nuclear Chemistry. A pretest-posttest quasi-experimental design was adopted with a population of 925 SS III Chemistry students in Zaria metropolis, from which 174 students were randomly sampled. The experimental group was taught using the video-enriched strategy while the control group received conventional instruction. Data were collected using the Nuclear Chemistry Performance Test and Nuclear Chemistry Interest Questionnaire (reliability coefficients 0.67 and 0.64) and analysed using mean, standard deviation, ANOVA and the Kruskal-Wallis H-test at $p \leq 0.05$. Students of varied ability taught with the video-enriched strategy performed better and showed higher interest than those taught by the lecture method. The study recommends teacher workshops to build skills for adopting the strategy.

Keywords: *Video-enriched teaching method, Nuclear chemistry, Academic performance, Varied ability, Interest.*

Imperative of Integrating Innovative Pedagogical Strategies into Chemistry Education to Drive Sustainable Technological Growth in 21st Century Nigeria

Kolawole Adetayo LAWAL — School of Sciences, Chemistry Department, FCT College of Education, Zuba, Abuja (kolex23@gmail.com, 0703 189 5708)

Wing Comdt. R. A. AJAYI, FSS, PSC, PGDFC, MED, MLDS, TRCN, AMNIM — Commandant, Airforce Girls Comprehensive School, Abuja (0803 684 8415)

Abstract: Chemistry education is a fundamental pillar for scientific literacy, technological innovation and industrial development, yet conventional Nigerian pedagogy often emphasises memorisation over critical thinking and problem-solving. This paper examines the imperative of integrating innovative pedagogical strategies — inquiry- and problem-based learning, green chemistry simulations, AI-driven virtual laboratories and contextualised instruction — into chemistry education to promote sustainable technological growth. It argues that connecting chemistry concepts to local industry, environmental sustainability and real-life challenges can foster innovation and entrepreneurship, though inadequate laboratories, poor digital infrastructure, limited teacher training and unstable power continue to hinder implementation. The paper concludes that such integration is essential for building a scientifically skilled workforce and recommends increased investment in science infrastructure, continuous teacher development, curriculum reform aligned with global STEM standards, and stronger collaboration among institutions, industry and government.

Keywords: *Chemistry Education, Innovative Pedagogies, Educational Innovation, Sustainable Development, Technological Growth, 21st Century Nigeria.*

Sustainable Chemistry Education in Nigeria: Integrating Green Chemistry for Environmental and Educational Excellence

Umar KABIR — Department of Chemistry Education, Federal College of Education (Technical), Yauri, Kebbi State (umaribeto20@gmail.com)

Usman, A. M. — Department of Chemistry, Federal University of Education, Kontagora (Abdulus117@gmail.com)

Abstract: Sustainable chemistry education is a critical pathway for addressing environmental challenges while promoting scientific innovation and national development. This paper examines the relevance of sustainable chemistry education in Nigeria and the role of green chemistry in fostering environmental and educational excellence, highlighting pollution, hazardous waste, and resource depletion associated with conventional chemical practices. It discusses strategies for embedding green chemistry into secondary and tertiary curricula through eco-friendly practicals, curriculum reform, teacher training and policy support, while noting challenges such as inadequate infrastructure, limited funding, and insufficient instructional materials. The study concludes that strengthening sustainable chemistry education will improve environmental protection, science education quality, industrial sustainability and alignment with global sustainability goals.

Keywords: *Green Chemistry, Sustainability, Chemistry Education, Environmental Protection, Educational Excellence.*

Assessment of Digital Communication Techniques and University Administrators' Prompt Delivery Strategies in Kaduna State Universities

Owamoyo Najeem — Computer Science Department, School of Science Education, Federal University of Education, Zaria (najolp@yahoo.com)

Abubakar Sadiq Ibrahim — Computer Science Department, School of Science Education, Federal University of Education, Zaria

Muhammed Abdulazeez Hassan — Computer Science Department, School of Science Education, Federal University of Education, Zaria

Abstract: This study examined the relationship between digital communication practices and prompt service delivery among administrators in Kaduna State universities. A cross-sectional survey design was used, drawing 90 permanent administrative staff (30 per university) from three universities through purposive sampling. Data were collected using structured questionnaires and analysed using Cronbach Alpha and Pearson Product Moment Correlation via SPSS version 23. Findings showed a strong correlation between promptness and use of instant messaging and social media. The study concludes that digital communication systems are crucial for prompt administrative service delivery and recommends that universities upgrade existing systems with better interfaces, faster delivery and task-management functionality.

Keywords: *Digital Communication, Administrators, Prompt Delivery, Instant Messaging and Social Media.*

Addressing Declining Enrollment in Mathematics Education for Sustainable STEM Development in Kaduna State University

Anas HALLIRU — Department of Science Education, Faculty of Education, Makera Campus, Kaduna State University, Nigeria (halliru.anas@kasu.edu.ng, WhatsApp: 0803 081 0345)

Abstract: This study examined declining enrollment trends in the Mathematics Education programme at Kaduna State University (KASU) and their implications for sustainable STEM development, analysing enrollment data from 2019/2020 to 2025/2026 alongside undergraduates' perceptions and admission factors. A descriptive survey design was adopted, sampling 180 undergraduates across Biology, Chemistry, and Mathematics Education streams at KASU's Makera Campus through stratified random sampling. Secondary data came from departmental records, while primary data were collected via the Declining Enrollment in Mathematics Education Questionnaire (DEMEQ) and analysed using frequencies, percentages, means and standard deviations. Findings confirmed a critical, systemic drop in Mathematics Education enrollment to single digits by 2025/2026, contrasting with stable Biology Education numbers, driven by mathematics anxiety, lack of early career counselling, and involuntary administrative placement. The paper recommends ICT-driven pedagogy, localized scholarship funding, and systemic career guidance frameworks.

Keywords: *Mathematics Education, Enrollment Trends, STEM Pipeline, Undergraduate Perceptions, Kaduna State University.*

Integrating Geography and STEM Education for Climate and Environmental Sustainability

Halidu Safiyanu Noma — Corresponding Author — Department of Science Education, Federal College of Education (Technical), Yauri, Kebbi State (halidusafiyanunoma@gmail.com)

Prof. Umar Saadu — School of Education, Federal College of Education (Technical), Yauri, Kebbi State (saadubirniny@gmail.com)

Dr. Jolaosho Raymond Adisa — Department of Business Education, School of Vocational Education, Federal College of Education (Technical), Yauri, Kebbi State (Jolashoraymonadisa17@gmail.com)

Abstract: Rising global temperatures require students to learn about climate change using locally relevant, system-wide approaches, yet most STEM curricula are not geographically or spatially grounded. This study explored sustainable and inclusive STEM-geography education that helps teachers move from teaching environmental science abstractly to practising sustainability in real life, using a mixed-methods approach combining institutional surveys, international case studies and a literature review. Findings showed that integrated environmental education improved students' understanding of the causes and mechanisms of climate change and fostered environmental stewardship, with schools offering comprehensive environmental education reporting higher student engagement in sustainability initiatives. Despite limitations such as curriculum constraints, limited teacher training and resources, the paper argues that integrating geography with STEM education is critical for preparing global citizens to address environmental problems, and offers strategies for inclusive, sustainable implementation across varied settings.

Keywords: *Environmental Education, Sustainable Development, Curriculum Integration, Geo-STEM Education, Ecological Awareness.*

Inclusive Computer Education for Digital Skills and Sustainable Innovation

Mohammed Abdulrahaman — Department of Computer Science, School of Sciences, Federal College of Education (Technical), Yauri, Kebbi State (elrahmanyalwa1@gmail.com)

Abstract: The rapid advancement of digital technologies has transformed education, economic participation and social development globally, yet unequal access to computer education continues to exclude millions of learners — particularly women, persons with disabilities, rural communities and economically marginalized populations in developing countries. This paper examines how inclusive, equity-driven approaches to computer science and digital literacy education can bridge participation gaps while fostering sustainable innovation, drawing on a review of pedagogical frameworks, policy landscapes and institutional case studies. It finds that equitable access to computational thinking, coding and digital skills enhances creativity, problem-solving, economic empowerment and community innovation, but is constrained by inadequate infrastructure, limited connectivity, insufficient teacher training and weak digital-inclusion policies. The paper recommends culturally responsive curricula, accessible learning environments, open-source tools and multi-stakeholder partnerships to scale inclusive digital education, positioning it as a transformative force for equitable development and resilient innovation ecosystems.

