

The Extent of Artificial Intelligence Utilisation and its Impact on Undergraduate Students' Cognitive Engagement in Kwara State

*Ebenezer Sanya Ibiroke, PhD.,¹ Akinmide Christopher Olawale, PhD.,²
Oluwatimilehin Esther Ogunlokun,³ & Olufemi Onweazu Okoji, PhD.⁴*

¹Department of Educational Technology, University of Ilorin, Nigeria.

Corresponding author, Email: ibisanya2@unilorin.edu.ng

²Department of Science and Technology Education, University of Ibadan, Nigeria.

Email: ac.olawale@ui.edu.ng

³Department of Educational Technology, University of Ilorin, Nigeria, Email: ogunlokuntimileyin@gmail.com

⁴ Department of Adult and Primary Education, University of Ilorin, Nigeria.

Email: okoji.oo@unilorin.edu.ng

Abstract:

This study assessed the extent of Artificial Intelligence (AI) utilization for cognitive engagement, examined the impact of AI utilization, and explored its effects based on gender and institutional affiliation. A stratified random sampling technique was employed to select 150 respondents for the study. A validated researcher-designed questionnaire constructed on a 4-point scale was used to elicit responses from the participants. The reliability coefficient obtained from the calculated Cronbach's Alpha was approximately 0.974. The data collected from respondents were analysed using frequency counts, percentages, means, and t-tests, with hypotheses tested at a 0.05 significance level, and the results showed that: the extent of utilization of Artificial Intelligence on undergraduates' cognitive engagement in Kwara State was high (2.94 > benchmark of 2.50), the impacts of Artificial Intelligence usage on cognitive engagement of students in higher education were considerably high, thus it enhanced their cognitive engagement in learning activities (2.66 > 2.50), there was significant difference in the utilization of Artificial Intelligence by the undergraduates in Kwara State based on their gender. ($t = -2.730$; $p < 0.05$), and there was a significant difference in the utilization of Artificial Intelligence by undergraduates in Kwara State based on their institutional affiliation. ($t = 3.761$; $p < 0.05$). Based on the findings, it was recommended that educational institutions should invest in AI training programs for students and faculty, organize workshops, implement regular assessments, and gather student feedback to improve cognitive engagement among undergraduates.

Keywords: Artificial Intelligence, Extent of Utilization, Impact, Undergraduates' Cognitive Engagement.

DOI: <https://doi.org/10.5281/zenodo.19919476>

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).



1. INTRODUCTION

Technology has transformed education by offering new tools to enhance teaching and learning. Artificial Intelligence (AI) is critical in this area. With AI, computer systems can do tasks needing human intelligence, like reasoning, learning, and making decisions. They can analyse data, detect patterns, and understand language. AI includes programs like machine learning and neural networks, which help systems improve over time (NASA, 2024; Britannica, 2024). Cognitive engagement is the mental effort students show when they interact with learning materials. It includes emotional, behavioural, and intellectual involvement. In AI education, cognitive engagement matters because it affects how well students learn. Studies show that AI tools, especially generative AI (GAI), can boost cognitive engagement by offering personalized learning tailored to each student (Bian *et al.*, 2023). These tailored interactions promote deeper thinking, creating a more engaging learning space.

Moreover, cognitive engagement in education refers to the mental effort students invest in learning, encompassing both active participation and the emotional and motivational aspects driving deep content interaction. AI tools enhance cognitive engagement by offering personalized learning, real-time feedback, and interactive content, fostering critical thinking and understanding (Google Cloud, 2024; McKinsey & Company, 2024). As AI becomes more integrated into education, understanding its impact on cognitive engagement is vital for adapting to individual learning needs and improving academic outcomes (Coursera, 2024; Azure Microsoft, 2024). Cognitive engagement encompasses affective, behavioural, and intellectual involvement in AI interactions. Affective engagement reflects users' emotional responses, indicating enjoyment and care in their interaction with AI, leading to positive emotions. Behavioural engagement involves observable user actions, such as effort and persistence, reflecting a commitment to using AI. Cognitive engagement refers to users' intellectual absorption, where they critically evaluate AI outputs, integrate them with prior knowledge, and may reject contradictory information, crucial for learning and decision-making.

