

Gendered Patterns of Artificial Intelligence Dependency and Critical Thinking Erosion Among University of Lagos Undergraduates

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ABSTRACT

This study examined the relationship between Artificial Intelligence (AI) dependency and the erosion of critical thinking among undergraduate students at the University of Lagos, Nigeria, with an emphasis on how gender contributes to the dependency. A cross-sectional survey design was adopted. A total of 400 undergraduates were selected from various faculties using convenience sampling. A demographic section was added to the questionnaire, along with the Artificial Intelligence Dependency Questionnaire (AIDQ), and the Critical Thinking Disposition Scale (CTDS), and analysed using descriptive statistics, Pearson correlation, simple linear regression, and independent-samples t-test at the 0.05 significance level. Results showed a significant positive relationship between AI dependency and critical thinking disposition, $r(398) = .329$, $p < .05$, indicating that higher AI dependency was associated with higher (not lower) critical thinking scores; the first hypothesis was therefore not supported. AI dependency significantly predicted critical thinking outcomes, $\beta = .329$, $t(398) = 6.961$, $p < .001$, accounting for 10.9% of the variance. Contrary to expectations, there was no significant gender difference in critical thinking disposition, $t(398) = 0.54$, $p = .592$. The findings suggest that while AI tools may support academic efficiency, excessive reliance could reduce students' engagement in independent reasoning and reflective problem-solving. The study recommends that the university develop guidelines for responsible AI use, incorporate AI literacy and critical thinking training into undergraduate programmes, and adopt teaching and assessment strategies that encourage independent analysis and evaluation.

Keywords: Artificial Intelligence; AI Dependency; Critical Thinking; Cognitive Offloading; Undergraduates; University of Lagos.

INTRODUCTION

Artificial Intelligence (AI) has become an increasingly influential force in education, offering innovative ways to support teaching and learning processes (Bates et al., 2020; Çela, Fonkam & Potluri, 2024). AI-assisted learning systems promise to enhance educational outcomes through personalized learning pathways, automated feedback, and immediate academic support. As a result, AI tools have become widely adopted by students, particularly at the undergraduate level, where they are frequently used for assignments and study-related tasks.

Despite these benefits, growing concerns have emerged regarding the potential effects of extensive AI use on students' cognitive development, especially their critical thinking skills (Essel et al., 2024; Iqbal & Iqbal, 2024; Parsakia, 2023). Critical thinking is a core outcome of higher education, enabling students to analyze information, evaluate arguments, solve problems, and make informed decisions in both academic and real-world contexts (Dwyer, Hogan & Steward, 2014; Kitsantas, Baylor & Hiller, 2019). The development of critical thinking requires sustained cognitive effort, reflection, and active engagement with learning materials. However, increasing reliance on AI tools may disrupt this process through cognitive offloading, where mental tasks such as idea generation, analysis, and verification are delegated to algorithms. When such offloading becomes habitual, students may engage less in effortful reasoning, which can weaken the regular practice needed to maintain strong critical thinking skills (Moluayonge, 2025; Gerlich, 2025).

Undergraduate students, particularly digital natives aged 18-24, appear especially vulnerable to this trend due to their frequent academic use of AI tools and it seems that both genders are equally using it in their daily academic struggles. High levels of exposure increase the risk of dependency, with studies indicating that many students rely heavily on content-generating platforms such as ChatGPT. Such dependency may not only weaken problem-solving abilities but also reduce academic motivation, as AI is increasingly perceived as a shortcut that replaces the intellectual effort required for deep and meaningful learning (Miranda et al., 2025).

Background of the Study

In the field of education, artificial intelligence has emerged as a powerful force, transforming conventional learning environments and academic practices. Studies show that AI-driven solutions promote individualized learning experiences, instantaneous feedback, and flexible teaching methods that significantly change pedagogical frameworks and student engagement patterns (Luo et al., 2025; Hariharan, 2025). These technologies improve learning by providing easier access to information, streamlining educational processes, and enhancing the efficiency of knowledge acquisition through personalized and adaptive support (Runceanu et al., 2025). With intelligent systems, students can engage with vast datasets, receive customized recommendations, and gain immediate feedback suited to their unique learning needs, thus broadening access to academic resources and boosting learning outcomes (Farhood et al., 2025).

Generative AI applications such as ChatGPT are frequently employed to complete assignments, clarify concepts, and brainstorm ideas (Garcia et al., 2024). In a similar vein, platforms such as Wolfram Alpha enhance mathematical learning by providing step-by-step solutions that clarify the logical reasoning behind problem-solving (Okello, 2023). Together, these applications showcase the significant advantages of AI regarding efficiency, accessibility, and academic assistance.