Keywords: *Digital inclusion, Computer science education, Digital literacy, Sustainable innovation, Equity-driven pedagogy.*

Revolutionizing Library Services: Exploring the Potential of Artificial Intelligence-Based Research Tools

Musa Muhammed — PhD Student — Department of Library and Information Science, Federal University of Technology, Minna (musamuhammed955@gmail.com, +234 806 876 2929)

Prof. Everest C. Madu — Department of Library and Information Science, Federal University of Technology, Minna, Niger State

Dr. Fatimah J. Abduldayan — Department of Library and Information Science, Federal University of Technology, Minna, Niger State

Dr. Enesi F. Aminu — Department of Computer Science, Federal University of Technology, Minna, Niger State

Abstract: The advent of ICTs has revolutionised library services, and the rise of artificial intelligence (AI) is a natural extension of this trend. This review article analyses how AI-based tools are changing the standard for effective and efficient library service delivery, examining their capabilities to improve user experience and operational efficiency. The article categorises AI-based research tools by function: topic discovery (Perplexity, Semantic Scholar, Elicit, ChatGPT), writing and proofreading (Grammarly, Ginger AI, Wordvice AI, ProWritingAid), research conduct (Aithor, Google Bard, Research Rabbit, Connected Papers), and reference management (Mendeley, EndNote, RefWorks, Zotero). It highlights benefits including improved user satisfaction, efficiency and decision-making, alongside challenges such as limited awareness and skills, data-quality concerns, ethical and privacy issues, and resistance to change among librarians and users. The study recommends that academic libraries embrace AI as a vital service-delivery tool, supported by staff training and development.

Keywords: *Library, Service Delivery, Artificial Intelligence, AI-Based Tools.*

Assessment of the Impact of Biomedical Waste on the Environment in Zaria and its Environs

Hannatu BABAJO — Department of Geography, Federal University of Education, Zaria (hannatubabajohh@gmail.com)

Bashir Yakubu LIMAN — Department of Environmental Education, Federal University of Education, Zaria (liman-albashir@hotmail.com)

Imrana HARI — Department of Environmental Education, Federal University of Education, Zaria (hariimrana@yahoo.com)

Marcel OGOLOWA — Department of Environmental Education, Federal University of Education, Zaria

Suleiman AKILU — Department of Environmental Education, Federal University of Education, Zaria

Abstract: Biomedical waste from hospitals, clinics and diagnostic laboratories is a growing environmental and public health concern in Nigerian urban centres, including Zaria and its environs. This study assessed the environmental impact of biomedical waste in Zaria, focusing on generation patterns, handling and disposal practices across public and private health facilities in Sabon-Gari, Tudun-Wada, Wusasa and Samaru. A stratified purposive sample of 11 health facilities — state general hospitals, private hospitals/clinics and primary health centres — was studied using structured questionnaires, field observation of waste sites, and review of institutional records, analysed with descriptive statistics and chi-square tests at 0.05. Findings revealed inconsistent waste segregation, continued open dumping and burning, and largely absent or poorly maintained incinerators, especially at primary health centres. Soil and water sampling near disposal sites showed elevated contamination, and nearby residents reported higher rates of skin irritation, respiratory complaints and odour nuisance. The study identified inadequate funding, weak regulatory enforcement, insufficient training and low public awareness as key drivers, and recommends investment in treatment infrastructure such as autoclaves and low-emission incinerators, stronger enforcement, and regular staff training.

Keywords: *Biomedical waste, Environmental impact, Healthcare facilities, Waste disposal, Zaria.*

Green Chemistry in the Classroom: Integrating Sustainable Laboratory Practices into Secondary and Tertiary Chemistry

Oluwafemi Fikayomi BAMIDELE — Department of Physical Science Education, Chemistry Unit, Kwara State University of Education, Ilorin, Nigeria (bamidele.of@kwasued.edu.ng; ORCID: 0009-0001-3821-1781)

Beatrice Yetunde OLANREWAJU — Department of Physical Science Education, Chemistry Unit, Kwara State University of Education, Ilorin, Nigeria (olanrewaju.by@kwasued.edu.ng; ORCID: 0009-0006-7939-1253)

Nusirat Bolanle YUSUF — Department of Physical Science Education, Chemistry Unit, Kwara State University of Education, Ilorin, Nigeria (yusuf.nb@kwasued.edu.ng; ORCID: 0000-0001-5368-5785)

Abstract: Green chemistry has reshaped industrial and research chemistry since Anastas and Warner formalised the 12 Principles in 1998, yet its presence in secondary and tertiary curricula remains limited. This review examines how green chemistry is being integrated into chemistry education at both levels, focusing on laboratory practice, pedagogy, and barriers to adoption in sub-Saharan Africa, the Philippines, and Southeast Asia, drawing on studies published between 1998 and 2026. It finds that curriculum inclusion is the strongest predictor of classroom adoption; that secondary-level interventions such as biodiesel synthesis and POGIL-based modules build measurable gains in environmental awareness; and that undergraduate laboratories are shifting toward solvent substitution, mechanochemical synthesis, and microscale techniques, cutting waste by up to 98%. Inquiry- and problem-based pedagogies consistently outperform lecture-based instruction, while digital tools such as PhET simulations extend access where device availability and content localisation remain limiting factors. The review concludes that green chemistry is a mature, evidence-based discipline rather than an optional add-on, requiring coordinated action from policymakers, institutions, educators and researchers to close the evidence gap in the Global South.

Keywords: *Green chemistry education, sustainable laboratory practices, curriculum integration, secondary and tertiary chemistry.*

Sustainable Chemistry Education and Application: Advancing Green Innovation for a Sustainable Future

A. I. MUHAMMAD — Department of Chemistry, Federal University of Education, Zaria

B. M. BUGAJE — Department of Chemistry, Federal University of Education, Zaria

Abstract: Sustainability has become a global priority due to increasing environmental challenges such as climate change, pollution, resource depletion, and waste generation. Chemistry plays a crucial role in addressing these challenges through the development of environmentally friendly technologies, materials, and processes. Sustainable chemistry education aims to equip learners with the knowledge, skills, and values necessary to promote green chemistry principles and sustainable development. This paper examines the concept of sustainable chemistry education and its significance in achieving the Sustainable Development Goals (SDGs), highlighting the integration of green chemistry principles into curricula, the advancement of green innovation in chemistry, and the role of artificial intelligence in sustainable chemistry education. The paper concludes that sustainable chemistry education is essential for preparing future scientists capable of developing innovative solutions to global sustainability challenges, and recommends stronger collaboration between academia, industry, and policymakers.

Keywords: *Sustainable Chemistry, Green Chemistry, Education, Sustainable Development, Artificial Intelligence, Innovation.*

Environmental Challenges and Solutions in Solar Photovoltaic Technology Life Cycle

Shamsuddeen Samaila Yauri — Department of Chemistry, Federal College of Education (Technical), Yauri, Kebbi State (abuummi2014@gmail.com)

Abstract: Heavy reliance on fossil fuels, given their inevitable depletion and environmental impact, has driven intensive research into sustainable, renewable energy sources. Solar radiation is a major source of clean, renewable energy with the potential to meet long-term global demand. This review paper draws on recent life-cycle assessment (LCA) studies, end-of-life management research, and operational emissions analyses to evaluate the environmental impacts of solar photovoltaic (PV) technology across its life cycle, from manufacturing to disposal, including hazards such as the release of toxic gases and trace elements. It also reviews mechanical, thermal and chemical recycling approaches, repair and reuse strategies, and global regulatory frameworks. Findings indicate that allocation method choice can alter cumulative energy demand for critical PV materials by factors of 6 to 27, that China alone may generate over 51 million tons of PV waste by 2050, and that strict recycling regulation (an 80% recycling rate) could cut landfill volumes by roughly 75% while yielding substantial CO2 savings.

Keywords: *Life cycle assessment; photovoltaic; end-of-life management; allocation; recycling; cumulative energy demand; circular economy; environmental impact.*

Machine Learning for Predicting At-Risk Learners in Inclusive Computer Science Education: An Empirical Study Bridging the Digital Skills Gap for Sustainable Innovation

Aminu Yakubu — Department of Computer Science Education, Faculty of Sciences and Science Education, Federal University of Education, Zaria, Nigeria

Hassana Zubairu Mahmud — Department of Computer Science Education, Faculty of Sciences and Science Education, Federal University of Education, Zaria, Nigeria

Muhammad Haruna Jumare — Department of Computer Science Education, Faculty of Sciences and Science Education, Federal University of Education, Zaria, Nigeria

Abstract: The persistent digital divide in sub-Saharan Africa continues to undermine equitable access to quality computer science (CS) education, leaving a substantial proportion of learners without the digital competencies required for participation in a technology-driven economy. This study empirically investigates whether machine learning (ML) classifiers can accurately identify undergraduate Computer Science Education students who are at risk of a digital-skills gap, using variables that capture infrastructural access, prior ICT exposure, engagement, and socio-demographic context. Data were analysed from 246 first- and second-year students drawn from tertiary institutions in North-West Nigeria. Four classifiers — Logistic Regression, Decision Tree, Random Forest, and Support Vector Machine (SVM) — were trained and evaluated using a 75/25 train–test split with five-fold cross-validation. Logistic Regression achieved the strongest overall performance (accuracy = .76, F1 = .62, AUC = .86), while Random Forest feature-importance analysis identified learning-management-system engagement, prior academic performance, self-study hours, and pre-tertiary ICT exposure as the strongest predictors of at-risk status, ahead of device ownership and rurality. The findings demonstrate that ML-based early-warning systems can feasibly support inclusive, data-driven intervention in resource-constrained CS education contexts, while also revealing that behavioural and engagement variables outweigh raw infrastructural access in predicting risk. Implications for curriculum design, targeted digital-inclusion interventions, and sustainable STEM education policy in Nigerian tertiary institutions are discussed, alongside limitations and directions for future research using longitudinal, multi-institutional datasets.

