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ARTIFICIAL INTELLIGENCE OVER-DEPENDENCE AND STUDENTS' LEARNING OUTCOMES IN TERTIARY INSTITUTIONS IN PLATEAU STATE, NIGERIA

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The rapid adoption of Artificial Intelligence (AI) tools such as ChatGPT and Gemini in tertiary education has raised concerns about students' over-dependence and its impact on learning. This study examined the influence of Artificial Intelligence over-dependence on students' learning outcomes in tertiary institutions in Plateau State, Nigeria. Anchored on Cognitive Load Theory and Vygotsky's Social Constructivism, the study adopted a descriptive survey design. A sample of 470 undergraduate students was selected using multi-stage sampling from 6 tertiary institutions in Plateau State. Data were collected using a validated questionnaire titled "Artificial Intelligence Over-dependence and Students' Learning Outcomes Questionnaire [AIOSLOQ]" with a reliability coefficient of 0.87. Out of 470 copies distributed, 421 were found usable, representing an 89.6% response rate. Data were analyzed using Mean, Pearson Product Moment Correlation, and Simple Linear Regression at 0.05 level of significance. The findings revealed that students exhibited a high level of AI over-dependence, (1) Grand Mean = 2.93; (2) there was a significant negative relationship between artificial intelligence over-dependence and critical thinking, $r = -0.482$, $p < .05$; (3) AI over-dependence significantly and negatively influenced creativity, $R^2 = .203$, $p < .05$; (4) AI over-dependence had a significant negative effect on independent learning, $r = -.519$, $p < .05$ and (5) AI over-dependence significantly and negatively related to human interaction, $R^2 = .158$, $p < .05$. The study concluded that while AI offers benefits, over-dependence undermines critical thinking, creativity, independent learning, and human interaction. It was recommended that National Universities Commission (NUC) develop a national policy on responsible AI use, institutions integrate AI literacy into the curriculum, and lecturers redesign assessments to emphasize process over product.

`Keywords: Artificial Intelligence, Artificial Intelligence Over-dependence, Critical Thinking, Creativity, Independent Learning, Human Interaction, Learning Outcomes, Tertiary Institutions.

Introduction

The 21st century has witnessed an unprecedented integration of Artificial Intelligence (AI) into education. From intelligent tutoring systems to generative AI tools like ChatGPT, Gemini, and Claude, AI is reshaping how students learn, write, and solve problems. In tertiary institutions, these tools are increasingly used for brainstorming ideas, drafting essays, summarizing research papers, debugging code, and preparing for examinations. Proponents argue that AI democratizes access to knowledge, provides instant feedback, and personalizes learning at scale (Duhaylungsod and Chavez, 2023; Kobaba, Smith and Lee, 2025; Gerlich, 2025).

However, alongside these benefits, scholars have raised concerns about the unintended consequences of excessive reliance on AI. When students delegate core cognitive tasks to AI, there is a risk of cognitive offloading — where the brain outsources thinking, memory, and problem-solving to technology. Educational psychologists warn that this may weaken the very skills that higher education is meant to develop (Buçinca, Malaya and Gajos, 2021; Duhaylungsod and Chavez, 2023; Gerlich, 2025). Four outcomes are particularly at risk: critical thinking, creativity, independent learning, and human interaction. These are widely recognized as key 21st-century learning outcomes and graduate attributes required for national development.

Critical thinking involves the ability to analyze, evaluate, and synthesize information rather than accept it at face value. Creativity requires original thought and the capacity to generate novel solutions. Independent learning reflects self-regulation, motivation, and academic autonomy. Human interaction encompasses collaboration, communication, and empathy skills that cannot be fully developed through human-AI interaction alone (Montenegro-Rueda, Fernandez-Cerero and Leon, 2023; May, 2024; Wu and Yu, 2024; Lu, Li and Chen, 2025). The balance between leveraging AI as a tool and preserving these human capacities is therefore a pressing issue for educators and policymakers.

In Nigeria, tertiary institutions are under pressure to produce graduates who are competitive in a digital economy. With increased internet penetration and the proliferation of smartphones, students in Plateau State now have easy access to free and paid AI tools. Universities and polytechnics in Jos, Pankshin, Barkin Ladi, and other areas are also integrating e-learning platforms and AI-based plagiarism checkers into their systems. Yet, the Nigerian education system still faces challenges of large class sizes, limited lecturer-student contact hours, and heavy emphasis on examination performance. In such a context, students may be tempted to use AI not just as a learning aid but as a shortcut to complete academic tasks. Plateau State presents a unique context because it houses a mix of federal, state, and private tertiary institutions with diverse student populations, but with limited studies on how digital technologies affect student learning processes

locally, especially on the influence of AI over dependence on students' learning outcomes – critical thinking, creativity, independent learning and human interaction.

Understanding AI use in this setting is important for developing context-specific policies useful to university administrators, lecturers, curriculum developers, and policymakers in Plateau State and Nigeria at large. It will provide empirical evidence to guide the development of AI-use policies that promote responsible use while safeguarding essential learning outcomes and raise awareness on the need to use AI as a support tool rather than a replacement for thinking as well as contributes to the growing body of literature on AI and education in the African context.