The integration of AI in education impacts students' emotional states and learning outcomes, offering both benefits and challenges. AI enhances learning experiences by providing personalized support and improving academic performance, and emotional well-being. AI systems adapt to individual learning styles, offering tailored resources that foster engagement and motivation (Sethi, 2024). These systems stimulate interest and curiosity, encouraging discovery and innovation in students' studies. AI also boosts efficiency in assignments and time management, providing immediate feedback to address understanding gaps. In addition, AI can automate routine cognitive tasks, enabling individuals to concentrate on more complex problem-solving, which increases productivity in professional settings (Chowdhury *et al.*, 2020). Additionally, machine learning, a subset of AI, enhances cognitive absorption by continuously improving its performance through adaptation to new data, offering users relevant insights and predictions (Aiplusinfo, 2023). Furthermore, AI is transforming higher education by

enhancing student cognitive engagement through tailored learning experiences, real-time feedback, and interactive opportunities. Studies show that students using AI tools experience increased self-efficacy, which boosts their cognitive involvement (Bian *et al.*, 2023).

However, over-reliance on AI tools may hinder the development of critical thinking and problem-solving skills (Shahzad *et al.*, 2024). In social-emotional learning (SEL), AI provides real-time feedback on students' emotions through sentiment analysis tools. Educators can create adaptive, engaging learning environments using AI, leveraging interactive methods and gamification to stimulate cognitive engagement (Digital Promise, 2024). The AI-ICE Framework evaluates cognitive engagement with AI, emphasizing the cognitive processes during AI interactions, which stimulate critical thinking, creativity, and problem-solving (Bansal, 2024). This integration requires careful implementation to balance benefits with potential drawbacks, prioritizing student well-being (Sethi, 2024). AI's limitations on cognitive engagement stem from over-reliance, cognitive atrophy, and issues with memory and attention. Heavy dependence on AI can undermine critical thinking and problem-solving abilities (Rudin, 2019; Sparrow *et al.*, 2011). Excessive use of AI for cognitive tasks may result in cognitive atrophy, such as weakened mathematical skills from relying on AI for calculations (Wei & Li, 2022). Furthermore, reliance on AI for memory tasks can impair memory capacity by weakening neural pathways involved in memory encoding and retrieval (PMC, 2024). Additionally, the instant gratification provided by AI tools can shorten attention spans and hinder deep focus and critical analysis (Dong *et al.*, 2013).

The influence of gender on the use of artificial intelligence (AI) is shaped by disparities in access, usage, and inherent biases in AI systems. The study of BIS (2024) revealed a "gen AI gender gap," with 50% of men using generative AI tools compared to 37% of women, largely due to differences in attitudes towards privacy, trust, and perceived risks. Self-assessed knowledge of AI accounted for almost three-quarters of this disparity. Additionally, societal gender biases influence AI development, with systems often reflecting stereotypes, such as voice assistants typically having female personas (UN Women, 2024). Addressing these disparities is crucial for a more inclusive technological future. Furthermore, in universities, AI is mainly used for instructional tasks like monitoring student behaviour and plagiarism detection, with limited application in institutional issues such as curriculum planning or admissions (EDUCAUSE, 2021). The variation in AI adoption across institutions highlights the need for further research into the factors influencing AI implementation.

In Kwara State, Nigeria, the integration of AI in higher education is on the rise, though its effects on cognitive engagement need further exploration. Research highlights AI's potential to improve learning outcomes, motivation, and problem-solving skills (Denton & Maatgi, 2016; Khaskhelly *et al.*, 2023). However, disparities in AI use based on gender and institutional affiliation suggest uneven benefits (Papamitsiou & Economides, 2014). This study aimed to assess AI's impact on undergraduate cognitive

engagement in Kwara State, providing insights to optimize its use and address inequalities.

Research objectives

The study focused on the impact of Artificial Intelligence on the undergraduate's cognitive engagement in Kwara State. Specifically, the study:

- i. assessed the extent of utilization of Artificial Intelligence by undergraduates for cognitive engagement in Kwara State
- ii. examined the impact of utilization of Artificial Intelligence on the undergraduate cognitive engagement in Kwara State.
- (iii) investigated the extent of Artificial Intelligence utilization on undergraduate cognitive engagement in Kwara State based on gender.
- (iv) examined the extent of Artificial Intelligence utilization on undergraduate cognitive engagement in Kwara State based on institutional ownership.

Research questions

1. What is the extent of utilization of Artificial Intelligence by undergraduates for cognitive engagement in Kwara State?
2. What is the impact of utilization of Artificial Intelligence on undergraduate cognitive engagement in Kwara State?
3. Is there a significant difference in the extent of utilization of Artificial Intelligence by undergraduates for cognitive engagement in Kwara State based on gender?
4. Is there a significant difference in the extent of utilization of Artificial Intelligence by undergraduates for cognitive engagement in Kwara State based on institutional affiliation?