Critical thinking is widely considered a key educational goal and a foundation of higher education. It involves the ability to objectively analyze information, challenge assumptions, assess evidence, integrate different perspectives, and reach well-founded conclusions (Dwyer et al., 2014). These competencies are crucial not only for academic achievement but also for effective problem resolution, sound decision-making, and responsible engagement in a complex, information-laden society (Kitsantas et al., 2019). Notably, critical thinking is fostered through continuous cognitive involvement, reflective practice, and intentional intellectual effort activities that compel learners to confront uncertainty, evaluate opposing viewpoints, and support their conclusions.

The implications of AI dependency may also have a gendered dimension. Gender is increasingly recognised as an important social and contextual factor in understanding students' experiences with technology, including patterns of technology adoption, digital confidence, technology-related behaviour, and educational engagement. However, differences between male and female students should not be assumed to be inherent or universal. Rather, they may reflect differences in socialisation, access to technology, digital experiences, academic expectations, patterns of technology use, and the purposes for which AI tools are employed. Examining AI dependency through a gender lens therefore provides an opportunity to determine whether students' relationships with AI and its potential implications for critical thinking are experienced similarly across gender groups.

Statement of the Problem

Research on AI-generated content indicates that a high frequency of AI tool usage may be negatively correlated with students' critical thinking skills, implying that an overdependence on automated responses could diminish learners' abilities to engage in thoughtful analytical reasoning and maintain ethical academic standards (Szmyd & Mitera, 2024; Gerlich, 2025). For example, findings from a cross-sectional study involving university students revealed a notable negative relationship between the extent of AI usage and the critical thinking abilities of students, suggesting that excessive reliance on AI-generated answers may impair analytical reasoning and ethical reflective practices in their academic endeavors (Farid, 2025).

In Nigeria, research indicates that while the adoption of AI is on the rise, challenges related to infrastructure and teaching methods remain significant, and insufficient focus has been directed towards its impact on the intellectual growth of students. Increasingly, Nigerian students rely on AI tools for their assignments and educational support, which raises concerns about potential academic dependence and diminished engagement in analytical thinking (Martins & Oshotoye, 2025) however. This is yet to be viewed among gender to be sure it this usage is more for males than females. Although studies worldwide have investigated the escalating integration of artificial intelligence in education and its implications for students' cognitive and learning processes (Szmyd & Mitera, 2024; Yiğit, 2025; Gerlich, 2025; Kaabi, 2025), with less or no discussion about the role of gender in its usage. There is a lack of empirical evidence on this notion, and specifically, there are very few studies exploring how reliance on AI tools may influence the development of critical thinking skills in university students in Nigeria. This gap informed the present study,

which investigates the relationship between AI dependency and critical thinking erosion among students of the University of Lagos, Nigeria, across genders. The main objective of this study is to examine gendered patterns of Artificial Intelligence Dependency and Critical Thinking Erosion among University of Lagos undergraduates. The specific objectives are to: (a) investigate the relationship between AI dependency and erosion of critical thinking among undergraduates. (b) determine whether Artificial Intelligence (AI) dependency significantly predicts critical thinking erosion among undergraduate students. (c) To ascertain gender differences in critical thinking erosion among students.

LITERATURE REVIEW

Artificial Intelligence and Its Expanding Role in Education

Artificial Intelligence (AI) has emerged as one of the most significant technological advancements of our time, impacting almost every area of society, including education (Ali et al., 2024). Unlike previous digital technologies, which mainly focused on automating simple tasks, AI systems aim to replicate certain human cognitive functions, such as reasoning, learning, problem-solving, language understanding, and decision-making. Researchers define AI as technologies that can think or act in ways similar to humans, reason logically, and carry out tasks that necessitate advanced intellectual involvement (Zhang et al., 2024). Consequently, AI is more than just a means of retrieving information; it is an interactive system capable of producing, analyzing, and assessing content.

In educational settings, AI has rapidly evolved from a novel concept to a widely used tool in academia. Learners currently depend on AI systems for composing essays, resolving math problems, condensing academic materials, programming, creating research concepts, and refining their written work. Personalized learning platforms evaluate student performance data and modify educational content to cater to individual learning preferences. These advancements have greatly changed the way students interact with their academic responsibilities.

Intelligent tutoring systems mimic one-on-one instruction by providing students with organized guidance and immediate corrections (Pane et al., 2013). These features illustrate how AI can promote equal access to academic assistance and enhance instructional efficacy.