Statement of the problem

Despite the growing adoption of AI tools among tertiary students, there is insufficient evidence on how over-dependence on these tools affects core learning outcomes. Anecdotal reports from lecturers in Plateau State suggest rising cases of AI-generated assignments, reduced class participation, and students' inability to defend their own work during presentations. If students become accustomed to having AI "think for them," their capacity for critical analysis, creative problem-solving, self-directed learning, and peer collaboration may decline.

Globally, some studies have linked heavy technology use to declines in deep thinking and social skills. However, most of this research comes from developed countries with different educational infrastructures and digital literacy levels. In the Nigerian context, and specifically in Plateau State, empirical data is scarce. Without local evidence, institutions cannot make informed decisions on AI integration, digital literacy training, or academic integrity policies.

Previous studies on AI in education have largely focused on its benefits, adoption rates, or ethical concerns like plagiarism. Few studies have empirically examined "over-dependence" as a behavioral pattern and linked it directly to multidimensional learning outcomes. Moreover, research from Sub-Saharan Africa, and Nigeria in particular, remains limited. This study therefore fills that gap by focusing on tertiary students in Plateau State and examining AI over-dependence in relation to four specific learning outcomes: critical thinking, creativity, independent learning, and human interaction.

Research questions

The following research questions guided this study:

1. To what extent are tertiary students in Plateau State dependent on AI tools for academic tasks?
2. What is the relationship between AI over-dependence and students' critical thinking skills in tertiary institutions in Plateau State?
3. What is the influence of AI over-dependence on students' creativity in tertiary institutions in Plateau State?
4. What is the effect of AI over-dependence on students' independent learning in tertiary institutions in Plateau State?
5. What is the relationship between AI over-dependence and students' human interaction in tertiary institutions in Plateau State?

Research hypotheses

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

H01: There is no significant relationship between AI over-dependence and students' critical thinking skills in tertiary institutions in Plateau State, Nigeria.

H02: AI over-dependence does not significantly influence students' creativity in tertiary institutions in Plateau State, Nigeria.

H03: There is no significant effect of AI over-dependence on students' independent learning in tertiary institutions in Plateau State, Nigeria.

H04: There is no significant relationship between AI over-dependence and students' human interaction in tertiary institutions in Plateau State, Nigeria.

Literature review

Conceptual review

Artificial Intelligence Over-dependence

Artificial Intelligence over-dependence refers to the excessive and habitual reliance on AI tools to perform cognitive and academic tasks that students are expected to do themselves. Unlike strategic AI use, over-dependence is characterized by reduced mental effort, low self-efficacy in task completion without AI, and preference for AI-generated solutions over personal reasoning. Scholars describe it as a form of "cognitive offloading" where learners outsource memory, analysis, and problem-solving to technology (Gerlich, 2025; Yulianti, Putra and Sari, 2024). In education, this manifests as using ChatGPT to write entire essays, using AI to solve problems without understanding the process, or inability to complete assignments without AI assistance. Zhang, Wang and Chen (2024) define AI dependency as relying on AI to obtain answers when tasks can be completed independently, which over time leads to increased laziness and reduced cognitive engagement.

Students' Learning Outcomes

Learning outcomes are the demonstrable skills, knowledge, and attitudes students acquire through education. In line with 21st-century skills frameworks by OECD and UNESCO, this study conceptualizes learning outcomes in four dimensions: Critical Thinking: The ability to analyze, evaluate, and synthesize information, and to make reasoned judgments(Montenegro-Rueda et al., 2023); Creativity: The capacity to generate novel and useful ideas, and to approach

Problems in original ways (May, 2024); Independent Learning: Self-regulation, academic autonomy, and the motivation to learn without external direction (Wu and Yu, 2024) and Human Interaction: Communication, collaboration, and interpersonal skills developed through peer and lecturer engagement (Lu et al., 2025).

Empirical review

Artificial Intelligence Over-dependence and Critical Thinking

Several studies suggest that excessive reliance on AI may erode critical thinking. Molenaar et al. (2023) found that students who frequently used generative AI for problem-solving scored lower on tasks requiring evaluation and inference compared to those who used AI sparingly. This is because AI provides ready-made answers, reducing the need for students to question assumptions or evaluate evidence. Yulianti et al. (2024) and Montenegro-Rueda et al. (2023) warn that overreliance on AI can replace cognitive functions and stifle logical thinking, critical thinking, and independent problem-solving. Alrazaq, Al-Obeidat and Zaki (2023) highlight the risk of AI tools generating convincingly false information, leading to undue trust in these technologies and impeding the development of critical thinking and problem-solving skills. Similarly, Gerlich (2025) found that frequent use of AI reduces critical thinking skills through cognitive offloading. A review by Didactica Danubiens (2025) of 7 empirical studies concluded that overreliance and uncritical acceptance of AI outputs hinder critical thinking. Hou (2025) also reported that superficial understanding resulting from AI dependence impacts critical thinking and problem-solving. However, some studies argue that when properly guided, AI can scaffold critical thinking. Rahimi (2025) and Singh, Kumar and Das (2025) suggest that training students to critically evaluate AI content can help them use AI as a thinking partner rather than a substitute. In the Nigerian context, anecdotal reports from the University of Port Harcourt (2025) indicate that students who submit AI-generated work often struggle to defend their arguments, suggesting a disconnect between product and process. Adebayo et al. (2024) reported that undergraduates who submitted AI-generated assignments struggled to explain or defend their arguments during oral presentations. This suggests a disconnect between product and process when AI does the thinking. However, other studies argue that when properly guided, AI can scaffold critical thinking by asking probing questions. The gap is whether students use AI to think with or to think for them.

