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Use of Generative Artificial Intelligence Tools for Research Activities of Postgraduate Students in Federal Universities in North-Central, Nigeria

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ABSTRACT

This paper examined the use of generative artificial intelligence tools for research activities of postgraduate students in federal universities in North-Central, Nigeria. The study was guided by two objectives. The population of the study was 13,841 postgraduate students in federal universities in North-central, Nigeria. The sample size of the population was 373. This sample size was obtained by subjecting the target population of 13,841 to Krejcie and Morgan's 1970 recommended table for determining the sample size of a population. Out of the 373 copies of questionnaire administered, 317 copies were returned representing 79% response rate. The findings of the study revealed that postgraduate students perceptions on the use of generative AI tools for research activities is high. The findings of the study revealed further that inadequate funds to pay for quality features, technical issues integrating generative AI tools with university databases and systems, data privacy and ethical concerns when using AI tools are factors that hinder the research activities of postgraduate students. The study concluded that generative AI tools have the potential to enhance research activities among postgraduate students. However, factors such as inadequate funds to pay for quality features, technical issues integrating generative AI tools with university databases and systems, data privacy and ethical concerns when using AI tools were seen as challenges hindering the research activities of postgraduate students. The study recommended among others that the management of federal universities in North-central Nigeria should educate postgraduate students about the misuse of AI-generated content, research misinformation, potential biases in the outputs generated by generative AI and data privacy concerns. Promoting critical thinking and awareness among postgraduate students will help them navigate the ethical challenges associated with AI technology.

Keywords: *Artificial Intelligence tools, Postgraduate students, Research activities, Use of generative AI.*

Introduction

Universities are globally known for teaching, learning, research and community services. The university system is structured to carry out intensive and extensive research, and the research programme of universities makes them unique, which sets them apart from other tertiary institutions. To this end, universities conduct research to solve or combat extant challenges facing humanity (Ogunode & Audu, 2022). Universities promote teaching, learning and research as essential activities in higher educational systems; this, no doubt, is geared towards improving learning and dissemination of knowledge, which increases postgraduate student research activities, socio-economic development, innovation and a highly skilled workforce.

Universities serve as the major strength for the growth and development of a nation as they serve as the highest citadel of learning that undergoes vigorous research activities to meet the needs of society through the discovery of new knowledge which augments the effective, relevant and adequate conduct of any research and this serves as the paradigm for undergoing any research activity. Research is vital in facilitating a nation's prosperity and people's well-being. Through research, universities and other higher institutions of learning make important contributions to the growth and development of vital sectors of a nation, thereby promoting national and global

development. Most of the research work in Nigeria takes place in the universities and PG students form the majority of the students carrying out extensive research. Ifijeh and Ogbomo (2018) defined research as rigorous, systematic, validating, verifiable, empirical, critical, analysing and interpreting information to answer questions.

According to the University of Southern Queensland (USQ) (2021), research activity usually results in the creation of new knowledge and the use of existing knowledge in a new and creative way so as to generate new concepts, methodologies and understandings. From the perspective of this definition, research activity could include synthesis and analysis of previous research to the extent that it leads to new and creative outcomes. The perspective of this definition centrally pinpoints a thorough use of documented sources of ideas upon which a new idea could be built, or by extension, expanding on already documented ideas for more or better understanding. Postgraduate students' research activities involve collecting, searching, and saving information for assignments, theses, projects, dissertations, seminars, and conferences. They also predict possible results through the use of research findings.

Law Insider (2021) described research activities as systematic investigations designed to develop or contribute to generalisable knowledge, including research development, testing, and evaluation. This includes but is not limited to designing research, directing research, performing experiments, enrolling research subjects, making decisions regarding eligibility to participate in research, participating in observational registry programs, analysing or reporting research data, or submitting manuscripts concerning research for publication. The research activity of postgraduate students is multivariate because the result of research can lead to the production of many types of papers. Typical research outputs among postgraduate students and other researchers are seminar papers, conference papers, workshop papers, projects, theses and dissertations, which are all aspects of their research. Critical reasoning, searching, sorting, and writing go into achieving these research outputs, which is usually tedious. However, with the revolution of IT tools, specifically artificial intelligence, generative artificial intelligence tools are adopted to ease the research process.