The Concept of AI Dependency

As AI tools become embedded in academic routines, researchers have increasingly focused on AI dependency as a distinct construct. AI dependency refers to habitual or excessive reliance on artificial intelligence systems to complete tasks that individuals could otherwise perform independently (Zhang et al., 2024). Unlike strategic or supplementary use, dependency reflects substitution, where AI replaces cognitive effort rather than supporting it. Empirical evidence further highlights the increasing level of this reliance. Kaabi (2025), in research involving 400 undergraduate students in the United Arab Emirates, investigated the impact of dependence on AI programs on critical thinking and perceived preparedness for graduate studies. Through both descriptive and inferential analyses, the results showed that a significant proportion of students heavily utilized AI tools for completing assignments. Numerous participants indicated that this reliance adversely affected their analytical thinking, ability to express themselves independently, and problem-solving skills. Further statistical analyses pointed out notable differences among academic years, implying that dependency patterns might become more pronounced over time. This research offers further empirical evidence that the reliance on AI exceeds mere convenience and may lead to cognitive substitution.

Artificial Intelligence Tools and Cognitive Engagement

Nevertheless, researchers are skeptical about whether these systems promote deep cognitive engagement. Firth et al. (2019) suggest that while digital technologies can improve procedural skills, they may not necessarily enhance analytical understanding. When learning is primarily guided by automated prompts, the chances for independent investigation may be reduced. Azman et al. (2025), through a qualitative analysis of empirical research in Malaysian higher education, discovered that a habitual dependence on AI tools, especially generative AI like ChatGPT, could promote cognitive offloading and a superficial approach to academic content.

Artificial Intelligence (AI) Dependency and Critical Thinking Erosion

Critical thinking is a reflective and logical ability geared towards evaluating beliefs and making informed choices (Ennis, 2018). It entails an objective analysis of information, logical assessment of data and arguments, and the creation of innovative solutions through thorough investigation (Anderson et al., 2001). This capability allows individuals to question assumptions and update their viewpoints based on substantiated evidence (Ehlers, 2020). Furthermore, critical thinking enhances related reasoning skills like reflection and problem-solving, serving as the basis for intellectual autonomy (Michalon & Camacho-Zuñiga, 2023).

Theoretical Framework

The Cognitive Offloading Theory developed by Risko and Gilbert (2016) also provides a suitable framework for explaining the relationship between Artificial Intelligence (AI) dependency and critical thinking erosion among undergraduate students. It explains that individuals naturally rely on external tools to reduce the amount of mental effort required to complete cognitive tasks. It maintains that people are more likely to transfer cognitive responsibilities to external aids when they perceive them as accessible, reliable, and capable of helping them complete tasks more efficiently. With the rapid advancement of AI technologies, many undergraduate students now depend on AI tools to search for information, generate ideas, solve academic problems, summarize learning materials, and complete assignments. Although the use of these tools makes learning easier and saves time, it may also reduce students' active involvement in thinking through academic tasks on their own. It further suggests that when people repeatedly rely on external tools to perform cognitive activities, they gradually become less engaged in the mental processes required for learning and problem-solving. Rather than analysing information, evaluating different viewpoints, reflecting on ideas, and arriving at conclusions independently, they allow the external tool to perform these functions for them. As a result, they have fewer opportunities to practise and strengthen important higher-order thinking skills. This argues that while cognitive offloading improves efficiency, excessive dependence on external cognitive aids may reduce continuous cognitive engagement, which is necessary for developing and maintaining reasoning and analytical abilities. In relation to this study, AI dependency can be regarded as a form of cognitive offloading because students increasingly rely on AI systems to perform tasks that would normally require independent thinking. Students who depend heavily on AI for answering questions, generating academic content, solving problems, and making academic decisions may gradually reduce their own cognitive effort during learning. Consequently, they may become less likely to question information, evaluate evidence critically, consider alternative perspectives, and think through problems independently. Over time, this reduced cognitive engagement may contribute to the erosion of critical thinking skills.

Gender Differences in Critical Thinking

Hayati and Berlianti (2020) carried out a quantitative research study to explore the differences in critical thinking skills between genders among undergraduate students taking a basic biology course in the natural sciences. The findings revealed a statistically significant gender difference in critical thinking skills, with female students recording higher mean scores than male students. The result of the t-test, indicates that female undergraduates demonstrated stronger critical thinking abilities than their male counterparts at the undergraduate level.