Research hypothesis

Ho1: There is no significant difference in the extent of utilization of Artificial Intelligence by the

undergraduates in Kwara State based on their gender

Ho2: There is no significant difference in the extent of utilization of Artificial Intelligence by the

undergraduates in Kwara State based on their institutional affiliation

2. LITERATURE REVIEW

AI in higher education enhances personalized learning, cognitive engagement, and academic support through adaptive learning platforms, intelligent tutoring systems, and virtual assistants. It also improves administrative efficiency and helps identify at-risk students for targeted support, leading to higher academic performance, engagement, and retention (Long *et al.*, 2025; California Miramar University, 2025; University of Florida, 2025; San Diego University, 2024; Naseer, 2024; Liaison, 2024).

Cognitive engagement refers to the level of mental effort students invest in understanding academic content and mastering complex ideas. It involves higher-order thinking processes such as critical thinking, analysis, reflection, and problem solving. Students with high cognitive engagement tend to adopt deep learning strategies rather than relying on surface memorization, which contributes to meaningful learning outcomes and academic success. Digital technologies, including AI-powered learning platforms, can enhance cognitive engagement by offering interactive and adaptive learning experiences (Long *et al.*, 2025).

The extent of utilization of AI by students and researchers across the globe is remarkably widespread. Artificial intelligence (AI) tools are widely used by students and researchers to simplify complex topics, enhance learning, and improve productivity. AI-powered platforms and summarization tools help condense large amounts of information, support literature reviews, and facilitate faster data analysis. These technologies also assist researchers in identifying patterns and trends, thereby improving research efficiency and accuracy (Easyaibeginner, 2024; Editpad, 2025; Notta, 2024; Semrush, 2025; Research to Action, 2024; Verma *et al.*, 2021; Zhao *et al.*, 2020).

Empirical studies indicate that artificial intelligence (AI) positively influences student engagement and learning in higher education. AI tools enhance academic participation, classroom interaction, personalized learning, and research efficiency, thereby improving motivation and academic outcomes. However, studies also caution that excessive reliance on AI may weaken students' critical thinking if not properly guided (Ezeoguine & Eteng-Uket, 2024; Kehinde-Awoyele *et al.*, 2024; Mojolou *et al.*, 2025; Pang & Wei, 2025; Long *et al.*, 2025).

According to Constructivist Learning Theory, meaningful learning occurs when students actively engage with information and connect new knowledge to existing cognitive structures. In technology-supported environments, AI tools can facilitate this process by providing interactive learning experiences, adaptive feedback, and personalized learning pathways that promote active knowledge construction. Furthermore, the Technology Acceptance Model explains that technology adoption is influenced by perceived usefulness and perceived ease of use. In higher education, students are more likely to adopt AI technologies when they find them beneficial for academic tasks and easy to use, while additional factors such as emotional engagement, self-efficacy, and institutional support can further influence their adoption (Liu *et al.*, 2025). This theory is therefore relevant for understanding how undergraduate students in Kwara State adopt and utilize AI technologies for academic purposes.

In summary, AI technologies enhance student engagement and academic performance by providing personalized learning, instant feedback, and interactive learning opportunities. However, excessive reliance on AI may reduce independent thinking, creativity, and critical reasoning skills (Pang & Wei, 2025; Kehinde-Awoyele *et al.*, 2024; Mojolou *et al.*, 2025).

3. METHODOLOGY

This study adopted a descriptive survey research design to obtain information on the impact of artificial intelligence (AI) on cognitive engagement among undergraduates on the following variables; impact of utilization of Artificial Intelligence on undergraduate cognitive engagement, and extent of utilization of Artificial Intelligence by undergraduates for cognitive engagement. The study was carried out in Kwara State. The population consisted of undergraduate students enrolled in various institutions of higher learning in Kwara State. A stratified random sampling technique was used to ensure representation across different universities and faculties. A sample size of 150 undergraduate students was used for the study. Data were collected using a structured questionnaire designed to assess demographic information (of gender, and institutional affiliation), the extent of utilization of AI, and its impact on undergraduates' cognitive engagement. Four-point scale pattern of; Regularly (RG), Often (O), Rarely (R) and Not at all (NA) was used for extent of utilization of AI, while Strongly Agree (SA), Agree (A), Strongly Disagree (SD) and Disagree (D) was used for impact of AI on undergraduates' cognitive engagement. The instrument was validated by educational technology experts. The suggestions of these experts were incorporated in the questionnaire and this helped to ensure face, content and construct validity. The reliability coefficient obtained from the calculated Cronbach's Alpha was approximately 0.974, indicating a very high level of internal consistency among the items. The respondents' data were subjected to both descriptive and inferential statistics analysis. Frequency count, percentage, and mean were used to answer the research questions while a t-test was used to test the hypotheses at a 0.05 significance level, using SPSS version 24.0.