Keywords: *Machine learning; artificial intelligence; inclusive computer science education; digital divide; digital skills; sustainable STEM education; at-risk prediction.*

Effects of Historically-Enriched Genetics Curriculum Model on Academic Performance among Secondary School Biology Students in Zaria Education Zone, Kaduna, Nigeria

Hauwa'u Adamu Usman — Department of Integrated Science, Federal University of Education, Zaria (hauwaadamuusman3@gmail.com)
Prof. Isa Alhaji Usman — Science Education, Faculty of Education, Kaduna State University (dr.isausman@gmail.com)
Prof. Sani Sale Bichi (Retired) — Science Education, Faculty of Education, Ahmadu Bello University, Zaria

Abstract: This study was undertaken to determine the effects of a Historically-Enriched Genetics Curriculum (HEGC) model on the academic performance of secondary school Biology students in Zaria Education Zone, Kaduna State, Nigeria. The study used a non-randomised pretest-posttest quasi-experimental and control-group research design. The population comprised all 6,222 SS II Biology students drawn from 21 co-educational public secondary schools in the research area, from which a sample of 202 students was selected from two schools using multistage and simple random sampling; an intact class of 102 students from the experimental school and 100 from the control school took part. Data were collected with the Genetics Academic Performance Test (GAPT; reliability = .81) and analysed using mean, standard deviation and independent-samples t-tests at $\alpha = 0.05$. Findings revealed a significant difference in mean academic performance in favour of the experimental group ($\bar{x} = 15.70$, SD = 3.75) over the control group ($\bar{x} = 11.90$, SD = 2.99), $t(132) = 6.49$, $p = .01$, while no significant difference existed between male ($\bar{x} = 15.18$, SD = 4.43) and female ($\bar{x} = 15.95$, SD = 3.39) students, $t(64) = -0.79$, $p = .44$. The study concludes that HEGC significantly improves students' academic performance regardless of gender and recommends its adoption by Biology teachers for teaching genetics in secondary schools in the zone.

Keywords: *Historically-enriched, Genetics Curriculum, Academic Performance, Secondary School, Biology Students.*

Soil Erosion Modelling in Central Senatorial Zone of Kaduna State, Nigeria

Kasimu, Salisu — Department of Geography, Federal University of Education, Zaria (salisukasimu1978@gmail.com)
Rabiu Alhassan — Department of Geography, Federal University of Education, Zaria
Oscar, Rowland — Department of Geography, Federal University of Education, Zaria
Idris, Kabir Rakiya — Department of Environment, Federal University of Education, Zaria

Abstract: Changes in land use driven by urbanisation, agricultural expansion and mono-cropping have led to an accelerated and spatial increase in soil erosion over time. This research examined soil erosion modelling in the Central Senatorial Zone of Kaduna State, with objectives of determining the soil erodibility (K) index using the SLEMSA model and estimating the amount of soil loss in the study area. SLEMSA and GIS were integrated; soil samples were collected and soil parameters analysed at the Department of Soil Science, Institute for Agricultural Research, Ahmadu Bello University, Zaria. Results revealed that Kaduna South and North-Eastern Igabi had the highest soil organic matter (2.53%); a soil texture class of 0.31% was found across Kaduna North, Kaduna South, Koriga and Wuya in Chikun LGA, and Kashirki, Runji, Sabon Birni and Wuchichiri in Igabi LGA. Kaduna North and North-Eastern Chikun recorded the highest soil permeability class (1.91-2.76%), while soil erodibility was very high in North-Eastern Igabi and North-Western Chikun, at 0.3-2.1%. The amount of soil loss varied across the four LGAs studied, with an estimated total of 17.99 t/ha/yr. The study recommends that farmers implement soil-fertility management practices, such as crop rotation and organic-matter incorporation, to improve soil health and reduce erosion.

Keywords: *Erosivity, Erodibility, Gully Erosion, Modelling, SLEMSA.*

Geo-Literacy in Action: Using GIS and Local Climate Data to Bridge Theory and Practice in Secondary Geography Education for Environmental Sustainability in Kaduna State, Nigeria

Dyaji Rufkatu Odesi — Department of Geography Education, Federal University of Education, Zaria (rifkatudyaji@gmail.com)
Bello Aduke Olufunmilayo — Department of Geography Education, Federal University of Education, Zaria
Maliki Adeku Joseph — Department of Geography Education, Federal University of Education, Zaria

Abstract: Environmental sustainability has become a global priority due to the increasing impacts of climate change, environmental degradation and resource depletion, highlighting the need for innovative approaches to geography education that promote sustainable and inclusive STEM learning. However, geography instruction in many Nigerian secondary schools remains largely theoretical, limiting students' geo-literacy, spatial thinking and practical environmental problem-solving skills. This study examined the effectiveness of integrating Geographic Information Systems (GIS) and local climate data into secondary geography education to enhance geo-literacy, environmental awareness and bridge the theory-practice gap. A quantitative research design was adopted involving 360 SS II students selected from a population of 12,480 using Taro Yamane's (1967) formula, and 27 geography teachers from nine purposively selected public secondary schools in Kaduna State, with students selected through stratified sampling to ensure gender representation. Data were collected using a Geo-literacy Assessment Test, a five-point Likert-scale Environmental Awareness Questionnaire, classroom observations and project evaluation forms, and analysed using descriptive statistics and paired-sample t-tests. Findings revealed statistically significant improvements ($p < .05$) in students' geo-literacy, spatial reasoning, environmental awareness and STEM engagement following the GIS-supported intervention. The study concludes that integrating GIS and local climate data effectively promotes learner-centred, sustainable STEM education and provides evidence for curriculum improvement, teacher development and technology-enhanced geography education.

Keywords: *Environmental Sustainability, Geo-Literacy, Geographic Information Systems (GIS), Local Climate Data, Secondary Geography Education.*

Effects of Problem-Solving and Computer-Assisted Instruction on Retention and Gender-Based Motivation of Slow Learners in Genetics

Junaidu Hafsah Ishaq — Samaru College of Agriculture, Division of Agricultural Colleges, Ahmadu Bello University, Zaria (hafsahjunaid@yahoo.com)

Abstract: This study investigated the effects of Problem-Solving Strategy (PSS) and Computer-Assisted Instruction (CAI) on the retention ability and gender-based motivation of secondary school slow learners in Genetics concepts. Retention, the ability to recall learned information over time, is critical for meaningful learning, yet slow learners often struggle to retain abstract scientific concepts. A quasi-experimental pretest, post-test, post-post-test control-group design was employed with 142 slow-learner Biology students from three public secondary schools in Giwa Education Zone, Kaduna State, divided into two experimental groups (PSS and CAI) and one control group taught by the conventional lecture method. Data were collected using the Genetics Concept Performance Test (GCPT) for retention measurement and the Genetics Concept Motivation Questionnaire (GCMQ) for motivation assessment, and analysed using one-way ANCOVA and the Kruskal-Wallis H-test at $p <= .05$. Findings revealed that students exposed to PSS and CAI demonstrated significantly higher retention scores than the control group, $F(2, 138) = 157.29$, $p < .001$, eta squared = .695, with PSS producing the highest retention. No significant gender differences were found in motivation levels among students taught with PSS and CAI, $H(1) = 0.128$, $p = .721$, indicating that both strategies are gender-inclusive. The study concludes that PSS and CAI effectively enhance retention among slow learners and are equally motivating for male and female students, and recommends adopting both strategies to improve long-term knowledge retention and promote gender equity in science education.

Keywords: *Problem-Solving Strategy, Computer-Assisted Instruction, Slow Learners, Retention, Gender, Motivation.*

Repositioning Digital Instruction in Nigerian Universities: A UTAUT-Based Perspective on Microsoft Teams Adoption

Awolusi, Bayo Ezekiel — Computer Science Education, Federal University of Education, Zaria (awolusibayoezekiel@fcezaria.edu.ng)
Eva Onyinye Onyeka — Computer Science Education, Federal University of Education, Zaria
Haruna Umar — Computer Science Education, Federal University of Education, Zaria
Abdulkarim, Umar Abubakar — Computer Science Education, Federal University of Education, Zaria

Abstract: Digital transformation has changed how universities teach, learn and manage academic activities; nevertheless, the adoption of digital learning platforms in many Nigerian universities remains slow and uneven. This conceptual paper discusses how digital instruction can be strengthened by using the Unified Theory of Acceptance and Use of Technology (UTAUT) to explain the adoption of Microsoft Teams. The paper argues that the successful use of Microsoft Teams depends not only on the availability of the technology but also on lecturers' expectations of its usefulness and ease of use, support from colleagues and university management, and the availability of the necessary technical and institutional support. Although Microsoft Teams provides valuable features for online teaching, collaboration, assessment and communication, its effective use is limited by poor internet connectivity, inadequate digital infrastructure, limited digital skills and weak institutional policies. The paper further argues that digital instruction should become a core part of university teaching and learning rather than an alternative used only during emergencies. To achieve this, universities should invest in reliable digital infrastructure, provide regular training for lecturers, develop clear policies that support digital teaching, and encourage the use of technology in curriculum delivery, with strong collaboration among government agencies, university administrators, technology providers and academic staff needed to support long-term digital innovation. The paper concludes that the UTAUT framework provides a useful guide for improving the adoption of Microsoft Teams and promoting sustainable digital instruction in Nigerian universities.