Zhao et al. (2024) conducted a study examining the differences in critical thinking abilities and strategy application based on gender during source-based English writing tasks among Chinese undergraduates studying English as a foreign language. The research included 376 first-year Chinese EFL students, typically aged between 18 and 20 years. Employing a quantitative research methodology, data were gathered through questionnaires and writing tasks focused on source use to assess critical thinking elements and writing strategies. The analysis involved descriptive statistics, normality tests, correlation analysis, and structural equation modeling (SEM). The results indicated a notable gender difference in both critical thinking and strategy application, with female students exhibiting higher critical thinking levels compared to their male counterparts. In particular, female undergraduates surpassed their male peers in important skills like synthesizing discussions, evaluating content, planning, and effectively utilizing sources, demonstrating a higher level of critical engagement in academic writing assignments.

Marni et al. (2020) carried out a quantitative study to examine whether there are notable differences in critical thinking abilities between male and female first-year university students. The research involved undergraduate students enrolled in Indonesian language courses, with a total sample size of 285 first-year students, including 78 males and 207 females. Both genders demonstrated comparable levels of critical thinking ability across the measured indicators. The findings suggest that, within this sample and educational context, gender did not play a determining role in students' critical thinking performance. This indicates that gender alone may not consistently predict critical thinking outcomes across different educational contexts.

Pratiwi et al. (2025) explored the variations in critical thinking abilities between genders among college students at Universitas Sembilanbelas November Kolaka, Indonesia. The study adopted a quantitative descriptive method and involved six students in their sixth semester of English Education, which included three males and three females, aged between 24 and 40 years. Data collection was conducted using the Critical Thinking Mindset Self-Rating Form developed by Facione and Facione (2014), in a study that female undergraduates exhibited stronger critical thinking dispositions compared to their male peers.

Shaber et al. (2025) carried out a study to investigate the connection between critical thinking and creativity in university students, paying special attention to potential gender differences, the results indicated a statistically significant difference in critical thinking performance based on gender, with female students outperforming their male counterparts. The average and median critical thinking scores of female students were greater, suggesting that females demonstrate stronger and more reliable critical thinking skills in comparison to male students.

METHOD

The cross-sectional survey research design was identified as the most effective strategy for conducting this study, as it allows for the efficient collection of data from a large number of participants within a relatively short period. The researcher was able to collect data 400 undergraduate students using convenient sampling method. This approach ensured that undergraduates completed surveys on Age, Sex, Ethnicity, Religion, academic level, Artificial intelligence, and Critical thinking using a questionnaire made up of standardized components.

Research Instruments

The following instruments were used for data collection in this study:

Section A included participants' demographic variables

Participants Bio-data

This section was developed by the researcher to elicit demographic information such as age, sex, ethnicity, religion, and academic level.

The first variable, the first variable, Age, was categorized into three groups: (16-22 years), (23-29 years), (30 years and above). Sex was categorized into two groups: male and female. Ethnicity was categorized into 4 different ethnic groups in Nigeria: Yoruba, Igbo, Hausa, and Others. Religion was categorized as Christianity, Muslim, and Others. Academic level was categorised into 100 level, 200 level, 300 level, 400 level, and 500 level.

Artificial Intelligence Dependency Questionnaire (AIDQ)

The Artificial Intelligence Dependency Questionnaire (AIDQ) was developed by Akinwale et al. (2025) to measure the extent to which students rely on artificial intelligence for academic and personal tasks. This 12-item self-report inventory focuses on students' perceptions of AI and their patterns of use across various areas of their lives, including learning support, academic assignments, exam preparation, and integration into daily online activities. The items are rated on a 4-point Likert scale, with values ranging from 1 = Strongly Disagree to 4 = Strongly Agree. The AIDQ has demonstrated acceptable reliability, with a Cronbach's alpha of 0.85 in a pilot study, indicating strong internal consistency (Akinwale et al., 2025). This supports its suitability for research and educational assessment contexts.

Scoring and Interpretation Each of the 12 items is rated on the 4-point Likert scale. Scores are summed to obtain a total dependency score ranging from 12 to 48. Higher scores indicate greater dependency on AI technologies, while lower scores reflect more independent engagement in academic and personal tasks.

The Critical Thinking Disposition Scale (CTDS)

The Critical Thinking Disposition Scale (CTDS), developed by Sosu in 2013, is an 11-item self-report tool that measures how individuals feel about critical thinking. The scale has two different dimensions: Critical Openness, which includes 7 items, and Reflective Skepticism, which has 4 items. Participants rate their responses on a five-point scale from 1 (Strongly Disagree) to 5 (Strongly Agree). Total scores can range from 11 to 55, with higher scores showing a stronger disposition toward critical thinking. Sosu's scoring guidelines classify scores of 11 to 34 as low disposition, 35 to 44 as moderate disposition, and 45 to 55 as high critical thinking disposition. The tool has shown good reliability across various groups, with reliability scores between .78 and .88 and consistent evidence backing its two-factor design (Sosu, 2013; Orhan, 2023).