4. DATA ANALYSIS AND RESULTS

Data collected based on the research questions were analysed using descriptive statistics (mean and standard deviation). The limit for decision rule: An average mean of 2.50 and above was considered as agreed, while an average mean of 2.49 and below were considered disagreed with respect to research questions. A mean of 2.5 was used as a criterion to judge mean scores for four-point item format. Therefore, the mean criterion of 2.5 was calculated from the sum of 4+3+2+1 divided by 4.

Demographic Information of Respondents

Table 1: *Distribution of Students by Gender*

Gender	Frequency	Percentage
Male	57	38.0
Female	93	62.0
Total	150	100.0

Table 1 shows that out of the 150 students' participants, 57(38%) were male while the remaining 93(62%) were female. The result from this table implies that the female participants were more than the male ones in this study. Figure 1 below further presents the result from the table in bar chart.

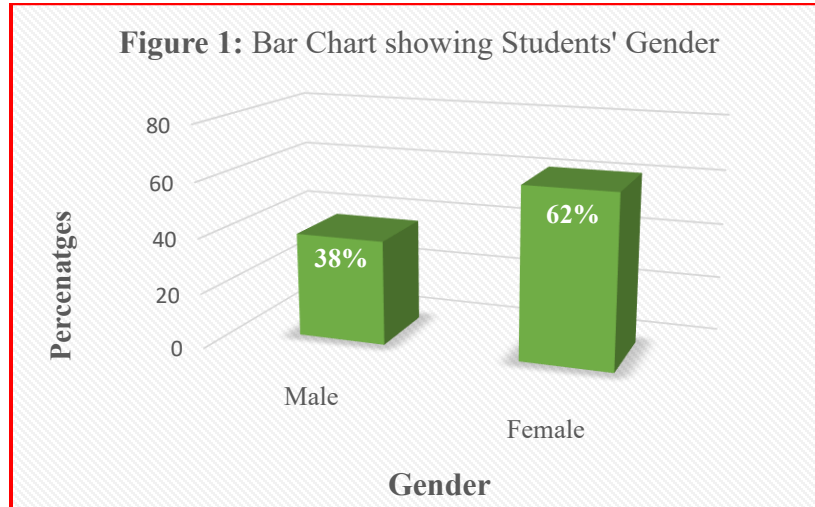
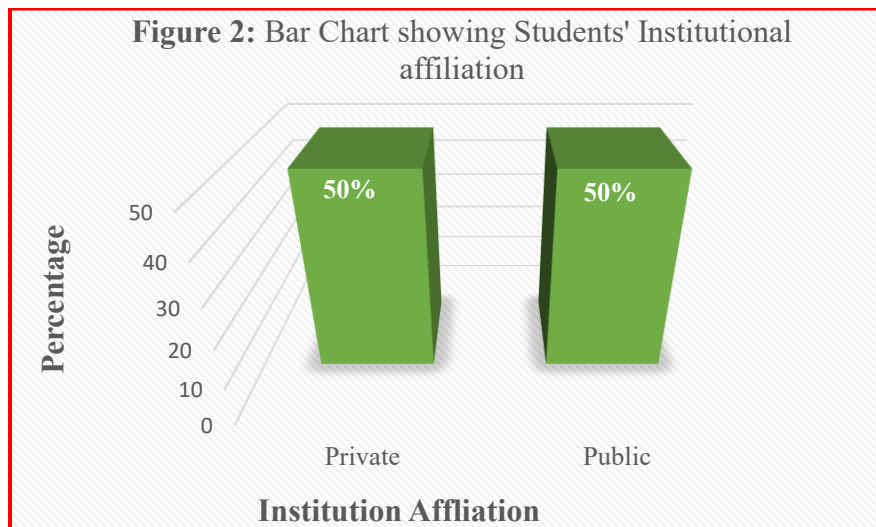


Table 2: Distribution of the Students by Institution affiliation

Institution Ownership	Frequency	Percentage
Private	75	50.0
Public	75	50.0
Total	150	100.0

Table 2 shows the distribution of the students by institution affiliation. The table shows that 75(50%) of the students selected from private institutions and another 75(50%) are selected from public institutions. Figure 2 below further presents the result from the table in bar chart.



4.1 Answers to research questions

Research question1: What is extent of utilization of Artificial Intelligence on undergraduates' cognitive engagement in Kwara State?