Across the globe, artificial intelligence is rapidly revolutionising the higher education sector, and postgraduate students at higher learning institutions often leverage various forms of artificial intelligence to enhance their academic pursuits. According to Van Dis *et al.* (2023), artificial intelligence (AI) plays a crucial role in assisting postgraduate students, especially master's students and doctoral candidates, in expediting their research processes and facilitating the retrieval of accurate information from previous studies for their research endeavours. AI enhances postgraduate students' productivity in research by offering advanced writing assistance. According to Dwivedi *et al.* (2023), AI has a significant impact, particularly on the research component of higher education. The adoption of AI in universities will influence the connectivity of information technology, actively support information usage, ease postgraduate students' research, and immediately address their needs. Postgraduate students in higher education, especially those from well-resourced universities, use AI tools to augment their academic activities. The adoption of AI tools into postgraduate studies has the potential to enhance postgraduate students' overall learning experience. According to Zhai (2022), AI tools are pivotal in improving students' critical thinking and problem-solving skills. AI tools serve as valuable tools for assisting postgraduate students in comprehending various academic challenges that require resolution.

Generative AI tools have the potential to aid in grant applications (Alshater, 2022), peer reviews (Liang et al., 2022), and academic article writing (Hosseini *et al.*, 2023). Generative AI can act as an advanced spellcheck, correcting errors such as logical errors and suggesting improvements without creating entirely new content. Ideally, human creativity will combine with AI's pattern recognition for the best results. Achieving this balance requires changes in public policies and societal views on AI. While there are worries about AI taking over academic roles, it cannot match humans in combining diverse data into new insights.

Statement of the Research Problem

Research activities are part of the academic activities carried out by university students, especially the postgraduate students in most universities. Through these researches, new knowledge is acquired and disseminated to the general public. Research activities equally enhances development and transformation of mankind and society at large. The process of research is usually rigorous and intensive and this has delayed

graduation of some postgraduate students in various universities. This is observed in various universities in Nigeria where some postgraduate students seek for extension of their program in order to achieve their research activities purposes. Oredein (2012) and Duze (2013) highlighted the lack of research skills among students and the lack of research equipment as some of the issues surrounding the timely graduation of postgraduate students in Nigeria. This situation is usually disturbing because some of the students may end up abandoning the programme while others who continue with the programme may not have adequate facilities to assist in the research activities and this might hinder the research process.

In addition, there is a dearth of research on the use of generative AI tools for research activities contextualised for the Nigerian academic landscape. Consequently, this study aims to bridge this gap by investigating how the use of generative AI tools influence the research activities of postgraduate students in North-central, Nigeria.

Objectives of the Study

The following objectives guided the study.

1. find out the perceptions of postgraduate students on the use of generative AI tools for research activities in federal universities in North-Central Nigeria;
2. determine the factors hindering research activities of postgraduate students in federal universities in North-central, Nigeria.

Literature Review

Use of generative AI in academic research

Exploration of various applications

Generative AI tools, with their capacity to autonomously create content, have found diverse applications across multiple facets of academic research. One prominent area is data analysis, where these tools extract patterns and insights from large datasets. For instance, generative models like Generative Adversarial Networks (GANs) have been employed to generate synthetic data that mirrors the characteristics of real-world datasets, aiding in research scenarios where access to extensive, accurate data is limited (Goodfellow et al., 2014). This application extends beyond traditional statistical methods, providing researchers with innovative approaches to analyse and interpret complex datasets. In natural language processing (NLP), generative AI tools have revolutionised language understanding and content generation. Models like OpenAI's GPT-3 have demonstrated the ability to generate coherent and contextually relevant text based on prompts or queries. Researchers leverage these capabilities for tasks such as automatic summarization, language translation, and even creating human-like text, streamlining literature reviews and content creation processes (Brown et al., 2020). The impact of generative AI in NLP is evident in its potential to enhance language-related research methodologies, offering new avenues for linguistic analysis and understanding.