Artificial Intelligence Over-dependence and Creativity

Creativity requires divergent thinking and the willingness to take intellectual risks. Critics argue that AI tools, by predicting the most probable responses, may lead to homogenization of ideas. Duhaylungsod and Chavez (2023) argue that the ease of access to AI tools can lead to complacency, reducing students' creativity and innovation. Zhang et al. (2024) also found that long-term AI dependency leads to reduced creativity. AlAli and Wardat (2024) similarly concluded that generative AI may undermine students' creativity. May (2024) reported that cognitive inertia associated with AI use is negatively correlated with divergent thinking and creative output. George (2023) noted that reliance on AI feedback weakens exploratory investment and creative thinking. Zhai, Chu and Li (2024) further observed that over-reliance on AI dialogue systems limits originality in smart learning environments. On the other hand, Singh et al. (2025) posit that when students are trained to critically select and optimize AI content, AI can serve as a "creative partner" for ideation. The Future Business Journal (2025) also notes that excessive reliance inhibits creativity, but regulated use can support it. Kooli (2023) observed that students using ChatGPT for essay writing produced structurally similar essays with limited originality. Similarly, a study by Zhai et al. (2024) found that heavy AI users generated fewer unique ideas in brainstorming tasks. On the other hand, some researchers posit that AI can enhance creativity by serving as a "creative partner" for ideation. The difference lies in the level of dependence. When students use AI to refine their own ideas, creativity is supported. When they use AI to generate ideas from scratch without personal input, creativity may decline.

Artificial Intelligence Over-dependence and Independent Learning

Independent learning depends on self-regulation, persistence, and metacognition. Over-reliance on AI may weaken these. Zhang et al. (2024) found that AI dependency decreases independent thinking. Gerlich (2025) argues that as reliance on AI grows, it diminishes the brain's natural capacity for independent thinking. Firat (2023) noted that students with high AI dependence reported lower confidence in studying without digital tools. Kobaba et al. (2025) in a systematic review reported that 70% of studies found a decline in independent problem-solving with increased AI reliance. Hyde, Jones and Patel (2024) and Monib, Alotaibi and Khan (2025) documented student concerns that overreliance might impact independent research skills. Sarwanti, Nugroho and Wijaya (2024) and Wirawan and Saputri (2024) also reported that AI use may weaken in-depth thinking and self-directed learning. In the Nigerian context where power outages and data costs can limit AI access, this dependence may affect academic continuity. Wu and Yu (2024) however suggest that AI can promote independent learning through 24/7 tutoring, but only when used as a tutor rather than a crutch. Rolf (2025) calls for a shift from "tool use" to "mindset enhancement" to reduce dependence.

Artificial Intelligence Over-dependence and Human Interaction

Human interaction is central to collaborative learning and socio-emotional development. Chan and Hu (2023) indicated that students who relied heavily on AI for academic help spent less time in study groups and office hours, which may affect communication and teamwork skills. Kobaba, Smith and Lee (2025) also linked high AI reliance to reduced peer collaboration. Lu et al. (2025) found that AI literacy has an indirect impact on critical thinking through peer interaction, suggesting that human dialogue mediates AI effects. Pinski, Benlian and Hess (2023) argue that AI literacy improves human-AI collaboration by fostering better task delegation, while Chiang and Yin (2022) note it can reduce overreliance. The Future Business Journal (2025) reports that tools like Copilot can promote collaborative learning when integrated properly. Interestingly, a study at the University of Port Harcourt (2025) found that students disagreed that AI tools affect their social skills, indicating they still apply human reasoning. This suggests the effect depends on whether AI replaces or complements human contact.

Research on AI in Nigerian tertiary education is still emerging. Owolabi and Adeyemi (2024) surveyed students in South-

West Nigeria and found high awareness of ChatGPT but low digital literacy on responsible use. Edeh, Okoro and Nwosu (2023) reported that 68% of students in Enugu used AI for assignments, but many lacked understanding of AI limitations. A recent study at the University of Port Harcourt (2025) among CSET and LIS students identified key challenges: data bias, privacy concerns, difficulty evaluating accuracy, and over-dependency on AI. Students also expressed concerns about plagiarism and poor critical thinking. Despite these challenges, students considered AI useful for tracking progress and personalized learning. To date, no study in Plateau State has specifically examined over-dependence and its link to the four learning outcomes, creating a need for localized data.