Keywords: *Microsoft Teams, UTAUT Framework, Digital Instruction, Nigerian Universities, Lecturers.*

Comparative Microbial Analysis of Two Different Brands of Sachet Water Sold in Gakiya, Zaria, Kaduna State

Abdurrauf Idris Rabiu — Department of Biology, Microbiology and Environmental Biology, Nuhu Bamalli Polytechnic, Zaria (rabiuidrisabdurrauf@gmail.com)
Ibrahim Aliyu Ladan — Department of Biology, Microbiology and Environmental Biology, Nuhu Bamalli Polytechnic, Zaria
Usman Muhammad Kurmi — Department of Biology, Microbiology and Environmental Biology, Nuhu Bamalli Polytechnic, Zaria

Abstract: This study compared the microbial quality of two different brands of sachet water sold in Zaria, Kaduna State, Nigeria. Two brands, coded Brand A and Brand B, were examined using bacteriological procedures including total viable bacterial count, coliform count, colonial and morphological examination, Gram reaction and biochemical tests. Brand A recorded a total viable bacterial count of 1.2 x 10^2 CFU/ml, whereas Brand B recorded 3.8 x 10^2 CFU/ml. The reported coliform counts were 1.0 x 10^1 CFU/100 ml for Brand A and 2.0 x 10^1 CFU/100 ml for Brand B. Staphylococcus aureus, Escherichia coli, Bacillus species and Pseudomonas aeruginosa were identified, each representing 25% of the reported isolate occurrence; Brand B therefore exhibited the poorer microbiological quality. The detection of coliform organisms and other bacterial contaminants suggests possible lapses in water treatment, production hygiene, packaging, transportation or storage. The study emphasises the need for effective treatment, good manufacturing hygiene, routine microbiological monitoring and strengthened regulatory surveillance of sachet-water production and distribution in Zaria, and recommends that relevant agencies intensify inspection of small-scale water-packaging plants to safeguard public health.

Keywords: *Sachet Water, Microbial Quality, Coliform Bacteria, Zaria, Drinking Water, Public Health.*

Effects of Project-Based Learning on Academic Achievement of Agricultural and Bio-Environmental Engineering Technology Students in Bee Keeping

Zubairu Usman Bashar — Department of Agricultural and Bio-Environmental Engineering Technology, Waziri Umaru Federal Polytechnic, Birnin Kebbi (Bashar.zubairu@wufpbk.edu.ng)

Salim Nasir Umar — Department of Agricultural and Bio-Environmental Engineering Technology, Waziri Umaru Federal Polytechnic, Birnin Kebbi

Haruna Haruna Bashar — Department of Agricultural and Bio-Environmental Engineering Technology, Waziri Umaru Federal Polytechnic, Birnin Kebbi

Abstract: This study investigated the effects of Project-Based Learning (PBL) on students' academic achievement in the Principles of Bee Keeping course (AGT 124) among Agricultural and Bio-Environmental Engineering Technology students in a Polytechnic, specifically examining the effectiveness of practical field-based PBL and collaborative group-based PBL instructional strategies. Three research questions and hypotheses guided the study. A quasi-experimental research design involving pre-test, post-test, non-equivalent, non-randomised comparison groups was adopted, with the population comprising Agricultural Technology and Agricultural Engineering students offering Principles of Bee Keeping, and a multi-stage purposive sampling technique employed to select participants. The Students' Achievement Test in Bee Keeping (SATBK), with a reliability coefficient of 0.86, was used for data collection; mean scores and standard deviation were used to analyse the data, while hypotheses were tested using t-test at the 0.05 level of significance. Findings revealed that students taught Bee Keeping using practical field-based PBL achieved significantly better academically than those taught using the collaborative group-based PBL strategy. Based on the findings, it was recommended that lecturers be encouraged and supported by government and institutional management in providing necessary instructional materials, apiary equipment and conducive learning environments for the effective implementation of Project-Based Learning in Bee Keeping courses.

Keywords: *Academic Achievement, Agricultural, Bio-Environmental, Bee Keeping, Project-Based Learning.*

Sustainable and Inclusive STEM Education on Teachers' Awareness of Edulastic Application in Basic Science Concept, Sabon Tasha Education Zone, Kaduna

Kas Tanko, PhD (Mathematics Education) — Department of Integrated Science, Federal University of Education, Zaria (tankokas@gmail.com)

Hamisu Ahmad — Department of Integrated Science, Federal University of Education, Zaria

Bala Yusuf — Department of Integrated Science, Federal University of Education, Zaria

Abstract: The study evaluated sustainable and inclusive STEM education and research of teachers' awareness and use of the Edulastic application for curriculum content delivery in Sabon Tasha Education Zone. The study adopted a descriptive survey research design, with the population comprising all teachers in the six senior secondary schools in the Area Council. A sample of 96 teachers was conveniently selected from four senior secondary schools during the 2021/2022 academic session. The instrument for data collection, developed by the researchers and titled the Level of Awareness, Use and Constraints of Edulastic Application Questionnaire (LAUCEAQ), was pilot-tested on 10 senior secondary school teachers not covered by the study; Cronbach's alpha was employed to determine reliability, yielding r = .89. The instrument was administered on the respondents by the researchers and a 100% return rate was achieved. Data collected were analysed using frequency counts, percentages and mean set values of 2.50-3.00, 1.51-2.49 and 0.50-1.50, representing high, moderate and low extents respectively. Findings revealed teachers' low level of awareness and use of the Edulastic application. Among the constraints encountered by senior secondary teachers were lack of awareness, poor supply of electricity, low or weak network/bandwidth, and non-integration of technology in the subject curricula.

Keywords: *Edulastic Application, Awareness, Sustainable, Inclusive.*

Impact of Field Trip Instructional Strategy on Students' Academic Performance in Ecology Concept in Zaria, Kaduna State, Nigeria

Yakubu Amina — Department of Biology, Federal University of Education, Zaria (aminayakubu12@gmail.com)
Kabir Sumayya Muhammad — Department of Biology, Federal University of Education, Zaria
Najmuddeen Alhassan — Department of Biology, Federal University of Education, Zaria

Abstract: This study examined the impact of the Fieldtrip Instructional Strategy on students' academic performance in ecology concepts among senior secondary school biology students in Zaria Education Zone, Kaduna State. A pretest-posttest control-group quasi-experimental design was adopted. A sample of 164 students was drawn from two randomly selected co-educational public secondary schools out of an eligible population of 7,097 biology students. The experimental group was instructed using the fieldtrip strategy, whereas the control group was taught using the conventional lecture method over a six-week intervention period. Data were collected using the validated Ecology Performance Test (EPT; KR-20 reliability = .79) and analysed using descriptive statistics (mean and standard deviation) and inferential statistics (independent-samples t-test and ANOVA) at alpha <= .05. The results revealed statistically significant improvement in academic performance for the experimental group (M = 31.22, SD = 1.66) compared with the control group (M = 20.70, SD = 4.00), t(162) = 25.11, p = .000, leading to the rejection of the null hypothesis. Gender-based performance between male (M = 33.45) and female (M = 32.00) students showed no significant difference (p = .83). The study concludes that the fieldtrip strategy is an effective and gender-inclusive instructional approach that significantly enhances biology students' learning performance in ecology, and recommends that the Science Teachers Association of Nigeria (STAN) organise workshops to train teachers on its effective implementation.

Keywords: *Academic Performance, Biology, Ecology, Field Trip, Senior Secondary School.*

Mathematics Lecturers' Perception on Integration of Artificial Intelligence (AI) in Flipped Classroom in Kebbi State Institutions of Higher Learning

Muhammad Sani Abdurrahman — Department of Science Education, Federal University, Birnin Kebbi (abdurrahman@wufpbk.edu.ng)
Sadiq Buhari Bello — Department of Computer Engineering, Waziri Umaru Federal Polytechnic, Birnin Kebbi (sbbello@wufpbk.edu.ng)

Abstract: Following the COVID-19 epidemic, educational institutions were forced to adjust and make use of online resources in order to continue teaching when remote learning was required; despite the pandemic's negative effects on education, this paradigm shift has made online learning increasingly effective alongside traditional classroom instruction. This study determined how mathematics lecturers perceive the integration of artificial intelligence (AI) in flipped classrooms in Kebbi State institutions of higher learning. The Krejcie and Morgan table was used to determine a sample size of 80 mathematics lecturers from a population of 109 lecturers. A self-developed Google Form questionnaire, designed on a four-point Likert scale, was used to collect data; the questionnaire was validated by experts and pilot-tested among mathematics lecturers who made up the study population but were not included in the study sample, achieving a reliability coefficient of 0.76 using Cronbach's alpha. Data were analysed using simple percentages and descriptive statistics of mean. The findings revealed that while mathematics lecturers believe flipped classrooms are good and satisfactory, they also encounter problems while integrating AI into them. The study recommends that, rather than replacing instructional work, the use of AI tools should be conditional and supportive; lecturers and students who see AI as a tool to improve teaching effectiveness while maintaining professional control are more likely to utilise it effectively.