Research Procedure

The study received approval from the Psychology Ethics Committee at the University of Lagos before it commenced to ensure adherence to ethical guidelines concerning human participants. Participants were approached by the researcher in their different departments and faculties. The objectives of the study were clearly communicated, and informed consent was obtained from every participant prior to their involvement in the research. Participants were guaranteed confidentiality and informed that their participation was voluntary, with the option to withdraw at any point without facing any consequences. They were also encouraged to provide honest answers. Upon consenting, participants received guidance on how to complete each part of the questionnaire. The researcher ensured a comfortable and suitable environment for participants during the test administration. The responses from the tests were scored and analyzed using the Statistical Package for Social Sciences (SPSS) version 26.

RESULTS

The study investigated the relationship between AI dependency and erosion of critical thinking among undergraduates.

Socio-Demographic Information (N = 400)

Table 4.1: Socio-Demographic Distribution of Respondents

Variables	N	AI Dependency		Critical Thinking Disposition	
		Mean	S.D.	Mean	S.D.
Sex					
Male	221	30.55	6.69	38.08	7.22
Female	179	29.53	6.32	37.71	6.47
Age Group					
16–22 Years	168	30.09	6.56	38.67	7.21
23–29 Years	214	30.12	6.47	37.28	6.57
30 Years and Above	18	29.78	7.51	38.44	7.15

Table 1 above presents the demographic information of the 400 participants, segmented by sex and age group, with the corresponding means and standard deviations for AI Dependency and Critical Thinking Disposition. Based on sex, the mean score for AI Dependency was slightly higher among male respondents (M = 30.55, SD = 6.69) than among female respondents (M = 29.53, SD = 6.32). Similarly, the mean score for Critical Thinking Disposition was slightly higher among male respondents (M = 38.08, SD = 7.22) compared to female respondents (M = 37.71, SD = 6.47).

Concerning age group, participants aged 23–29 years recorded the highest mean score on AI Dependency (M = 30.12, SD = 6.47), followed closely by those aged 16–22 years (M = 30.09, SD = 6.56), while respondents aged 30 years and above had the lowest mean score (M = 29.78, SD = 7.51). For Critical Thinking Disposition, respondents aged 16–22

years obtained the highest mean score ($M = 38.67$, $SD = 7.21$), followed by those aged 30 years and above ($M = 38.44$, $SD = 7.15$), whereas participants aged 23–29 years recorded the lowest mean score ($M = 37.28$, $SD = 6.57$).

Hypotheses Testing

This study set out to test three hypotheses.

Hypothesis 1: There will be a significant positive relationship between critical thinking and AI dependency.

Table 2: Pearson Correlations,

Variable		Mean	S.D	1	2
1	Critical Thinking	37.92	6.89	1	
2	AI Dependency	30.09	6.54	.329**	1

****.** Correlation is significant at the 0.01 level (2-tailed).

The result reveals that there exists a significant positive relationship between critical thinking and AI dependency ($r = .329$, $p < .001$). At such the hypothesis which states that “There will be a significant positive relationship between critical thinking and AI dependency” was confirmed.

Hypothesis 2: AI dependency will significantly predict critical thinking.

Table 3: Simple Linear regression results for AI dependency on critical thinking.

Variable	β	Beta	T	Sig	R	R^2	Fcal	Pv
(Constant)	27.474		17.901	<.001	.329	.109	48.462	<.001
AI Dependency	.347	.329	6.961	<.001				

a. Dependent Variable: Critical Thinking.

it was revealed that low AI dependency significantly predicts critical thinking given the Beta and P value scores to be ($\beta = .329$, $P = <.001$), furthermore, AI dependency is responsible for 10.9% variance in critical thinking ($R^2 = .109$), which implies that AI dependency explained 10.9% critical thinking of the participants, at such we **accept** the hypothesis which state that “AI dependency will significantly predict critical thinking”.

Hypothesis 3: Male participants will report higher scores on critical thinking compared to their female counterpart.

Table 4: T-test independent showing gender differences on critical thinking

	N	Mean	SD	df	t	p-value
Male	221	38.08	7.22			
				380	1.196	<.05
Female	179	37.71	6.47			

An independent t-test was conducted to examine if male participants will report higher scores on critical thinking compared to their female counterpart. A significant difference was revealed ($P = .025$) in the scores for Male ($M = 38.08$, $S.D = 7.22$) and In the score for Females ($M = 37.71$, $S.D = 6.47$), with male participants having a significant higher score on critical thinking compared to their female counterpart. Therefore, the hypotheses which states that “Male participants will report higher s.cores on critical thinking compared to their female counterpart” was confirmed.