The literature generally agrees that AI has both potentials and risks for education. While AI can support learning, over-dependence poses a threat to critical thinking (Yulianti et al., 2024), creativity (Duhaylungsod and Chavez, 2023), independent learning (Kobaba et al., 2025), and human interaction (Chan and Hu, 2023). Most existing studies are from Asia, Europe, and North America. African and Nigerian studies are limited (Edeh et al., 2023; Owolabi and Adeyemi, 2024), and none in Plateau State has operationalized learning outcomes along these four dimensions. This study therefore seeks to fill that gap.

Theoretical framework

This study is anchored on Cognitive Load Theory and Vygotsky's Social Constructivism. Together, these theories explain how AI over-dependence can influence the four learning outcomes: critical thinking, creativity, independent learning, and human interaction. Cognitive Load Theory (Sweller, 1988) posits that human working memory has limited capacity. Learning is most effective when instructional design manages intrinsic, extraneous, and germane cognitive load to allow for deep processing and schema construction (Sweller, 1988). In the context of AI use, Cognitive Load Theory helps explain the relationship between AI over-dependence and critical thinking and independent learning. When students use AI to instantly generate answers, summaries, or solutions, they reduce their germane cognitive load — the mental effort required for understanding, problem-solving, and knowledge construction (Gerlich, 2025; Yulianti et al., 2024). Over time, this "cognitive offloading" can lead to atrophy of thinking skills because the brain is no longer trained to struggle, analyze, or evaluate (Zhang et al., 2024).

Cognitive Load Theory further suggests that if AI performs the higher-order thinking for the student, there is little opportunity for schema development. This can result in "high efficiency, low autonomy" learning (Montenegro-Rueda et al., 2023), where students can produce work quickly but cannot explain, adapt, or transfer knowledge without AI. Thus, over-dependence on AI may weaken independent learning because students fail to develop self-regulation and metacognitive strategies needed to learn without external support (Kobaba et al., 2025). Therefore, Cognitive Load Theory predicts that excessive reliance on AI will negatively affect critical thinking and independent learning because it bypasses the cognitive effort essential for mastery.

Vygotsky's Social Constructivism (Vygotsky, 1978) emphasizes that learning occurs through social interaction and collaboration. Knowledge is co-constructed within the "Zone of Proximal Development" through dialogue with more knowledgeable others — peers and lecturers. Language, negotiation of meaning, and social engagement are central to cognitive development. This theory explains the relationship between AI over-dependence and creativity and human interaction. Creativity is often enhanced through brainstorming, feedback, and exposure to diverse perspectives during social interaction (Singh et al., 2025). When students replace peer discussions and lecturer consultations with AI chatbots, they miss opportunities for collaborative idea generation and critical discourse (Chan and Hu, 2023). This can lead to homogenized outputs and reduced originality, as AI tends to produce the most probable responses rather than novel ones (Duhaylungsod and Chavez, 2023).

Similarly, human interaction is fundamental to developing communication, empathy, and teamwork skills (Lu et al., 2025). If students rely on AI for explanations and feedback instead of engaging with classmates and lecturers, their opportunities for socio-cognitive development are reduced (Pinski et al., 2023). In collectivist contexts like Nigeria, where group learning is common, this shift may have broader implications for social skills (University of Port Harcourt, 2025). Thus, Social Constructivism predicts that over-dependence on AI will negatively affect creativity and human interaction by reducing meaningful social engagement that drives these outcomes.

The two theories complement each other. Cognitive Load Theory explains the individual cognitive effects of AI over-dependence on thinking and autonomy. Social Constructivism explains the social effects on creativity and interaction. Together, they provide a framework for understanding that AI should function as a "cognitive tool" and "collaborative partner" rather than a replacement for human thought and interaction (Rolf, 2025). When AI is used to augment rather than substitute mental effort and social learning, it can support the four learning outcomes. When it is over-used, it risks undermining them.

Methodology

This study adopted a descriptive survey research design with a correlational approach. The design was suitable because the study examined the relationship between AI over-dependence (Independent Variable) and students' learning outcomes (Dependent Variables) without manipulating any variable (Creswell & Creswell, 2023).

The population consists of all undergraduate students in public and private tertiary institutions in Plateau State, Nigeria for the 2024/2025 academic session. Based on data from National Universities Commission (NUC) and National Board of Technical Examination (NBTE), Plateau State has 8 major tertiary institutions with an estimated total enrollment of 62,450 students. The breakdown is: University of Jos 28,000; Plateau State University, Bokkos 7,500; Federal College of Animal Health and Production, Vom, 6,200; Plateau State Polytechnic , Barkin Ladi 5,800; Federal College of Education, Pankshin 6,000; College of Education, Gindiri 4,200; Bingham University, Kuru 3,250 and University of Mkar, Jos Campus 1,500. Total 62,450. Note: Students from Plateau State campus/affiliates were included. Source: NUC Statistical Digest, 2024; NBTE Digest, 2024.