Furthermore, generative AI application extends to image generation, where models like Deep Convolutional Generative Adversarial Networks (DCGANs) have shown remarkable proficiency. These tools enable the creation of realistic images that align with specific criteria, facilitating research in computer vision, art generation, and content synthesis (Radford et al., 2015). The ability to generate visual content has implications for fields such as design, architecture, and medical imaging, where researchers can benefit from generating synthetic visual data for experimentation and analysis.

Discussion on Impact on Data Analysis, NLP, and Image Generation

The impact of generative AI tools on data analysis is profound, allowing researchers to uncover hidden patterns and trends within large datasets. GANs, for example, have been utilised to generate synthetic medical images for training machine learning models in diagnostic procedures, overcoming challenges related to limited real-

world medical data (Wolterink et al., 2017). This application enhances the robustness of machine learning models, ensuring better generalisation to real-world scenarios. In NLP, generative AI tools have streamlined research processes by automating tasks that traditionally demanded significant manual effort. GPT-3, with its language generation capabilities, has been employed in content creation, automatic summarization, and even conversational agent development. Researchers can leverage these tools to expedite literature reviews, generate coherent summaries of research articles, and explore the nuances of language use in various contexts (Brown et al., 2020).

The impact of generative AI in image generation is evident in the creation of realistic visual content. DCGANs, for instance, have been utilised in art and design, where generating novel and aesthetically pleasing images is a valuable asset. Additionally, in medical imaging, generative models assist in generating synthetic images to augment limited datasets, facilitating the training of more robust diagnostic models (Shin et al., 2018). The widespread adoption of generative AI tools in data analysis, NLP, and image generation reflects their transformative potential in academic research. Researchers are now equipped with powerful tools that enhance the efficiency of existing processes and open new avenues for exploration and discovery.

Challenges in AI Education

1. **Limited Resources and Infrastructure Constraints**

A prominent challenge in advancing AI education in Africa is the limitation of resources and infrastructure constraints. Recent studies indicate that many educational institutions face difficulties acquiring state-of-the-art hardware, software, and computing resources necessary for effective AI education (Ayodele et al., 2021). Insufficient funding and budgetary constraints further exacerbate the challenge, hindering the development of AI labs and research facilities.

Addressing this challenge requires strategic interventions, including increased investment in educational infrastructure, collaboration with industry partners for resource sharing, and seeking international partnerships to access shared resources. A study by Ngwenya and Pym (2021) emphasises the importance of collaborations with external entities, such as AI research laboratories, to bridge the resource gap and create a conducive environment for AI education.

2. Digital Divide and Accessibility Issues

The digital divide poses a significant hurdle to AI education in Africa. Unequal access to technology and the Internet among students and educational institutions exacerbates disparities in learning opportunities. Recent research highlights how students from rural areas or economically disadvantaged backgrounds may lack access to the digital tools and online resources essential for effective AI education (African Union, 2019).

To tackle this challenge, initiatives such as providing subsidised or free access to digital resources, implementing e-learning programs tailored to low-bandwidth environments, and establishing community-based learning centres have been proposed (Ngwenya & Pym, 2021). Bridging the digital divide is crucial for equitable access to AI education and aligns with broader goals of fostering inclusivity and reducing socio-economic disparities.

3. Shortage of Qualified Instructors and Capacity Building

A shortage of qualified instructors proficient in AI poses a considerable challenge to African educational institutions. Recent studies highlight the need for skilled educators who can teach theoretical concepts and guide students in practical applications of AI technologies (Ayodele et al., 2021). The fast-evolving nature of AI necessitates continuous capacity building for instructors to stay abreast of the latest developments.

To address this challenge, opportunities for professional development, workshops, and collaborative programs with AI experts from industry and research institutions are essential. Establishing partnerships with international

universities and organisations can facilitate knowledge exchange and capacity-building initiatives, ensuring instructors are equipped to deliver high-quality AI education (Ngwenya & Pym, 2021).