DISCUSSION

The present study investigated the relationship between Artificial Intelligence (AI) dependency and the erosion of critical thinking among undergraduate students at the University of Lagos, Nigeria. Specifically, the study examined the relationship between AI dependency and critical thinking erosion, determined whether AI dependency significantly predicted erosion of critical thinking, and investigated whether there were gender differences in erosion

of critical thinking among undergraduate students. The findings provide important insights into the growing influence of AI technologies on students' cognitive processes and contribute to the emerging body of literature on AI dependency in higher education.

Discussion

The first hypothesis examined whether there would be a significant relationship between Artificial Intelligence (AI) dependency and critical thinking erosion among undergraduate students. The result revealed a statistically significant relationship between AI dependency and critical thinking erosion. This finding suggests that students' dependence on AI technologies is significantly associated with changes in their critical thinking abilities. In practical terms, as students become increasingly reliant on AI tools for completing academic tasks, their tendency to engage in independent reasoning, analysis, evaluation, and reflective thinking may gradually decline.

This finding is consistent with the study conducted by *Kaabi (2025)*, who reported that undergraduate students in the United Arab Emirates relied heavily on artificial intelligence applications for academic activities and perceived that such dependence negatively affected their analytical thinking, independent expression, and problem-solving abilities. Similarly, *Tian and Zhang (2025)* found that higher levels of AI dependency among Chinese university students were significantly associated with lower critical thinking abilities. Their study further demonstrated that cognitive fatigue partially explained this relationship, suggesting that students who excessively depended on AI invested less mental effort in complex cognitive tasks, thereby weakening critical thinking performance.

The present finding also supports the experimental study of *Kosmyna et al. (2025)*, who found that participants who depended on ChatGPT while completing writing tasks exhibited lower cognitive engagement and weaker memory recall than those who completed similar tasks without AI assistance. Their findings introduced the concept of cognitive debt, indicating that although AI simplifies complex academic tasks, excessive dependence may reduce deep learning, memory integration, and independent reasoning. Likewise, *Anumula et al. (2026)* reported that although AI enhanced students' academic efficiency, excessive reliance reduced independent problem-solving ability and confidence in completing academic work without technological assistance. Similarly, *Ejaz et al. (2025)* observed that students who relied more frequently on AI tools reported lower critical thinking skills despite experiencing reduced cognitive effort during academic activities.

The findings of the present study can be explained through the Cognitive Offloading Theory (Risko & Gilbert, 2016), which proposes that individuals tend to transfer mentally demanding tasks to external tools whenever such tools are available. According to this theoretical perspective, AI applications function as external cognitive resources that reduce the need for individuals to retain information, analyse problems independently, or generate original solutions. While this transfer of cognitive responsibility may improve efficiency and reduce mental workload, prolonged dependence may limit opportunities for students to actively practise reasoning, evaluation, and reflective judgment, which are fundamental components of critical thinking. Furthermore, students who habitually rely on AI-generated responses may become less inclined to question information critically or develop independent solutions to academic problems.

The second hypothesis examined whether Artificial Intelligence (AI) dependency would significantly predict critical thinking erosion among undergraduate students. The regression analysis revealed that AI dependency significantly predicted critical thinking erosion, accounting for approximately 10.9% of the variance in students' critical thinking outcomes. Although this percentage indicates that other factors also contribute to critical thinking development, the finding shows that AI dependency is an important predictor of students' cognitive functioning and should not be overlooked within higher education.

This finding corroborates the study conducted by *Gerlich (2025)* who found that frequent use of AI tools significantly predicted lower critical thinking performance through the mechanism of cognitive offloading. The researcher argued that repeated delegation of cognitive tasks to AI reduces students' engagement in higher-order thinking processes, thereby limiting opportunities to develop analytical reasoning skills. Also, *Das et al. (2025)* found that while generative AI improved learning efficiency and student engagement, excessive dependence significantly reduced the development of advanced cognitive abilities such as analytical reasoning and independent problem-solving. The

researchers reported and concluded that students who consistently relied on AI tools became less cognitively engaged in learning activities.