Keywords: *Flipped Classroom, Artificial Intelligence (AI), AI Integration, Institutions of Higher Learning.*

Biotechnology Education for Sustainable Agriculture and Food Security

Surayyah Shuraihu Ladan — Department of Microbiology, Faculty of Life Sciences, Kaduna State University (surayya.ladan@kasu.edu.ng)

Suwaiba Mohammed Rufai — Department of Microbiology, Faculty of Life Sciences, Kaduna State University

Abstract: Food insecurity remains a major challenge in developing countries, particularly in Sub-Saharan Africa, where rapid population growth, climate change, declining soil fertility and emerging crop diseases continue to threaten agricultural productivity. Biotechnology offers sustainable solutions through the development of improved crop varieties, disease-resistant plants, biofertilizers and climate-smart agricultural practices; however, the effective adoption of these innovations depends largely on biotechnology education, which equips learners with the scientific knowledge and practical skills needed to address agricultural challenges. This paper examines the role of biotechnology education in promoting sustainable agriculture and strengthening food security, highlighting how integrating biotechnology into science and STEM education enhances scientific literacy, innovation, critical thinking and problem-solving skills while preparing learners to apply biotechnology in crop improvement, pest and disease management, soil fertility enhancement and sustainable food production. The paper also discusses major challenges affecting biotechnology education in developing countries, including inadequate laboratory facilities, limited funding, insufficient teacher training and public misconceptions about biotechnology. Drawing on contemporary literature and global best practices, the study argues that strengthening biotechnology education through curriculum reform, practical learning experiences, interdisciplinary collaboration and increased investment in research infrastructure can bridge the gap between scientific knowledge and agricultural practice, concluding that biotechnology education is a critical driver of sustainable agricultural development and long-term food security.

Keywords: *Biotechnology Education, Sustainable Agriculture, Food Security, STEM Education, Agricultural Biotechnology, Climate-Smart Agriculture.*

Artificial Intelligence Readiness and Adoption among Technical College Teachers in North-East Nigeria

Baba Yakubu — Technical Education Department, School of Secondary Education (Vocational and Technical Education), Aminu Saleh College of Education, Azare, Bauchi State (bbyakubu4@gmail.com)

Bello Aminu — Isa Kaita College of Education, Dutsin-Ma, Katsina State

Idris Muhammad Inuwa

Faizu Muhammad Isiaku

Ishaq Muhammad Julde

Abstract: This study investigated artificial intelligence (AI) readiness and adoption among technical college teachers in North-East Nigeria. Two research objectives guided the study and one null hypothesis was tested at the 0.05 level of significance, using a descriptive survey research design with a cross-sectional approach. The population comprised 1,734 technical college teachers in the 42 technical colleges in North-East Nigeria. A sample of 325 teachers was determined using the Taro Yamane (1967) formula at a 5% level of precision and selected through proportionate stratified random sampling. Data were collected using a 20-item validated instrument, the Artificial Intelligence Readiness and Adoption Questionnaire (AIRAQ), structured on a 5-point rating scale ranging from Very High Extent to Very Low Extent; the instrument was validated by three experts and pilot-tested among 30 technical college teachers outside the study area, yielding a Cronbach's alpha reliability coefficient of 0.85. Data were analysed using mean and standard deviation to answer the research questions, while Pearson Product Moment Correlation (PPMC) was used to test the hypothesis. The findings revealed that technical college teachers demonstrated a moderate level of AI readiness (grand mean = 2.85), while their extent of actual AI adoption in teaching and learning activities was low (grand mean = 2.23). The study further revealed a significant positive relationship between AI readiness and AI adoption ($r = 0.61$, $p < .05$), leading to the rejection of the null hypothesis, and recommended sustained AI-focused professional development programmes and reliable internet connectivity.

Keywords: *Artificial Intelligence, Readiness, Adoption, Technical College Teachers, TVET, North-East Nigeria.*

Biology Education in Climate Resilience: Harnessing Genetics for Sustainable Food Security

Odeyemi Rofiat Adeola — Department of Biology Education (rofiatadeolaodeyemi@gmail.com)

Abstract: Climate change is increasingly affecting the biological, agricultural and social systems on which food security depends. Rising temperatures, irregular rainfall, droughts, flooding, emerging pests and diseases, and declining biodiversity are placing additional pressure on food production, particularly where agriculture remains highly dependent on climatic conditions. Responding to these challenges requires more than advances in genetic science; it also requires an education system capable of helping learners understand, evaluate and responsibly apply emerging biological technologies. This paper examines the potential of biology education to use genetics as a pathway towards climate resilience, with particular attention to crop improvement, food security, biodiversity conservation and human health, employing a qualitative narrative review that drew on authoritative reports and recent peer-reviewed literature on climate change, genetic resources, genomics, crop breeding, genome editing, biodiversity and sustainability education. The review indicates that genetic diversity provides an important reservoir for adaptation, while molecular breeding, genomic selection, pangenomics and genome-editing technologies can increase the capacity to develop crops suited to changing environmental conditions, and that conservation of agricultural biodiversity remains essential for maintaining options for future adaptation. The paper argues that genetics education should move beyond the conventional teaching of inheritance and Mendelian principles to include practical questions about adaptation, crop diversity, biotechnology, biodiversity and food systems, using locally important African crops such as maize, sorghum, millet, cassava, cowpea and rice as entry points, and recommends curriculum integration, continuous teacher professional development, and school-based biodiversity and seed projects.

Keywords: *Biology Education, Climate Resilience, Genetics, Genomics, Crop Improvement, Food Security, Biodiversity Conservation.*

Impact of Collaborative Learning Strategy on Secondary School Students' Academic Performance in Biology as a STEM Subject within Sabon Gari Local Government Area, Kaduna State

Muinat Mahmoud Ibrahim — Department of Biology, Federal University of Education, Zaria (Muinat.im@gmail.com)
Nana Oziehisa Dauda — Department of Biology, Federal University of Education, Zaria
Janet Funke Jesulowo — Department of Science Education, Ahmadu Bello University, Zaria

Abstract: The study investigated the impact of collaborative learning strategy on secondary school students' academic performance in Biology as a STEM subject in Sabon Gari Local Government Area of Kaduna State. The study adopted a quasi-experimental pretest-posttest non-equivalent control-group design. The population comprised 2,176 students; two schools were selected, and one intact SS II class was selected from each school. A 40-item Biology Academic Performance Test (BAPT) was used for data collection, validated by three experts and yielding a reliability coefficient of 0.86 using Cronbach's alpha. Mean and standard deviation were used to answer the research question, while analysis of covariance (ANCOVA) was used to test the first null hypothesis and an independent-samples t-test was used to test the second null hypothesis at the 0.05 level of significance. The ANCOVA result showed a statistically significant effect of instructional strategy on students' academic performance, $F(1, 81) = 153.85$, $p < .001$, partial eta squared = .655. Students exposed to collaborative learning recorded a higher posttest mean score ($M = 29.77$, $SD = 4.21$) than those taught using conventional instruction ($M = 21.98$, $SD = 3.00$). The independent-samples t-test showed that the difference between male ($M = 30.04$, $SD = 4.18$) and female ($M = 29.46$, $SD = 4.29$) students in the collaborative-learning group was not statistically significant, $t(41) = 0.46$, $p = .648$. The study concluded that collaborative learning strategy significantly enhanced students' academic performance and produced comparable outcomes for male and female students.

Keywords: *Collaborative Learning, Academic Performance, STEM Education, Cooperative Learning, Gender.*

Income, Poverty and Unemployment as Predictors of Water Accessibility, Sanitation and Resource Management in Rural Kaduna State, Nigeria: A Two-Ward Comparative Analysis and Its Implications for SDG 6

Musa Inusa — Department of Geography, Federal University of Education, Zaria (inusaecole@gmail.com)
Adamu Gaddafi Aliyu — Department of Environmental Education, Federal University of Education, Zaria
Ogolowa Marcel Ogie — Department of Environmental Education, Federal University of Education, Zaria
Jimoh Abdulra'uf Kayode — Department of Geography, Federal University of Education, Zaria

Abstract: Rural water programmes in northern Nigeria have absorbed sustained public and donor investment without a commensurate improvement in household water security, a pattern that points to constraints operating beyond the engineering of supply. This article tests whether three household economic conditions, namely income, poverty and unemployment, predict the outcomes such programmes are designed to deliver, and whether the relationships hold across communities with different livelihood structures. A descriptive survey was conducted in Lere Local Government Area, Kaduna State, where two of eleven wards, Garun Mariri and Gure/Kahugu, were selected by simple random sampling from a local population of 501,900. A sample of 382 respondents determined by the Krejcie and Morgan table was distributed equally between the wards and surveyed with a 24-item instrument organised around six constructs and rated on a five-point scale; frequencies, percentages, means and simple linear regression were computed at the 0.05 alpha level. Income significantly and positively predicted sanitation and hygiene, explaining 46.4 and 46.2 per cent of the variance in the two wards. Poverty significantly and negatively predicted water accessibility, explaining 52.3 and 51.8 per cent, while unemployment significantly and negatively predicted water resource management, explaining 42.9 and 41.0 per cent. The estimates were near-identical across a predominantly commercial and a predominantly agrarian ward, indicating the relationships are not artefacts of local livelihood structure. Boreholes were the mainstay of supply and piped water the least available source. The article proposes that water investment be sequenced alongside livelihood and employment measures and anchored in community-managed maintenance.