Methodology

Descriptive survey research design was adopted for the study. The descriptive survey research design is considered appropriate because it is an efficient way of gathering data to assist in handling research questions. It is also a valuable tool for evaluating or assessing opinions. Hess *et al.* (2022) defined survey research as collecting data to gain insight on a specific topic. The population of the study was 113,841. This consisted of postgraduate students in federal universities in North-central, Nigeria. The sample size of the population was 294. This sample size of the study was 373. This was obtained by subjecting the target population of 13,841 to Krejcie and Morgan's 1970 recommended table for determining the sample size of a population. Questionnaire was the instrument used for data collection. Descriptive statistics of mean scores and standard deviation (STD) was used to analyse the research questions.

Results and Discussion

Table 1: Perceptions of Postgraduate Students on the Use of Generative AI Tools for Research Activities

S/N	Statements	SA	A	D	SD	n	FX	$\bar{x}$	STD	Decision
1	**Performance Expectancy**									
	I believe that using generative AI tools can significantly improve the quality and efficiency of research activities	113	122	61	21	317	961	3.03	0.53	Agreed
	The use of generative AI tools adds significant value to research activities	112	123	48	34	317	947	2.98	0.48	Agreed
	Using generative AI tools helps complete research tasks faster	94	107	82	34	317	895	2.82	0.32	Agreed
	Generative AI tools provide me with valuable insights that improve my research analysis.	101	117	56	43	317	910	2.87	0.37	Agreed
	The use of generative AI tools increases my productivity in conducting research	100	119	72	26	317	927	2.92	0.42	Agreed
2	**Effort Expectancy**									
	Generative AI tools easy to integrate into my research processes	112	122	61	22	317	958	3.02	0.52	Agreed
	A lot of learnings is not needed to use generative AI tools for my research activities	71	86	113	47	317	729	2.29	0.20	Disagreed
	Generative AI tools are accessible and available for use in research environments	102	124	46	45	317	917	2.89	0.39	Agreed
	Using generative AI tools does not require a significant amount of effort	82	95	73	67	317	826	2.61	0.11	Disagreed
	I am confident in my ability to effectively use generative AI tools for my research	91	103	84	39	317	880	2.78	0.28	Agreed
3	**Reliability**									
	Outputs by generative AI tools for use in researches are not trusted.	43	58	116	100	317	678	2.14	0.36	Disagreed
	Generative AI tools are reliable in assisting me with various stages of my research	95	108	59	55	317	877	2.76	0.26	Agreed
	Generative AI tools are dependable in supporting my research needs without failure.	100	102	67	48	317	888	2.80	0.30	Agreed
	Generative AI tools are not dependable in supporting my research needs without failure.	61	71	87	98	317	729	2.29	0.20	Disagreed
4	**Ethical Concerns**									
	The use of generative AI will affect the critical thinking skills of postgraduate students	108	100	66	43	317	907	2.86	0.36	Agreed
	Generative AI tools may plagiarise articles by other authors	44	49	132	92	317	679	2.14	0.35	Disagreed
	There may be potential biases in the outputs generated by generative AI tools.	69	82	106	60	317	794	2.51	0.01	Disagreed
	Generative AI tools can be used for research misinformation	56	78	113	70	317	754	2.38	0.12	Disagreed
	There would be over-reliance on generative AI tools for research activities	93	103	73	48	317	875	2.76	0.26	Agreed
	Data privacy and security are concerns when using generative AI tools for research.	87	109	79	42	317	875	2.76	0.26	Agreed
	Weighted mean							2.68		

SA= Strongly Agreed, A= Agreed, Disagreed= D, SD= Strongly Disagreed, n = Number of Retrieved Copies of Questionnaire, $\bar{X}$=Mean and (Benchmark mean = 2.68)