Table 3: *Extent of Utilization of Artificial Intelligence by Undergraduates in Kwara State*

Item	NA	R	O	RG	Mea n	Std. D
I use Artificial Intelligence-based resources (e.g., educational apps, online platforms) to support my learning.	0	14	50	86	3.48	.66
I use artificial intelligence tools to break down complex topics.	2	16	40	92	3.48	.74
I summarize paragraphs using Artificial Intelligence tools.	13	44	37	56	2.91	1.01
I research using artificial intelligence.	3	17	51	79	3.37	.76
I use artificial intelligence to develop course contents.	18	35	46	51	2.87	1.02
I paraphrase using artificial intelligence.	16	27	44	63	3.03	1.02
I use artificial intelligence to develop course objectives.	23	35	47	45	2.76	1.05
I use artificial intelligence to create schedules.	42	41	32	35	2.40	1.13
I use artificial intelligence to learn new languages.	46	32	33	39	2.43	1.18
I use artificial intelligence to create developmental skills	31	37	35	47	2.65	1.13
Grand Mean					2.94	

Key; NA = Not at all, R= Rarely, O = Often, RG = Regularly

Table 3 highlights the utilization of Artificial Intelligence (AI) in undergraduates' cognitive engagement. The students reported using AI-based resources like educational apps and online platforms to support learning ($\bar{x} = 3.48$), to break down complex topics ($\bar{x} = 3.48$), and to summarize paragraphs ($\bar{x} = 3.48$). They also reported using AI for research ($\bar{x} = 3.37$), paraphrasing ($\bar{x} = 3.03$), and course content development ($\bar{x} = 2.87$). However, they showed less engagement in using AI for creating course objectives ($\bar{x} = 2.76$), developing skills ($\bar{x} = 2.65$), creating schedules ($\bar{x} = 2.40$), and learning new languages ($\bar{x} = 2.43$). The overall weighted average score of 2.94 out of 4.00 suggests that the extent of AI utilization in undergraduates' cognitive engagement in Kwara State is high.

Research question2: What are the impacts of Artificial Intelligence on the cognitive engagement of students in higher education?

Table 4: *Impacts of Artificial Intelligence on the Cognitive Engagement of Students*

Item	SA	A	D	SD	Mea n	Std. D	Remark
The use of Artificial Intelligence enhances my cognitive engagement in learning activities	15	3	92	40	3.05	.83	Accepted
Artificial Intelligence tools help me understand complex concepts better	14	3	73	60	3.19	.87	Accepted
I feel more motivated to engage in learning tasks when utilizing Artificial Intelligence	12	15	90	33	2.96	.80	Accepted
Artificial Intelligence based learning experiences stimulate my curiosity and interest in the subject matter	13	13	87	37	2.99	.83	Accepted
The use of Artificial Intelligence encourages me to explore and discover new ways of learning	10	10	81	49	3.13	.81	Accepted
Integrating Artificial Intelligence into my studies has improved my efficiency in completing task	11	3	85	51	3.17	.79	Accepted
The feedback and support provided by Artificial intelligence powered systems enhance my learning experience	8	7	96	39	3.11	.72	Accepted
Artificial intelligence has improved my problem-solving abilities	9	16	84	41	3.05	.79	Accepted
Artificial intelligence has helped me to manage time more effectively	6	21	75	48	3.10	.78	Accepted
Artificial intelligence has hindered my critical thinking	36	57	48	9	2.2 0	.88	Not Accepted
Artificial Intelligence has reduced my cognitive engagement with course materials	38	65	37	10	2.13	.87	Not Accepted
I believe Artificial Intelligence is a distraction and negatively affects my cognitive engagement.	46	70	26	8	1.97	.84	Not Accepted
Artificial Intelligence has decreased my interest and enthusiasm for learning	53	68	23	6	1.88	.81	Not Accepted

Artificial Intelligence powered tools have negatively impacted my ability to develop original ideas	46	64	34	6	2.00	.84	Not Accepted
I rely on Artificial intelligence generated summaries instead of reading course materials	45	68	23	14	2.04	.91	Not Accepted
Average Mean						2.66	

Key; *SD* = Strongly Disagree, D = Disagree, A= Agree, SA = Strongly Agree

Table 4 presents the effects of Artificial Intelligence (AI) on students' cognitive engagement in higher education. The data reveals general agreement among students on the positive impact of AI in several areas, with average scores ranging from 2.96 to 3.19. These areas include enhanced cognitive engagement in learning, better understanding of complex concepts, increased motivation, stimulation of curiosity and interest, encouragement to explore new learning methods, improved efficiency in task completion, better feedback and support, enhanced problem-solving abilities, and more effective time management. However, students disagreed with several negative aspects of AI's impact, with average scores ranging from 1.88 to 2.20. They believed AI had not hindered critical thinking, reduced cognitive engagement, or acted as a distraction. They also felt AI did not decrease their enthusiasm for learning, negatively impact originality, or lead to over-reliance on AI-generated summaries. Overall, AI appears to have a positive influence on students' cognitive engagement in learning activities, improving their understanding, motivation, curiosity, efficiency, and problem-solving skills

4.3 Hypothesis testing

Ho₁: There is no significant difference in the extent of utilization of Artificial Intelligence by the undergraduates in Kwara State based on their gender.