The sample size of 398 was determined using Yamane (1967) formula. To account for 15% non-response rate, 398 / 0.85 = 468, hence the final sample size was 470 students. A multi-stage sampling technique was used. Institutions were

first stratified into Federal, State, and Private then two institutions were randomly selected from each stratum giving six institutions. By proportionate sampling, sample was allocated to each selected institution based on enrollment and finally simple random sampling was used to select respondents using class registers. According to institutions, samples were drawn as follows: University of Jos 211 (44.8%); Plateau State University 56 (12.0%); Plateau State Polytechnic 44 (9.3%); FCE Pankshin 45 (9.6%); Bingham University 24 (5.2%) and COE Gindiri 32 (6.8%); Federal College of Animal Health and Production, Vom 48 (10.2%) and University of Mkar, Jos Campus 10 (2.1) Total 470 (100%).

The instrument was a structured questionnaire titled "AI Over-dependence and Students' Learning Outcomes Questionnaire [AIOSLOQ]". It has 4 sections: A - Demographics: Age, Gender, Institution, Level, Department 6, Nominal; B - AI Over-Dependence Scale (adapted from Zhang et al., 2024) 10, 4-point Likert; C - Learning Outcomes Scale: Critical Thinking 8 items, Creativity 8 items, Independent Learning 8 items, Human Interaction 8 items (adapted from Lu et al., 2025; May, 2024) 32, 4-point Likert. Total 48. Response options: SA=4, A=3, D=2, SD=1. High score = High dependence/low outcome.

Face and content validity was established by 3 experts in Educational Technology and Measurement and Evaluation from University of Jos. Corrections were effected accordingly. A pilot test was conducted on 40 students from Federal College of Education, Zaria (outside study area). Cronbach's Alpha was computed: AI Over-dependence = 0.84; Critical Thinking = 0.81; Creativity = 0.79; Independent Learning = 0.83 and Human Interaction = 0.80. The overall reliability coefficient was 0.87. Since all values were greater than 0.70, the instrument was reliable (Nunnally, 1978).

Copies of the questionnaire were administered physically and via Google Forms to students in lecture halls with help of 6 trained research assistants. It took 3 weeks. 470 copies were distributed, 432 were retrieved, and 421 were found usable, having the response rate of 89.6%.

Data was analyzed using SPSS version 26. Research Question 1 - Descriptive statistics: Mean and Standard Deviation. Decision rule: Mean ≥ 2.50 = High dependence. Hypotheses 1-4: Pearson Product Moment Correlation [PPMC] and Simple Linear Regression at 0.05 level of significance. Assumptions: Normality, linearity, and homoscedasticity were tested before regression. Decision Rule: Reject H0 if p-value < 0.05. Otherwise, accept.

Ethical principles were observed throughout the study. Participation was voluntary, and respondents were informed about the purpose of the study before completing the questionnaire. Respondents were not required to provide personally identifying information. Confidentiality and anonymity were maintained, and the data were used strictly for academic research purposes.

Results

This section presents the analysis of data collected from 421 usable questionnaires out of 470 distributed, representing a response rate of 89.6%.

Demographic characteristics of respondents: This was presented in Table 1.

Table 1:**Demographic Characteristics of Respondents**

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	238	56.5
	Female	183	43.5
Age	16–20 years	145	34.4
	21–25 years	219	52.0
	26 years and above	57	13.6
Institution Type	Federal	256	60.8
	State	101	24.0
	Private	64	15.2
Level of Study	100–200 level	178	42.3
	300–400 level	243	57.7
Total		**421**	**100.0**

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Note: N = 421.

Table 1 shows that majority of respondents were male, aged 21-25, from federal institutions, and in 300-400 level.

Answer to research questions

Research question 1: To what extent are tertiary students in Plateau State dependent on AI tools?

The Mean and Standard Deviation of AI Over-dependence was presented in Table

Table 2:**Mean and Standard Deviation of AI Over-Dependence in Tertiary Institutions in Plateau State**

S/N	Item Statement	Mean	SD	Decision
1	I prefer using AI tools like ChatGPT to find answers instead of thinking through problems myself	3.12	0.84	**High**
2	I feel anxious when I have to complete an assignment without using AI	2.89	0.91	**High**
3	I copy and submit AI-generated responses without reading or editing them	2.76	0.95	**High**
4	I use AI for every aspect of my schoolwork including brainstorming, writing and editing	3.05	0.88	**High**
5	I find it difficult to start an assignment without first consulting AI	2.94	0.87	**High**
6	I rely on AI to explain concepts that I could learn from my lecturer or textbook	2.98	0.82	**High**
7	I spend more time interacting with AI tools than discussing with my classmates or lecturers	2.71	0.93	**High**
8	I trust AI answers more than my own judgment or that of my lecturer	2.63	0.97	**High**
9	I use AI to complete quizzes, tests and take-home assignments	3.18	0.79	**High**
10	I cannot imagine completing my academic work successfully without AI tools	3.01	0.85	**High**
	Grand Mean	**2.93**	**0.59**	**High**