Table 1 showed the perceptions of postgraduate students on the use of generative AI tools for research activities. Out of the twenty items listed, thirteen items produced high mean scores which were above the weighted mean of 2.68. Based on performance expectancy, all the items produced high mean scores with the highest mean on item 1: I believe that using generative AI tools can significantly improve the quality and efficiency of research activities ($\bar{x}$=3.03; SD=0.53) and the lowest mean item 3: Using generative AI tools helps complete research tasks faster ($\bar{x}$=2.82; SD=0.32). Based on effort expectancy, three items produced high mean scores which were: Generative AI tools easy to integrate into my research processes ($\bar{x}$=3.02; SD=0.52), Generative AI tools are accessible and available for use in research environments ($\bar{x}$=2.89; SD=0.39) and I am confident in my ability to effectively use generative AI tools for my research ($\bar{x}$=2.78; SD=0.28), while two items produced low mean score which are: Using generative AI tools does not require a significant amount of effort ($\bar{x}$=2.61; SD=0.11) and A lot of learnings is not needed to use generative AI tools for my research activities ($\bar{x}$=2.29; SD=0.20). Based on reliability, two items produced high mean scores which are: Generative AI tools are dependable in supporting my research needs without failure ($\bar{x}$=2.80; SD=0.30) and Generative AI tools are reliable in assisting me with various stages of my research ($\bar{x}$=2.76; SD=0.26), while two other items produced low mean scores which are: Generative AI tools are not dependable in supporting my research needs without failure ($\bar{x}$=2.29; SD=0.20) and Outputs by generative AI tools for use in researches are not trusted ($\bar{x}$=2.14; SD=0.36). Similarly, based on ethical concerns, three items produced high mean scores which are: The use of generative AI will affect the critical thinking skills of postgraduate students ($\bar{x}$=2.86; SD=0.36), There would be over-reliance on generative AI tools for research activities ($\bar{x}$=2.76; SD=0.26) and Data privacy and security are concerns when using generative AI tools for research ($\bar{x}$=2.76; SD=0.26), while three other items produced low mean scores which are: There may be potential biases in the outputs generated by generative AI tools ($\bar{x}$=2.51; SD=0.01), Generative AI tools can be used for research misinformation ($\bar{x}$=2.38; SD=0.12) and Generative AI tools may plagiarise articles by other authors ($\bar{x}$=2.14; SD=0.35).

Table 2: Factors that Hinder the Research Activities of Postgraduate Students

S/N	Statements	SA	A	D	SD	n	FX	$\bar{x}$	STD	Decision
		4	3	2	1	317				
1	Due to university IT restrictions, I have difficulty accessing generative AI tools for research	51	84	153	29	317	791	2.49	0.04	Disagreed
2	Inadequate funds to pay for quality features on the AI tools	117	130	38	32	317	966	3.05	0.55	Agreed
3	I face technical issues integrating generative AI tools with university databases and systems	107	112	72	26	317	934	2.94	0.44	Agreed
4	Inadequate prompting skills to get my desired results	37	75	109	96	317	687	2.17	0.33	Disagreed
5	The use of generative AI tools requires using lots of data	98	115	75	29	317	916	2.89	0.39	Agreed
6	I require additional training to use generative AI tools effectively in my research	97	105	64	51	317	882	2.78	0.28	Agreed
7	I find it challenging to prepare data for use with generative AI tools	95	101	67	54	317	871	2.75	0.25	Disagreed
8	I often have to double-check the findings produced by AI tools for accuracy	102	112	52	51	317	899	2.84	0.34	Agreed
9	I find it challenging to ensure data privacy when using AI tools	108	134	41	34	317	950	2.99	0.49	Agreed
10	The use of AI tools in research raises ethical concerns for me	101	137	44	35	317	938	2.96	0.45	Agreed
	Weighted mean							2.78		

SA= Strongly Agreed, A= Agreed, Disagreed= D, SD= Strongly Disagreed, n = Number of Retrieved Copies of Questionnaire, $\bar{X}$=Mean and (Benchmark mean = 2.78)