Table 5: *Summary of T-test Showing Difference in Male and Female Undergraduates' extent of Utilization of Artificial Intelligence in Kwara State*

Grouping Variable (Gender)	N	Mean	Std. D	Df	T	Sig.	Remark
Male	57	31.28	6.41	148	-	.007	Ho ₁ is rejected
Female	93	28.22	6.83		2.730		

Table 5 shows the difference in male and female undergraduates' extent of utilization of Artificial Intelligence in Kwara State. The table shows that the mean score for male undergraduates is 31.28 while that of female is 28.22. The values of the mean

scores revealed an appreciable difference. Therefore, there is significant difference in the extent of utilization of Artificial Intelligence by the undergraduates in Kwara State based on their gender ($df = 148$; $t = -2.730$; $p < 0.05$). Hence, hypothesis 1 is rejected.

Ho2: There is no significant difference in the extent of utilization of Artificial Intelligence by the undergraduates in Kwara State based on their institutional affiliation.

Table 6: *Summary of T-test Showing Difference in Private and Public Institution Undergraduates' extent of Utilization of Artificial Intelligence in Kwara State*

Grouping Variable (Institution affiliation)	N	Mean	Std. D	Df	T	Sig.	Remark
Private	75	31.39	6.09	148	3.761	.001	Ho ₂ is rejected
Public	75	27.37	6.96				

Table 6 shows the difference in private and public-institution undergraduates' extent of utilization of Artificial Intelligence in Kwara State. The table shows that the mean score for private school undergraduates is 31.39 while that of public is 27.37. The values of the mean scores revealed an appreciable difference. Therefore, there is significant difference in the extent of utilization of Artificial Intelligence by the undergraduates in Kwara State based on their institutional affiliation ($df = 148$; $t = 3.761$; $p < 0.05$). Hence, hypothesis 2 is rejected.

5. DISCUSSIONS

The integration of Artificial Intelligence (AI) into higher education has become increasingly significant, particularly among undergraduates in Kwara State, Nigeria. This discussion explores various aspects of AI utilization, its impacts on cognitive engagement, demographic differences, and institutional affiliations.

This research finding indicated that the extent of AI utilization among undergraduates in Kwara State is notably high, in line with the studies of Research to Action 2024), Verma *et al.*, (2021), and Zhao *et al.* (2020). This may be attributed to the increasing awareness and access to digital technologies, which facilitate the exploration of AI tools for learning purposes. Students are increasingly leveraging AI for various academic tasks, enhancing their engagement and participation in learning activities. Furthermore, the impacts of AI on students' cognitive engagement are profound and multifaceted. This corroborates the findings of Sethi (2024), and Chowdhury *et al.* (2020), but contrary to the findings of Sparrow *et al.* (2011), Rudin (2019), and Shahzad *et al.* (2024). Hence a balanced approach is essential to maximize the benefits of AI while preserving core cognitive skills.

In addition, the finding of gender influence on the utilization of AI on cognitive engagement revealed an appreciable difference. This is in agreement with the research of BIS (2024). Thus, for a meaningful AI utilization, gender influence must be put into consideration because gender plays a crucial role in how AI technologies are utilized in the academic context. Similarly, the extent of AI utilization also varies based on institutional affiliation, in consonance with the findings of EDUCAUSE (2021), different universities have varying levels of infrastructure, resources, and training programs related to AI. This can lead to discrepancies in how effectively students from different institutions can leverage AI for their educational needs. Institutions that prioritize technological integration into their curricula tend to see higher engagement levels among students.

5.1 Implications for Learning

This study provides valuable insights for various educational stakeholders. Educators can learn how AI technologies enhance student learning and engagement. Students stand to benefit from more engaging, personalized learning experiences, with AI tailored to their needs and learning styles. Technology developers can use the findings to improve AI tools for education, focusing on factors that enhance cognitive engagement and optimize learning outcomes. Policymakers can use the research to guide decisions on AI integration in education, informing regulations and funding initiatives for responsible implementation. Researchers can build on these findings to further advance AI in education, exploring its broader impact on teaching and learning.