***Note**:Decision rule: Mean scores of 2.50 and above were regarded as High; scores below 2.50 were regarded as Low.*

Table 2 shows the grand mean of 2.93 indicating a high level of AI over-dependence among students.
Research Question 2-5: Relationship between AI over-dependence and learning outcomes
Descriptive statistics of learning outcomes: The descriptive statistics of learning outcomes was presented in Table 3

Table 3:**Descriptive Statistics of Learning Outcomes: Mean and Standard Deviation (SD)**

Variable	Mean	SD	Remark
Critical thinking	2.41	0.79	**Low**
Creativity	2.38	0.84	**Low**
Independent learning	2.33	0.77	**Low**
Human interaction	2.45	0.81	**Low**

Note. SD = Standard Deviation. The remark "Low" reflects the study's stated interpretation criterion.

Table 3 shows that all four learning outcomes have mean scores below 2.50, indicating low manifestation among respondents.

Test of hypotheses

Hypothesis 1: There is no significant relationship between AI over-dependence and critical thinking
Pearson Moment Correlation between AI over-dependence and critical thinking was presented in Table 4

Table 4:**Pearson Product Moment Correlation Between AI Over-Dependence and Critical Thinking**

S/N	Variable	N	r	p-value
1	AI Over-dependence & Critical Thinking	421	**-0.482**	**0.000***

Note. **Correlation is significant at the 0.05 level (2-tailed).*

Table 4 shows that $p < 0.05$, and as a result H01 is rejected. Therefore, there is a significant negative relationship between AI over-dependence and critical thinking. As AI dependence increases, critical thinking decreases.

Hypothesis 2: AI over-dependence does not significantly influence creativity
Simple Linear Regression of AI over-dependence on creativity was presented in Table 5

Table 5:**Simple Linear Regression of AI Over-Dependence on Creativity**

Model	R	R^2	β	F-ratio	Sig.
AI Over-dependence → Creativity	0.451	0.203	**-0.451**	106.42	**.000***

Note. **Significant at $p < 0.05$. $R^2 = 0.203$ indicates that AI over-dependence accounts for approximately 20.3% of the variance in creativity.*

From Table 5, $R^2 = 0.203$ meaning 20.3% of variation in creativity is explained by AI over-dependence. Since $p < 0.05$, H02 is rejected. AI over-dependence significantly and negatively influences creativity.

Hypothesis 3: There is no significant effect of AI over-dependence on independent learning
Table 6: Pearson Correlation between AI over-dependence and independent learning was presented in Table 6

Table 6:**Pearson Product Moment Correlation Between AI Over-Dependence and Independent Learning**

S/N	Variable	N	r	p-value
1	AI Over-dependence & Independent Learning	421	**-0.519**	**0.000***

** Correlation is significant at the 0.05 level (2-tailed).*

Table 6 indicates that $p < 0.05$, and as a result H03 is rejected. Therefore, there is a significant negative effect of AI over-dependence on independent learning.
Hypothesis 4: There is no significant relationship between AI over-dependence and human interaction

Table 7: Simple Linear Regression of AI over-dependence on human interaction was presented in Table 7

Table 7:**Simple Linear Regression of AI Over-Dependence on Human Interaction**

Model	R	R^2	β	F-ratio	Sig.
AI Over-dependence → Human Interaction	0.398	0.158	**-0.398**	78.91	**.000***

Note. **Significant at $p < 0.05$. $R^2 = 0.158$ indicates that AI over-dependence accounts for approximately 15.8% of the variance in human interaction.*

From Table 7, $R^2 = 0.158$. This means that 15.8% of variation in human interaction is explained by AI over-dependence.

Since $p < 0.05$, H04 is rejected. AI over-dependence significantly and negatively relates to human interaction.

Test of hypotheses using ANOVA (Post-hoc analysis)

To determine if there are significant differences in AI over-dependence based on demographic variables, One-Way ANOVA was conducted at 0.05 level of significance.

Hypothesis: There is no significant difference in AI over-dependence among students based on gender.

Table 8:**ANOVA of AI Over-Dependence by Gender**

Source	Sum of Squares	Df	Mean Square	F-ratio	Sig.
Between Groups	2.341	1	2.341	**3.128**	**.078**
Within Groups	313.892	419	0.749		
Total	**316.233**	**420**			

Note. Df = Degrees of freedom; F-ratio = F statistic; Sig. = significance level.

Table 8 indicates that p = .078. Since p > .05, H0 was not rejected. Therefore, there is no significant difference in AI over-dependence between male and female students.

Hypothesis: There is no significant difference in AI over-dependence among students based on institution type - University, Polytechnic, and College of Education.

Table 9:**ANOVA of AI Over-Dependence by Institution Type (University, Polytechnic, and College of Education)**

Source	Sum of Squares	Df	Mean Square	F-ratio	Sig.
Between Groups	8.915	2	4.458	**6.102**	**.002**
Within Groups	307.318	418	0.735		
Total	**316.233**	**420**			

Note. Df = Degrees of freedom; F-ratio = F statistic; Sig. = significance level.