Keywords: *Water Accessibility, Sanitation and Hygiene, Poverty, Unemployment, Sustainable Development Goal 6, Rural Nigeria.*

Effect of 5C's Instructional Strategies on Performance in Cell Division Concept among Secondary Students in Zaria Metropolis, Kaduna, Nigeria

Suleiman Samaila — Department of Science Education, Ahmadu Bello University, Zaria

Abstract: This research investigated the effect of 5C's instructional strategies in teaching Cell Division concepts in Biology on the performance of senior secondary school students in Zaria Metropolis. A randomised pretest-posttest experimental control-group research design was employed. The population comprised 1,434 SS II Biology students drawn from 21 secondary schools, 14 co-educational and 6 single-sex, within the Metropolis. A sample of 110 students was randomly selected after their equivalence had been established through a pretest, and assigned into a control group of 65 students and an experimental group of 45 students. Data were collected using the Students' Performance in Cell Division Test (SPCDT), with a reliability coefficient of 0.89 determined using the test-retest method and analysed using the PPMC statistical tool. One research question, examining the difference between the performance of students taught Cell Division using the 5C's and those taught using the conventional method, was answered using mean and standard deviation; the corresponding hypothesis was tested at the 0.05 alpha level using t-test. Results revealed that students taught using the 5C's instructional strategy performed significantly better than those taught using the conventional method. Based on the findings, it was recommended that Biology teachers adopt the 5C's instructional strategy in teaching Cell Division, because its emphasis on critical thinking, creativity, collaboration, communication and character development provides students with active learning experiences that improve their academic performance in Biology.

Keywords: *5C's, Cell Division, Performance.*

The Quality and Efficiency of Large Models in Coding Environments

Zakariyau Adamu Abbas — Department of Computer Science, Federal University of Education, Zaria
Aminu Jafar Abdul — Department of Computer Science, Federal University of Education, Zaria
Eva Onyinye Onyeka — Department of Computer Science, Federal University of Education, Zaria

Abstract: Large language models (LLMs) are increasingly embedded in integrated development environments (IDEs) for code completion, generation, debugging, refactoring, testing, documentation and repository-level software engineering. However, their usefulness cannot be judged by functional correctness alone. This paper examines the quality and efficiency of large models in coding environments through a mixed-methods evidence-synthesis approach, considering functional correctness, software quality, code efficiency, model-inference efficiency and security. Evidence from HumanEval, SWE-bench, Mercury and recent model-selection research shows that passing tests may conceal inefficient, fragile, insecure or difficult-to-maintain implementations. The paper therefore proposes a verified engineering loop that combines model generation with compilation, static analysis, automated testing, performance profiling, security checks and human review. It further argues for workload-aware routing, in which smaller models handle routine IDE tasks while stronger models are reserved for complex reasoning, and situates these practices within the broader movement towards trustworthy, production-grade AI-assisted software engineering. The central conclusion is that effective deployment of large models in coding environments should optimise dependable software production at acceptable latency and cost, rather than maximise performance on a single benchmark score, and that institutions adopting such tools need clear evaluation frameworks before scaling their use.

Keywords: *Large Language Models, Coding Environments, Software Quality, Computational Efficiency, IDEs, Code Evaluation.*

Integrating GIS and Spatial Data Science in Environmental Education: A STEM Framework for Bridging Theory and Field Practice at FUEZ Zaria

Kawai, Mataru Joseph — Department of Environmental Education, Federal University of Education, Zaria (Mjkawai73@gmail.com)
Manasseh, Simon Loms — Department of Environmental Education, Federal University of Education, Zaria
Kor, Daniel Akuha — Department of Environmental Education, Federal University of Education, Zaria

Abstract: The rapid development of spatial computing requires teacher-training institutions to transition from passive instructional delivery to technologically integrated, data-driven frameworks. This empirical study examines the role of Geographic Information Systems (GIS) and spatial data science within the Environmental Education (EE) curriculum as a practical mechanism to bridge the theory-practice gap and foster educational excellence. The research was conducted at the Federal University of Education, Zaria (FUEZ), using a mixed-methods descriptive survey design; primary data were gathered from a stratified sample of 180 students and 30 academic lecturers within the Faculty of Science Education, using a validated, highly reliable questionnaire ($r = .87$) alongside structured key-informant interviews. The quantitative findings revealed a significant instructional imbalance: while 82.1% of respondents demonstrated high conceptual literacy regarding spatial environmental theories, only 14.3% possessed practical competence in operating open-source GIS software, such as QGIS, or executing digital spatial analysis. Inferential statistical analysis using a paired t-test confirmed that integrating hands-on spatial data collection exercises significantly enhanced student-teachers' analytical problem-solving skills and the quality of their scientific research outputs ($t = 5.84$, $p < .05$). Qualitative thematic analysis identified severe shortages of digital infrastructure, erratic power supply, and a lack of specialised faculty training in data science as the primary barriers to effective STEM implementation. The study concludes that embedding spatial data science within environmental education equips pre-service teachers with the technical skills needed for contemporary STEM research, and recommends a dedicated spatial computing laboratory and mandatory GIS modules at FUEZ.

Keywords: *Spatial Data Science, Geographic Information Systems, Environmental Education, STEM Research, Theory-Practice Gap, FUEZ Zaria.*

Emotional Intelligence and Proclivity to Digital Tool Usage for Learning among Student Teachers in a Nigerian Teacher Training Institution

Yussuf Yakubu — Computer Science Education Department, TeCETEL / Teaching Practice Unit, Federal University of Education, Zaria (yussyak@gmail.com)

Rabiatu Lawal Umar — Computer Science Education Department, Federal University of Education, Zaria

Abstract: This study investigated the relationship between emotional intelligence and student teachers' proclivity to use digital tools for learning in a Nigerian teacher-training institution. A descriptive correlational survey design was used. Data were collected from 214 student teachers at the Federal University of Education, Zaria, using an adapted emotional intelligence scale and a researcher-developed Digital Tool Proclivity Scale, and analysed using descriptive statistics, Pearson's correlation and multiple regression. The findings showed that respondents reported high overall emotional intelligence and high proclivity to use digital tools for learning. Emotional intelligence was positively and significantly related to digital tool proclivity, and its components collectively predicted students' readiness to adopt educational technology. The findings suggest that emotional competencies, such as self-control, emotionality, well-being and sociability, are relevant to student teachers' confidence and willingness to engage with digital learning tools, underscoring the interplay between affective disposition and technology adoption in pre-service teacher preparation. The study recommends that teacher-education programmes integrate emotional intelligence development with digital pedagogy training to prepare future teachers for technology-rich learning environments, and calls for further research across a wider range of Nigerian teacher-training institutions to confirm the generalisability of the findings.

Keywords: *Emotional Intelligence, Digital Tools, Teacher Training, Technology Adoption, Educational Platforms.*

Community Sport Management for Healthy Aging and Inclusive Lifelong Participation in Nigeria: Strategies for Sustainable Physical Activity

Joy Ibekwe Kingsly — Department of Physical and Health Education, Federal University of Education, Zaria (joyibekwetalking@gmail.com)

Abstract: Community sport management is essential for promoting healthy aging and sustaining lifelong physical activity among older adults in Nigeria. This paper examines how effective planning, leadership, partnerships, inclusive programming and resource mobilisation can create accessible, safe and sustainable opportunities for participation. Nigerian evidence indicates that physical activity is associated with improved psychological well-being, reduced loneliness and depression, greater social support, enhanced self-efficacy and successful aging. However, participation is constrained by financial difficulties, inadequate facilities, transportation challenges, chronic illness, mobility limitations, fear of falling, social isolation and weak policy implementation; these barriers demonstrate the need for age-friendly programmes that accommodate different functional abilities and individual preferences. Community sport managers should collaborate with local governments, healthcare providers, sport organisations, community leaders, families, universities, voluntary groups and older-adult associations to provide affordable facilities, trained personnel, adapted activities and supportive social environments. Intergenerational initiatives, volunteer engagement, digital technologies, wearable devices and public-private partnerships can further improve motivation, monitoring, outreach and programme sustainability. Although existing Nigerian evidence is concentrated mainly in the South-East and South-West, its implications extend across all six geopolitical zones; strategies should nonetheless be adapted to local cultural, environmental, socioeconomic and infrastructural conditions rather than applying a single national model. Sustainable community sport management should therefore prioritise accessibility, safety, equity, inclusion, social participation, collaboration and lifelong engagement, helping older adults remain physically active, functionally independent and socially connected.