Table 2 showed the factors that hinder the research activities of postgraduate students. Out of the ten items listed, seven items produced high mean scores which were above the weighted mean of 2.78. These items include item 2: Inadequate funds to pay for quality features on the AI tools ($\bar{x}$=3.05; SD=0.55), item 9: I find it challenging to ensure data privacy when using AI tools ($\bar{x}$=2.99; SD=0.49), 10: The use of AI tools in research raises ethical concerns for me ($\bar{x}$=2.96; SD=0.46), item 3: I face technical issues integrating generative AI tools with university databases and systems ($\bar{x}$=2.94; SD=0.44), item 5: The use of generative AI tools requires using lots of data ($\bar{x}$=2.89; SD=0.39), item 8: I often have to double-check the findings produced by AI tools for accuracy ($\bar{x}$=2.84; SD=0.34) and item 6: I require additional training to use generative AI tools effectively in my research ($\bar{x}$=2.78; SD=0.28). On the other hand, three items produced low mean scores which were below the weighted mean of 2.78. These items include item 7: I find it challenging to prepare data for use with generative AI tools ($\bar{x}$=2.75; SD=0.25), item 1: Due to university IT restrictions, I have difficulty accessing generative AI tools for research ($\bar{x}$=2.49; SD=0.04) and item 4: Inadequate prompting skills to get my desired results ($\bar{x}$=2.17; SD=0.33). These items with mean scores above the weighted mean of 2.78 indicated the factors that hinder the research activities of postgraduate students.

Discussions

As regards to research question 1, postgraduate students perceptions on the use of generative AI tools for research activities is high. Based on performance expectancy, postgraduate students believed that using generative AI tools can significantly improve the quality, efficiency and value of their research activities, complete research tasks faster, improve research analysis and productivity in conducting research. Based on effort expectancy, the postgraduate students indicated that generative AI tools is easy to integrate for their research processes, available and accessible for use in research environments and they have the confidence to use AI tools effectively for their research. Based on reliability, postgraduate students agreed that AI tools are reliable in assisting them with various stages of their research and supporting their research needs without failure. This is in line with the findings of Van Dis *et al.* (2023) who argued that artificial intelligence (AI) plays a crucial role in assisting postgraduate students, especially master's students and doctoral candidates, in expediting their research processes and facilitating the retrieval of accurate information from previous studies for their research endeavours.

However, most of the postgraduate students disagreed that generative AI tools are not dependable in supporting their research needs without failure, may also plagiarise articles by other authors and the outputs by generative AI tools for use in researches are not trusted. The postgraduate students have ethical concerns on the use of AI tools which include affecting critical thinking skills, over-reliance on generative AI tools for research activities and data privacy and security concerns. The use of AI tools among postgraduate students can be hazardous especially on their academic activities due to over-reliance or dependent on AI for everything. This would affect their critical thinking skills. This is in contrast with the findings of Zhai (2022) who posited that AI tools are pivotal in improving students' critical thinking and problem-solving skills.

In line with the findings of research question 2, the study equally revealed that the respondents agreed with all the factors that hinder the research activities of postgraduate students which include inadequate funds to pay for quality features, technical issues integrating generative AI tools with university databases and systems, data privacy and ethical concerns when using AI tools with the exceptions of item 1, 4 and 7 as seen in Table 4.11. This is in line with the findings of Ayodele *et al*. (2021) who emphasized that limited access to computing resources, financial constraints, and a shortage of qualified instructors are among the hurdles that need to be addressed. Adequate funding, investments in infrastructure, and strategic partnerships with international institutions are essential to overcoming these challenges.

Conclusion

The study concludes that generative AI tools have the potential to enhance research activities among postgraduate students. However, factors such as inadequate funds to pay for quality features, technical issues integrating generative AI tools with university databases and systems, data privacy and ethical concerns when using AI tools were seen as challenges hindering the research activities of postgraduate students.

Recommendations

1. The management of federal universities in North-central Nigeria should educate postgraduate students about the misuse of AI-generated content, research misinformation, potential biases in the outputs generated by generative AI and data privacy concerns. Promoting critical thinking and awareness among postgraduate students will help them navigate the ethical challenges associated with AI technology.
2. The management of federal universities in North-central Nigeria should ensure the provision of adequate fund necessary for the acquisition of AI tools and organise training sessions for postgraduate students on how to use Generative AI tools effectively in accessing information for their research.

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