Table 9 shows that p = .002 < .05, hence, H0 was rejected. Therefore, there is a significant difference in AI over-dependence among students across University, Polytechnic, and College of Education. Post-hoc test shows University students had the highest mean.
Hypothesis: There is no significant difference in AI over-dependence among students based on level of study.

Table 10:**ANOVA of AI Over-Dependence by Academic Level (100L, 200L, 300L, and 400L)**

Source	Sum of Squares	Df	Mean Square	F-ratio	Sig.
Between Groups	12.404	3	4.135	**5.731**	**.001**
Within Groups	303.829	417	0.729		
Total	**316.233**	**420**			

Note. Df = Degrees of freedom; F-ratio = F statistic; Sig. = significance level.

Table 10 shows that p = .001 < .05, hence, H0 was rejected. Therefore, there is a significant difference in AI over-dependence across levels. Post-hoc test shows 100L and 200L students are more dependent than 300L and 400L students.

Summary of findings

1. Tertiary students in Plateau State exhibit a high level of AI over-dependence, Grand Mean = 2.93.
2. There is a significant negative relationship between AI over-dependence and critical thinking, r = -0.482, p < 0.05.
3. AI over-dependence significantly and negatively influences students' creativity, $R^2 = 0.203$, p < 0.05.
4. There is a significant negative effect of AI over-dependence on independent learning, r = -0.519, p < 0.05.
5. AI over-dependence significantly and negatively relates to students' human interaction, $R^2 = 0.158$, p < 0.05.

Discussion of findings

Level of AI over-dependence among students

The study found that students in tertiary institutions in Plateau State exhibited a high level of AI over-dependence with a grand mean of 2.93. This implies that many students now rely heavily on AI tools such as ChatGPT, Gemini, and Grammarly to complete assignments, generate ideas, summarize content, and answer academic questions. This finding aligns with Zhang et al. (2024) who defined AI dependency as relying on AI to obtain answers when tasks can be completed independently, and reported that such dependency is increasingly common among college students. This finding aligns with Edeh et al. (2023) and Owolabi and Adeyemi (2024) who reported high AI usage among Nigerian undergraduates. It also supports Gerlich (2025) and Zhang et al. (2024) who noted growing dependency on AI for academic work. The high dependence may be attributed to the convenience, speed, and 24/7 availability of AI tools. The high dependence may also be attributed to large class sizes, limited lecturer contact, easy access to smartphones, and the perceived efficiency of AI in producing quick answers. However, this trend is concerning because, as Carobene Ghanem and Alharbi (2024) cautioned, over-dependence on AI dialogue systems, together with issues like AI hallucinations and lack of transparency, could hinder the development of essential cognitive skills.

Relationship between AI over-dependence and critical thinking

The study revealed a significant negative relationship between AI over-dependence and critical thinking, r = -.482, p <.05. This means that as students' dependence on AI increases, their ability to analyze information, evaluate arguments, and think logically decreases. This finding is consistent with Crompton and Burke (2023) who stated that excessive reliance on AI-generated content may weaken students' analytical and critical thinking skills. It also agrees with Patrick (2025) who

reported that students and faculty worry that overreliance on AI could reduce effort in crafting well-structured arguments and compromise the development of research and writing skills. This result corroborates Yulianti et al. (2024), Montenegro-Rueda et al. (2023), and Alrazaq et al. (2023) who found that overreliance on AI stifles logical reasoning and evaluation skills. From the lens of Cognitive Load Theory, when students offload thinking to AI, they reduce the germane cognitive load needed to build schemas, thereby weakening critical thinking capacity. If students accept AI outputs without questioning, they fail to engage in the deep processing required for critical thought. The implication is that students may produce good grades but lack the ability to defend or critique ideas — a problem already observed anecdotally in Nigerian universities (University of Port Harcourt, 2025).

Influence of AI over-dependence on creativity

The result showed that AI over-dependence significantly and negatively influenced students' creativity, $\beta = -.451$, $R^2 = .203$, $p < .05$. This indicates that AI over-dependence accounted for 20.3% of the variance in students' creativity. This means that students who depend excessively on AI are less likely to generate original ideas or think divergently. This supports Duhaylungsod and Chavez (2023) who argued that over-reliance on AI could reduce students' skills of creativity and innovation because they become overly reliant on technology for information. This supports May (2024) who argued that ease of access to AI leads to complacency and reduced divergent thinking. Similarly, AlAli and Wardat (2024) found that AI may undermine students' creativity by encouraging reproduction rather than ideation. The finding also aligns with Li and Ganapathy (2026) who noted that it is the manner of AI use, rather than frequency, that determines cognitive consequences. When AI is used to replace rather than augment thinking, students' creative "muscle" atrophies and they produce less novel work. The implication for Plateau State is that over-reliance on AI may produce graduates with standardized thinking rather than innovative problem-solvers needed for national development.