Keywords: *Community Sport Management, Healthy Aging, Sustainable Physical Activity, Older Adults.*

Leveraging Generative Artificial Intelligence to Enhance Personalized Learning Experiences in Inclusive Education: Opportunities, Challenges and Ethical Considerations

Basiru Ibrahim Musawa — Department of Primary School Education / School of Education, Yusuf Bala Usman College of Education and Legal Studies, Daura (abdulbasirmusawa@gmail.com)

Abstract: The integration of generative artificial intelligence (AI) in education has the potential to revolutionise personalised learning experiences, particularly in inclusive settings. By leveraging AI's capabilities, educators can create tailored learning pathways that cater to diverse learning needs, abilities and styles. This paper explores the opportunities, challenges and ethical considerations of harnessing generative AI-driven adaptive learning in inclusive education. It discusses the benefits of AI-driven adaptive learning, such as improved student engagement and outcomes, while also addressing concerns around bias, accessibility and data privacy that can undermine equitable access if left unaddressed. The paper further considers institutional readiness, teacher capacity and infrastructural constraints as factors that shape how effectively generative AI tools can be deployed in inclusive classrooms across varied Nigerian educational contexts. The paper concludes by highlighting the need for a balanced approach that prioritises both innovation and responsibility in the development and implementation of AI-powered learning systems. Based on the findings of this study, the researcher recommends embracing the deployment of artificial intelligence in inclusive education, alongside clear ethical safeguards and capacity-building for teachers, in order to ensure continuous and quality education in Nigeria.

Keywords: *Artificial Intelligence, Personalized Learning, Inclusive Education, Learning Experience, Innovation.*

Determination of 27Al (n, p) 27Mg and 27Al (n, alpha) 24Na Reaction Cross-Sections as a Tool for Enhancing Experimental Learning in Nuclear Physics

Yahaya Yamusa — Department of Physics, Faculty of Sciences and Science Education, Federal University of Education, Zaria (yahayayamusa@fcezaria.edu.ng)

Ziyau Muhammad — Department of Physics, Faculty of Physical Science, Ahmadu Bello University, Zaria

Musa Lukman

Zainab Musa

Abstract: Experimental activities play a crucial role in strengthening practical competencies and scientific inquiry in STEM education. This study demonstrates how threshold reaction cross-section measurements can serve as an effective platform for enhancing experimental learning in Nuclear Physics Education. The threshold reactions 27Al(n,p)27Mg and 27Al(n,alpha)24Na were investigated using Al-0.1%Au monitor foils irradiated in the cadmium-lined irradiation channels of the Nigeria Research Reactor-1 (NIRR-1). The induced activities of the reaction products were measured using a calibrated 2x2 NaI(Tl) gamma-ray spectrometer, and the cross-sections were determined using neutron activation techniques. The measured cross-sections were found to be 4.76 mb for the 27Al(n,p)27Mg reaction and 0.61 mb for 27Al(n,alpha)24Na; these values compare favourably with previously reported literature data, confirming the reliability of the experimental procedure. Beyond the scientific results, the experiment provided students with hands-on experience in neutron activation and gamma-ray spectrometry, exposing them to instrumentation and analytical techniques rarely encountered in standard undergraduate laboratory work. The study highlights the value of research-based laboratory activities in promoting experimental learning and sustainable capacity development in Nuclear Physics Education, and recommends wider adoption of reactor-based practicals to strengthen STEM research training.

Keywords: *Nuclear Physics Education, Experimental Learning, Cross-Section, Neutron Activation Analysis, STEM Education.*

Effect of Realistic Mathematics Education Approach on Mathematics Students' Interest, Learning Engagement, and Performance: Implications for Sustainable and Inclusive STEM Teacher Education

Sagir Sulaiman — Directorate of General Studies Education, Federal University of Education, Zaria (sagirsulaiman77@gmail.com)

Umar Bashir — Department of IJMB Science, Nuhu Bamalli Polytechnic, Zaria (fbashumar@gmail.com)

Abstract: This study investigated the effect of the Realistic Mathematics Education (RME) approach on mathematics students' interest, learning engagement and performance at the Federal University of Education, Zaria, with implications for sustainable and inclusive STEM teacher education. The study was anchored on constructivist learning theory and Freudenthal's Realistic Mathematics Education theory, which emphasise meaningful learning through realistic contexts, active participation and learners' construction of mathematical knowledge. A quasi-experimental one-group pretest-posttest research design was adopted, with the population and sample consisting of 39 undergraduate mathematics students selected through census sampling due to the manageable population size. Data were collected using the Mathematics Interest Questionnaire (MIQ), the Mathematics Learning Engagement Scale (MLES) and the Mathematics Achievement Test (MAT), all validated by experts in Mathematics Education and Measurement and Evaluation, with reliability coefficients established before administration. Students were exposed to the RME approach through lessons involving real-world applications, collaborative problem-solving, guided discovery and mathematical discussions. Data were analysed using mean, standard deviation and paired-sample t-test at the 0.05 level of significance. Findings revealed improved interest, learning engagement and performance after exposure to RME, with the paired-sample t-test showing a significant difference between pre- and post-intervention performance scores. The study concludes that RME is an effective instructional approach for improving undergraduate mathematics learning and preparing future teachers for sustainable and inclusive STEM education, and recommends integrating RME principles into mathematics teacher education programmes.

Keywords: *Realistic Mathematics Education, Mathematics Students, Teacher Education, Learning Engagement, Mathematics Performance, Sustainable STEM Education.*

The Intersection of Faith and Health: Exploring the Influence of Religion on Nursing Mothers' Health-Seeking Behaviour

Abdulmuhit Temitope Isiaq — Department of Health Education, Federal University of Education, Zaria (abdulmuhitisiaq@gmail.com)

Bilkisu Kila Usman — Department of Health Education, Federal University of Education, Zaria

Adam Abiola Akorede — Department of Health Education, Federal University of Education, Zaria

Abstract: This study examined the influence of religion on the health-seeking behaviour of nursing mothers in Kwara State, Nigeria, within the broader context of socio-demographic determinants of maternal and child health outcomes. A cross-sectional research design was adopted, targeting nursing mothers attending postnatal clinics in public Primary Health Centres. From a population of 46,423 registered mothers, a sample of 420 respondents was selected using a multi-stage sampling technique. Data were collected through a structured questionnaire validated by experts and tested for reliability (Cronbach's alpha = 0.892), and analysed using descriptive statistics and inferential analyses, including one-sample t-test and Analysis of Variance (ANOVA), at the 0.05 level of significance. Findings revealed that nursing mothers generally demonstrated good health-seeking behaviour, with an overall mean score of 3.16 exceeding the benchmark of 2.5; most respondents reported consulting medical professionals when symptoms arose, although notable engagement with alternative care sources such as religious centres, traditional healers and self-medication was also observed. Hypothesis testing showed that health-seeking behaviour was statistically significant ($p < .05$), indicating generally appropriate practices, whereas religious affiliation did not significantly influence health-seeking behaviour ($p > .05$), suggesting that while religion may shape perceptions, it does not determine healthcare choices in this context. The study concludes that religious affiliation alone is not a significant determinant of health-seeking behaviour among nursing mothers in Kwara State, and recommends sustained health education and strategic engagement of religious leaders to reinforce positive health practices.

Keywords: *Health-Seeking Behaviour, Nursing Mothers, Religion, Primary Healthcare, Nigeria.*

Primary Education for Sustainable Technology and Inclusive Innovation in Nigeria

Yakubu Bala — Department of Primary Education, School of Early Childhood & Primary Education, Aminu Saleh College of Education, Azare, Bauchi State (yakubu_bala@ascoea.edu.ng)

Abstract: Primary education plays a fundamental role in preparing young learners for active participation in a rapidly changing technological and global society. Sustainable technology and inclusive innovation have become essential components of modern educational development, especially in fostering creativity, critical thinking, digital literacy and equal learning opportunities among pupils. This paper examines the importance of integrating sustainable technological practices and inclusive innovative strategies into primary education to enhance quality teaching and learning outcomes, highlighting how technology-driven instructional methods, environmentally sustainable practices and inclusive classroom approaches can improve access to education, learner participation and academic achievement among diverse groups of learners. The paper also discusses major challenges confronting the implementation of sustainable technology in primary schools, including inadequate infrastructure, insufficient teacher training, limited digital resources and unequal access to technological tools. It further proposes practical strategies such as teacher capacity building, government investment in educational technology, curriculum innovation and community participation to promote inclusive and sustainable primary education. The paper concludes that integrating sustainable technology and inclusive innovation into primary education is essential for achieving equitable, quality and future-oriented education aligned with global educational development goals, and recommends that Nigerian governments increase funding for educational technology and digital learning in primary schools.

Keywords: *Primary Education, Sustainable Technology, Inclusive Innovation, Digital Learning, Educational Development.*

Rethinking Sustainable STEM Education and Research: A Philosophical Analysis of Inclusivity, Practice, and Educational Development

Auwal Muhammad, PhD (auwalmohammad2@gmail.com)

Abstract: The growing demand for scientific and technological advancement in contemporary societies has intensified global attention toward sustainable and inclusive STEM (Science, Technology, Engineering and Mathematics) education and research. Despite remarkable progress in STEM-oriented policies and innovations, many educational systems, particularly in developing nations, continue to face challenges related to inequality, limited access, poor instructional practices and the disconnection between theoretical knowledge and practical application. This paper examines sustainable STEM education and research from a philosophical perspective, with emphasis on inclusivity, practice-oriented learning and educational development, adopting the analytical and critical methods of philosophical inquiry to interrogate the conceptual foundations, ethical assumptions and educational implications of STEM practices in modern society. The paper argues that sustainable STEM education should not merely focus on technological competence and economic productivity, but must also promote human development, social justice, moral responsibility, creativity and equitable participation among diverse learners. Drawing from philosophical traditions such as John Dewey's pragmatism, humanism and social reconstructionism, the study emphasises the need for learner-centred and socially responsive STEM education capable of addressing contemporary societal problems, further contending that inclusive STEM practices can foster national development by empowering marginalised groups, improving critical thinking and promoting innovation for sustainable living. It concludes that educational stakeholders should integrate philosophical reflection into STEM curriculum design, pedagogy and research policies in order to achieve holistic and sustainable educational development.