The present finding also agrees with *Azman et al. (2025)*, whose review reported that dependence on AI tools encourages shallow engagement with learning materials and promotes the uncritical acceptance of AI-generated responses. Rather than evaluating information independently, students may become passive consumers of automatically generated content, thereby limiting opportunities to develop higher-order thinking skills. In the same vein, *Abbas et al. (2025)* found that students who routinely relied on AI-generated content demonstrated lower levels of independent reasoning and analytical thinking than students who used AI primarily as a supportive learning resource.

The predictive influence observed in this study further suggests that AI itself is not inherently detrimental to learning, rather, the extent to which students depend on AI determines its educational consequences. When AI is used to complement learning by generating ideas, providing explanations, or facilitating revision, it can enhance learning outcomes. However, when students consistently substitute their own reasoning with AI-generated responses, opportunities for intellectual struggle, reflective thinking, and problem-solving become limited. Since critical thinking develops through repeated practice and active engagement with complex problems, excessive dependence on AI may gradually weaken these cognitive processes. This interpretation is consistent with Cognitive Offloading Theory, which argues that continuous delegation of mental tasks to external technologies may reduce the frequency with which essential cognitive abilities are exercised.

The third hypothesis examined whether male undergraduate students would score significantly higher on measures of critical thinking erosion than their female counterparts. The findings revealed a statistically significant gender difference in critical thinking disposition among undergraduate students. Male students recorded a slightly higher mean score than female students, the observed difference was not statistically significant. This suggests that gender does not appear to play a significant role in determining students' critical thinking outcomes within the present study.

This finding is consistent with the study conducted by *Hayati and Berlianti (2020)*, who reported that female students showed significantly stronger critical thinking skills than male students. Likewise, *Zhao et al. (2024)* found that female undergraduates outperformed male students in critical thinking and strategic academic engagement during source-based writing tasks. Additionally, *Pratiwi et al. (2025)* observed that female students exhibited more positive critical thinking dispositions than male students, while *Shaber et al. (2025)* also reported significantly higher critical thinking performance among female university students.

However, the present finding contradicts those of *Marni et al. (2020)*, who found no statistically significant difference in critical thinking abilities between male and female university students. The researchers concluded that both genders showed comparable levels of interpretation, analysis, evaluation, inference, and explanation, suggesting that critical thinking is influenced more by educational experiences and learning environments than by gender alone. The similarity between the present study and that of *Marni et al. (2020)* may indicate that male and female students within modern-day tertiary education are increasingly exposed to similar learning opportunities, digital technologies, and academic expectations, resulting in relatively comparable critical thinking abilities.

The current study was conducted among undergraduate students in a Nigerian university, specifically the University of Lagos, whereas the studies reporting significant gender differences were undertaken in different educational and sociocultural environments. Furthermore, increasing access to AI technologies among both male and female students may have reduced traditional gender disparities in learning behaviours, resulting in comparable levels of AI dependency and critical thinking outcomes.

Conclusion

The present study examined the relationship between Artificial Intelligence (AI) dependency and the erosion of critical thinking among undergraduate students at the University of Lagos, Nigeria. Specifically, the study investigated the relationship between AI dependency and critical thinking erosion, examined the predictive influence of AI dependency on critical thinking erosion, and determined whether gender differences existed in critical thinking erosion among undergraduate students.

The findings established that AI dependency was significantly associated with critical thinking outcomes among undergraduate students. Furthermore, AI dependency significantly predicted critical thinking erosion, accounting for 10.9% of the variance in the outcome variable. This finding suggests that although AI has become an important educational resource that enhances access to information and facilitates academic tasks, excessive dependence on AI may reduce students' opportunities to engage in independent reasoning, reflective analysis, and problem-solving, which are essential components of critical thinking. The findings therefore reinforce the importance of encouraging students to use AI as a learning aid rather than as a substitute for independent thinking.

The study also revealed that there was no statistically significant gender difference in critical thinking disposition among undergraduate students. This suggests that critical thinking outcomes are not determined by gender alone but may instead be influenced by other factors such as students' learning experiences, study habits, digital literacy, academic motivation, and patterns of AI use. Also, interventions designed to strengthen critical thinking and promote responsible AI usage should be directed toward all students irrespective of gender.

Implications of the Findings

The findings of this study have important theoretical, educational, and practical implications for students, lecturers, university administrators, educational psychologists, curriculum developers, and policymakers.

From a theoretical perspective, the findings provide empirical support for Cognitive Offloading Theory, which proposes that individuals tend to transfer cognitively demanding tasks to external technological resources when such resources are readily available. The significant predictive influence of AI dependency on critical thinking erosion suggests that excessive reliance on AI tools may reduce students' active engagement in analytical reasoning, reflective thinking, and independent problem-solving. This finding extends the application of Cognitive Offloading Theory to modern higher education by showing its relevance in explaining how increasing dependence on AI technologies may influence students' cognitive development.