6. CONCLUSION

The impact of Artificial Intelligence on students' cognitive engagement is profound. By personalizing learning experiences and enhancing self-efficacy, AI tools can significantly improve student engagement and academic performance. Despite the benefits, the implementation of AI in education comes with challenges such as data privacy concerns and the potential for overreliance on technology. A balanced approach is essential to maximize the benefits of AI while preserving core cognitive skills. As educational institutions continue to integrate these technologies, it is crucial to consider the ethical implications and ensure a balanced approach in teaching methods.

Recommendations

Based on the findings, it was recommended that educational institutions should invest in AI training programs for students and faculty, organize workshops, implement regular assessments, and gather student feedback to improve cognitive engagement among undergraduates' cognitive *engagement*. Additionally, addressing gender differences in AI usage by investigating underlying factors can promote equal participation, with initiatives designed to encourage both genders in tech fields. Collaboration should be promoted among universities to further enhance resource sharing and best practices, particularly considering variations in AI use across institutions. By focusing on these strategies, higher

education institutions in Kwara State can significantly improve the cognitive engagement of undergraduates through AI.

REFERENCES

- Azure Microsoft. (2024). What is Artificial Intelligence? Retrieved from <https://azure.microsoft.com/en-us/resources/cloud-computing-dictionary/what-is-artificial-intelligence>
- Bansal, A. (2024). Evaluating the impact of generative AI on students' learning experiences through the AI-ICE framework. *Emerald Insight*. <https://www.emerald.com/insight/content/doi/10.1108/jrit-06-2024-0151/full/html>
- Bian, Y., Zhang, Y., & Liu, X. (2023). The relationship between student interaction with generative artificial intelligence tools and learning achievement. *PMC*. Retrieved from <https://pmc.ncbi.nlm.nih.gov/articles/PMC7605294/>
- BIS. (2024). *The gen AI gender gap*. Retrieved from <https://www.bis.org/publ/work1197.htm>
- UN Women. (2024). *Artificial Intelligence and gender equality*. Retrieved from <https://www.unwomen.org/en/news-stories/explainer/2024/05/artificial-intelligence-and-gender-equality>
- Britannica. (2024). Artificial intelligence (AI). Retrieved from <https://www.britannica.com/technology/artificial-intelligence>
- California Miramar University. (2025). Applications of artificial intelligence in education. Retrieved from <https://www.calmu.edu/news/applications-of-artificial-intelligence>
- Coursera. (2024). What Is Artificial Intelligence? Definition, Uses, and Types. Retrieved from <https://www.coursera.org/articles/what-is-artificial-intelligence>
- Digital Promise. (2024). Artificial intelligence and social-emotional learning: Transforming student engagement through adaptive technologies. *Digital Promise Report*. Retrieved from <https://digitalpromise.org>
- Denton, J., & Maatgi, M. (2016). The impact of artificial intelligence on undergraduates' effectiveness in higher learning institutions. *International Journal of Research in Management & Technology*, 6(2), 1-10.
- Dong, G., Hu, Y., & Zhang, Y. (2013). Internet addiction and cognitive function: A review of the literature.

- Easyai beginner. (2024). How to use ChatGPT to break down and explain a topic. Retrieved from <https://www.easyai beginner.com/how-to-use-chatgpt-to-break-down-and-explain-a-topic/>
- Editpad. (2025). *Text Summarizer - Best AI Summarizing Tool (Free)*. Retrieved from <https://www.editpad.org/tool/text-summarizer>
- EDUCAUSE. (2021). *EDUCAUSE QuickPoll Results: Artificial Intelligence Use in Higher Education*. Retrieved from <https://er.educause.edu/articles/2021/6/educause-quickpoll-results-artificial-intelligence-use-in-higher-education>
- Ezeoguine, E. P., & Eteng-Uket, S. (2024). Artificial intelligence tools and higher education student engagement. *Edukasi: Jurnal Inovasi Pendidikan*, 3(3), 300–312. <https://doi.org/10.56916/ejip.v3i3.733>.
- Google Cloud. (2024). What Is Artificial Intelligence (AI)? Retrieved from <https://cloud.google.com/learn/what-is-artificial-intelligence>
- Kehinde-Awoyele, A. A., Adeowu, W. A., & Oladejo, B. (2024). Enhancing classroom learning: The impact of AI-based instructional strategies on student engagement and outcomes. *International Journal of Research and Innovation in Social Science*, 8(3), 5732–5742.
- Khaskhelly, A., Khamis, M., & Alshahrani, S. (2023). The application of artificial intelligence in enhancing cognitive skills among undergraduates. *Journal of Educational Technology Systems*, 52(1), 45-60.
- Liaison. (2024). Improve Student Retention Strategies in Higher Education. Retrieved from <https://www.liaisonedu.com/leveraging-ai-for-student-retention-strategies-for-undergraduate-success/>
- Liu, Y., Zhang, H., & Chen, X. (2025). Enhancing student acceptance of artificial intelligence-driven hybrid learning in business education: Interaction between self-efficacy, playfulness, emotional engagement, and university support. *International Journal of Management Education*, 23(2), 101184.
- Long, D. Y., Wang, S., Rashid, S. M., & Lu, X. T. (2025). Artificial intelligence in higher education: A systematic review of its impact on student engagement and the mediating role of teaching methods. *Frontiers in Education*, 10, 1648661.