Keywords: *Sustainable STEM Education, Inclusivity, Educational Development, STEM Research, Social Justice, Human Development, Innovation.*

Environmental Education and Sustainable Energy Practices among Women in Soba Local Government Area of Kaduna State, Nigeria

Dr. Yakubu Bobai Akut — Department of Environmental Geography, Federal University of Education, Zaria (yabqutt68@gmail.com)

Salamatu Suleiman — Department of Environmental Geography, Federal University of Education, Zaria

Rakiya K. Idris — Department of Environmental Geography, Federal University of Education, Zaria

Samira Bello — Department of Environmental Geography, Federal University of Education, Zaria

Imrana Hari — Department of Environmental Geography, Federal University of Education, Zaria

Abstract: The transition to sustainable energy has become a global priority due to increasing concerns over climate change, environmental degradation and energy insecurity. Despite numerous interventions aimed at promoting renewable energy technologies in Nigeria, rural households continue to rely heavily on traditional biomass fuels such as firewood and charcoal. This study examined the influence of environmental education on sustainable energy practices among rural women in Soba Local Government Area of Kaduna State, specifically determining the level of environmental education awareness, assessing sustainable energy practices, identifying challenges affecting adoption, and examining the influence of environmental education on sustainable energy practices. A descriptive survey research design was adopted, with a sample of 131 respondents selected through a multistage sampling technique from communities within Soba LGA. Data were collected using a researcher-developed Environmental Education Awareness and Sustainable Energy Practices Questionnaire (Cronbach's alpha = .853) and analysed using frequency, percentage, mean, standard deviation, Pearson correlation and simple linear regression at the 0.05 level of significance. Findings revealed a high level of environmental education awareness (mean = 2.64) but low sustainable energy practices (mean = 2.12); awareness showed a significant positive relationship with practices ($r = .398$, $p < .001$) and significantly predicted them ($R^2 = .159$; $F(1,129) = 24.313$, $p < .001$). The study concludes that environmental education significantly influences sustainable energy practices, though awareness alone is insufficient for widespread adoption, and recommends strengthening community-based environmental education, improving access to affordable renewable technologies, and enhancing government support through subsidies and rural electrification.

Keywords: *Environmental Education, Sustainable Energy, Rural Women, Renewable Energy, Kaduna State, Soba LGA.*

Impact of Artificial Intelligence in the Teaching and Learning of Social Studies Education in Junior Secondary Schools in Katsina State, Nigeria

Bello Mohammad Jamo — School of General Studies, Department of Social Studies, Yusuf Bala Usman College of Education and Legal Studies, Daura (bellomjamo@gmail.com)

Abstract: This study investigated the impact of artificial intelligence (AI) in the teaching and learning of Social Studies education in junior secondary schools in Katsina State, Nigeria, guided by two objectives and two corresponding research questions. The study employed a descriptive survey research design; the population comprised all 55 Social Studies teachers of seven public junior secondary schools in Jibia LGA, from which a purposive sampling technique was used to select 35 teachers from four urban public junior secondary schools. Data were collected using a 30-item structured questionnaire titled Benefits and Challenges of Artificial Intelligence (BACAI) in Teaching and Learning Social Studies, adapted from Poripo (2025) and validated by three experts for face, content and construct validity, yielding a reliability coefficient of 0.84. Data were analysed using mean and standard deviation, with items rated 2.50 and above regarded as accepted and those below rejected. Results revealed that AI is beneficial to junior secondary school students, though the study also revealed challenges associated with integrating AI into junior secondary schools in Katsina State. The study concluded that AI is of great benefit to both teachers and students, especially in the teaching and learning of Social Studies, and recommended free teacher capacity-building on AI learning resources, procurement and distribution of smart devices and personal computers, and adequate provision of solar power and internet services to bridge the digital gap in schools.

Keywords: *Artificial Intelligence, Social Studies Education, Teaching and Learning, Junior Secondary Schools, Benefits, Challenges.*

Personalized and Collaborative Learning Strategies: Leveraging Technology to Support Student-Centered Learning in Schools across Nigeria in the 21st Century

Habiba Mohammed Tukur, PhD — Department of Curriculum and Instruction, Faculty of Education, Federal University of Education, Zaria (htkur15@gmail.com)

Kabir Zainab Abdulkadir — Department of Curriculum and Instruction, Faculty of Education, Federal University of Education, Zaria

Asmau Dalhatu Alhassan — Department of Curriculum and Instruction, Faculty of Education, Federal University of Education, Zaria

Abstract: The rapid pace of digital technology innovation and the growing demand for 21st-century skills have necessitated a reconsideration of traditional pedagogical methods, particularly in developing countries like Nigeria. This paper explores leveraging technology to support student-centred learning through personalised and collaborative learning strategies aimed at enhancing teaching and learning outcomes. It identifies the current state of digital learning practices and their vital roles, such as access to information, interactive and personalised learning, communication, assessment, feedback and career readiness, while highlighting persistent barriers such as lack of institutional coordination, technical glitches, financial considerations, low digital literacy and policy gaps. Key drivers of change discussed include youth digital engagement, institutional reforms supporting teachers, data safety and public-private partnerships. Drawing from recent Nigerian research and policy development, the paper emphasises the importance of adopting holistic strategies encompassing infrastructural development, capacity building, curriculum redesign and inclusive access to technology, and stresses the need for alignment with global trends and investment in sustainable frameworks for integration. The paper concludes that, with coordinated stakeholder effort, leveraging technology to support student-centred learning holds strong promise for improved access, equity and instructional quality across Nigerian schools.

Keywords: *Personalized Learning, Collaborative Learning, Leveraging Technology, Student-Centered Learning, 21st Century.*

BEYOND THE LAB: The Role of Narrative Pedagogy and Linguistic Clarity in Fostering Inclusive STEM Excellence

Jibril LAWAL - Department of English and Literary Education, Federal University of Education, Zaria (FUEZ) Zaria, Nigeria (jblawali@yahoo.co.uk, jblawal@fuez.edu.ng)

Abstract: Lawal (2024) identifies a persistent gap in STEM education: the language of instruction and the pedagogy used to deliver it are routinely treated as neutral, even though student performance in laboratory reports, calculations, and examinations is assessed almost entirely through English-medium scientific discourse. Success in STEM depends not only on technical mastery but on the linguistic ability to understand, analyse, and apply that content to real-world problems. This paper argues that integrating language and literature into STEM education is essential to closing this gap, as engagement with the humanities fosters comprehension, critical thinking, and ethical reasoning in ways that technical training alone cannot provide. Drawing on transdisciplinary scholarship in educational linguistics, science pedagogy, and literary studies, the paper shows how scientific jargon excludes multilingual and rural Nigerian students from STEM participation, and how narrative pedagogy — the deliberate use of storytelling and literary technique — makes scientific concepts more accessible without sacrificing precision. Building on Vygotsky (1978), Brown and Ryoo (2008), Norris and Phillips (2003), and the National Academies of Sciences, Engineering, and Medicine (2018), the paper argues that the shift from STEM to STEAM represents a philosophical reorientation of science education's purpose, and closes with five practical recommendations for the Federal University of Education, Zaria: cross-departmental collaboration, writing across the curriculum, narrative-based science teaching, African speculative fiction as a teaching resource, and structured local-language bridging strategies.

Keywords: *Personalized Learning, Collaborative Learning, Leveraging Technology, Student-Centered Learning, 21st Century.*

A Review of Cybersecurity Practices in Mitigating Social Media-Related Crimes among University Students

Ummusalma Shuraihu Muhammad - Department of Computer Science, Federal University of Education, Zaria (FUEZ) Zaria, Nigeria (mrsiabbaa@gmail.com)

Abubakar Abba - Department of Computer Science, Federal University of Education, Zaria (FUEZ) Zaria, Nigeria

Abstract: The increasing trend of use of social media platforms by university students has opened avenues for communication, academic collaboration, and sharing of information. At the same time, it has exposed the students to various criminal activities associated with social media which include phishing, impersonation, cyberbullying, online fraud, romance scams and identity theft. Although there is the presence of the Cybercrimes Act as well as increasing awareness about the threats online, data reveal that many students still indulge in various unsafe online practices owing to the absence of cybersecurity practices and online safety practices. This paper reviews the adoption of cyber security practices as an avenue for preventing criminal activities on social media by students of Federal University of Education, Zaria. Specifically, the paper aims to determine the level of cybersecurity practice among students, identify common crimes associated with social media, assess the contribution of cybersecurity practices to the prevention of such crimes, and explore ways to ensure online safety.

Keywords: *Cybersecurity Practices, Social Media, Cybercrime, Cyberbullying, Online fraud.*