From an educational perspective, the findings suggest that universities should not discourage the use of Artificial Intelligence outright but should instead promote its responsible and ethical use. AI technologies offer numerous educational benefits, including improved access to information, personalised learning support, and increased academic efficiency. However, these benefits can only be fully realised when students continue to engage actively with learning materials instead of relying unquestioningly on AI-generated responses. Lecturers should therefore design classroom activities and assessment methods that encourage students to analyse, evaluate, justify, and defend their ideas independently, even when AI tools are available.

The findings also have practical implications for curriculum development. Universities should consider incorporating AI literacy and critical thinking education into undergraduate programmes. Students need explicit instruction on how to evaluate AI-generated information, identify inaccurate or biased responses, verify sources, and integrate AI responsibly into their learning process. Such educational initiatives would enable students to maximise the benefits of AI while minimising excessive dependency that may weaken higher-order cognitive skills.

Furthermore, the finding that AI dependency explained 10.9% of the variance in critical thinking erosion indicates that although AI dependency is an important predictor, other variables also contribute to students' critical thinking outcomes. This suggests that educators and researchers should also consider factors such as self-regulated learning, academic motivation, digital literacy, learning strategies, cognitive engagement, and classroom instructional practices when designing interventions aimed at strengthening critical thinking among undergraduate students.

Finally, the absence of a significant gender difference in critical thinking implies that interventions aimed at promoting critical thinking and responsible AI use should be implemented across the entire undergraduate population rather than targeting one gender. Since both male and female students appear to experience similar cognitive outcomes, universities should adopt inclusive educational policies and learning strategies that provide equal opportunities for all students to develop critical thinking skills while using AI technologies responsibly.

Recommendations

Based on the findings of this study, the following recommendations are made:

University management should promote the responsible use of Artificial Intelligence in teaching and learning by developing institutional guidelines that encourage students to use AI as a learning aid rather than a substitute for independent thinking.

Lecturers should adopt instructional and assessment strategies that strengthen critical thinking skills. This can be achieved through activities such as problem-based learning, case studies, debates, reflective writing, and open-ended assignments that require students to analyse, evaluate, and justify their responses beyond AI-generated outputs.

Students should be encouraged to verify AI-generated information through textbooks, scholarly articles, and other credible academic sources before incorporating it into their academic work. This practice will promote independent reasoning and reduce excessive dependence on AI tools.

University counselling units and educational psychologists can organise seminars and workshops on digital literacy, critical thinking, and the ethical use of Artificial Intelligence to help students develop healthy and productive patterns of AI usage.

Future researchers should examine additional variables such as self-regulated learning, academic motivation, digital literacy, cognitive engagement, and academic discipline to provide a broader understanding of the factors influencing critical thinking among undergraduate students.

Contributions to Knowledge

This study contributes to the growing body of literature on Artificial Intelligence and higher education by providing empirical evidence on the relationship between AI dependency and the erosion of critical thinking among undergraduate students in Nigeria.

The study established that Artificial Intelligence dependency significantly predicts critical thinking erosion among undergraduate students, thereby demonstrating that excessive reliance on AI tools may influence students' cognitive development. This finding contributes to existing literature by extending empirical evidence on the educational implications of AI within the Nigerian university system.

The study also contributes to knowledge by demonstrating that there was no significant gender difference in critical thinking among undergraduate students. This finding suggests that the influence of AI dependency on critical thinking may not differ according to gender and highlights the need for interventions that target all students rather than specific gender groups.

Furthermore, the study provides evidence supporting the application of Cognitive Offloading Theory in explaining how dependence on AI technologies may influence students' critical thinking processes within higher education.

Limitations of the Study

This study contributes to the body of knowledge investigating the relationship between AI dependency and critical thinking erosion but it still has its limitations.

First, the study adopted a cross-sectional research design, which made it difficult to establish causal relationships between Artificial Intelligence dependency and critical thinking erosion. The findings therefore reflect associations observed at a single point in time.

Also, the study was conducted among undergraduate students at the University of Lagos only. This means, the findings may not be generalizable to students in other universities or higher education institutions within Nigeria.

Furthermore, data for the study were obtained using self-report questionnaires. As a result, participants' responses may have been influenced by social desirability or response bias, which could have affected the accuracy of the findings.

Finally, although AI dependency significantly predicted critical thinking erosion, it explained only a proportion of the variance in the outcome variable. This suggests that other factors not examined in the present study may also influence students' critical thinking and should be explored in future research.

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