- McKinsey & Company. (2024). What is AI (artificial intelligence)? Retrieved from <https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-ai>
- Mojolou, D. N., Madli, F., Abdullah, A. S., Thomas, H., & Nayve Jr., R. (2025). Transforming student engagement in higher education: The impact of artificial intelligence on learning involvement. *ASEAN Artificial Intelligence Journal*, 3(1), 58–65.
- NASA. (2024). What is Artificial Intelligence? Retrieved from <https://www.nasa.gov/what-is-artificial-intelligence/>
- Naseer, F. (2024). Integrating deep learning techniques for personalized education in higher education. *PMC*. Retrieved from <https://pmc.ncbi.nlm.nih.gov/articles/PMC11219980/>
- Notta. (2024). 10 Best Text Summarizers Powered by AI. Retrieved from <https://www.notta.ai/en/blog/ai-text-summarizer>
- Pang, W., & Wei, Z. (2025). Shaping the future of higher education: A technology usage study on generative AI innovations. *Information*, 16(2), 95.
- Papamitsiou, Z., & Economides, A. A. (2014). Learning analytics and educational data mining in practice: A systematic literature review. *Educational Technology & Society*, 17(4), 49-64.
- PMC. (2024). The impact of artificial intelligence reliance on human memory and cognitive processes. *Frontiers in Psychology*, 15, 1187654. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/>
- Research to Action. (2024). AI in Research: Its Uses and Limitations. Retrieved from <https://www.researchtoaction.org/2024/04/ai-in-research-its-uses-and-limitations>
- Rudin, C. (2019). Stop explaining black box machine learning models for high stakes decisions and use interpretable models instead.
- San Diego University. (2024). 39 examples of artificial intelligence in education. Retrieved from <https://onlinedegrees.sandiego.edu/artificial-intelligence-education/>

- Sedaghat, M., Khosravi, H., & Sadeghi, A. (2024). Exploring the impact of artificial intelligence application in online learning environments on student engagement and motivation. *Nature*, 24(1), 123-145. <https://doi.org/10.1038/s41599-024-04168-x>
- Semrush. (2025). *AI Text Summarizer Generate Summary for Free*. Retrieved from <https://www.semrush.com/contentshake/summary-generator/>
- Sethi, S. S. (2024). AI technologies for social emotional learning. *Journal of Research in Interactive Technology*, 10(2). <https://doi.org/10.1108/jrit-03-2024-0073>
- Shahzad, M. F., et al. (2024). Artificial intelligence and social media on academic performance and mental well-being. *PMC*. Retrieved from <https://pmc.ncbi.nlm.nih.gov/articles/PMC11043955/>
- Sparrow, B., Liu, J., & Wegner, D. M. (2011). Google effects on memory: Cognitive consequences of having information at our fingertips.
- TechTarget. (2024). What is AI? Artificial Intelligence Explained. Retrieved from <https://www.techtarget.com/searchenterpriseai/definition/AI-Artificial-Intelligence>
- UN Women Knowledge. (2024). *Artificial Intelligence and gender equality: key findings*. Retrieved from <https://knowledge.unwomen.org/en/articles/explainer/artificial-intelligence-and-gender-equality>
- University of Florida. (2025). AI certificate program. Retrieved from <https://ai.ufl.edu/students/ai-certificate/>
- Verma, R., Zhao, Y., & others. (2021). The Use of Artificial Intelligence (AI) in Qualitative Research for Data Analysis. *The Qualitative Report*.
- Wei, J., & Li, Y. (2022). The impact of artificial intelligence on mental health and self-efficacy.

Zhao, Y., Wang, X., & Li, Q. (2020). Artificial intelligence applications in research: Enhancing data analysis, pattern recognition, and knowledge discovery. *Journal of Informetrics*, 14(4), 101090.