Effect of AI over-dependence on independent learning

The study found a significant negative effect of AI over-dependence on independent learning, $r = -.519$, $p < .05$. This suggests that students who depend too much on AI are less likely to engage in self-regulation, initiative, persistence, and the ability to study without external aid. This finding corroborates Buçinca et al. (2021) who stated that over-reliance on AI-generated support may undermine students' capacity to make independent, well-reasoned choices. It also agrees with Kobaba, et al. (2025) who reported that 70% of studies found a decline in independent problem-solving skills with increased AI reliance. Similarly, Zhang et al. (2024) and Hyde et al. (2024 reported declines in self-directed learning with increased AI reliance. Furthermore, Montenegro-Rueda et al. (2023) noted that dependence can undermine mastery of essential problem-solving skills. This implies that AI, if not used reflectively, can erode students' autonomy as learners and make them passive recipients rather than active constructors of knowledge. From Cognitive Load Theory, outsourcing cognitive tasks to AI prevents students from experiencing productive struggle — a key mechanism for building metacognitive skills. In the Nigerian context where power outages and data costs can disrupt AI access, such dependence may also affect academic continuity. Institutions therefore need to train students to use AI as a tutor, not a crutch (Rolf, 2025).

Relationship between AI over-dependence and human interaction

The findings revealed a significant negative relationship between AI over-dependence and human interaction, $\beta = -.398$, $R^2 = .158$, $p < .05$. This means that increased use of AI for academic help is associated with reduced engagement with peers and lecturers. This is in line with Seo, Tang, Roll, Fels and Yoon (2021) who found that AI-supported tools can reduce teacher-student interaction and weaken the human dimension of education, especially in tasks such as presenting course material, evaluating assignments, and providing feedback. Lu et al. (2025) also noted that peer interaction plays a mediating role between AI literacy and critical thinking. This agrees with Chan and Hu (2023) who linked heavy AI use to reduced participation in study groups and office hours. When students bypass human discussion and go straight to AI, they miss opportunities for dialogue, collaboration, argumentation, and social construction of knowledge as emphasized by Vygotsky's Social Constructivism. Over time, this may lead to isolation and reduced communication skills. In collectivist societies like Nigeria, this may weaken teamwork and interpersonal skills. However, the moderate R^2 suggests that other factors like classroom culture also matter.

Difference in AI over-dependence by demographic variables

Gender: The study found no significant difference in AI over-dependence based on gender, $F(1, 419) = 3.128$, $p = .078$. Post-hoc analysis indicated that both male and female students are equally likely to depend on AI tools. This finding agrees with Patrick (2025) who reported that adoption of AI tools cuts across gender lines in higher education. It implies that access to AI tools and the motivation to use them are not gendered in the context of Plateau State.
Institution Type: There was a significant difference in AI over-dependence based on institution type, $F(2, 418) = 6.102$, $p = .002$. Post-hoc analysis revealed that university students exhibited higher AI over-dependence than polytechnic and college of education students. This supports Kobaba et al. (2025) who found that university students rely more on AI due to greater internet access, higher research workload, and more exposure to digital tools. University curricula that emphasize research papers and projects may also push students toward AI for efficiency.

Level of Study: There was also a significant difference based on level of study, $F(3, 417) = 5.731$, $p = .001$. Post-hoc analysis showed that 100L and 200L students exhibited higher AI over-dependence than 300L and 400L students. This aligns with Duhaylungsod and Chavez (2023) who noted that lower-level students exhibit higher AI dependence because they are still developing academic skills and problem-solving strategies. As students advance, they may develop more

confidence and skills to work independently, thus reducing over-reliance. This suggests the need for early intervention in year 1 and 2.

Overall Implication of Findings

Taken together, the findings indicate that while AI offers efficiency, over-dependence comes at a cost to core learning outcomes. The negative relationships with critical thinking, creativity, independent learning, and human interaction suggest that students may be trading deep learning for convenience. The demographic differences further show that institutional context and academic maturity matter. These results are consistent with both Cognitive Load Theory and Social Constructivism, which emphasize the importance of active mental engagement and social interaction for meaningful learning. The Plateau State context mirrors global trends but with added concerns around digital literacy and infrastructure.

Conclusion

This study examined the influence of AI over-dependence on students' learning outcomes in tertiary institutions in Plateau State, Nigeria. Based on data from 421 undergraduate students across 6 institutions, the study concludes that AI over-dependence is high among tertiary students in Plateau State. Many students rely on AI tools to complete academic tasks that they are capable of doing independently; AI over-dependence significantly and negatively relates to critical thinking. Excessive reliance on AI reduces students' capacity to analyze, evaluate, and synthesize information; AI over-dependence significantly and negatively influences creativity. Over-reliance on AI-generated ideas limits divergent thinking and originality; AI over-dependence significantly and negatively affects independent learning. Students who depend heavily on AI demonstrate lower self-regulation, persistence, and academic autonomy and AI over-dependence significantly and negatively relates to human interaction. Heavy use of AI for academic help reduces engagement with peers and lecturers, thereby limiting communication and collaborative skills.

Anchored on Cognitive Load Theory and Vygotsky's Social Constructivism, the study concludes that when AI is used as a substitute rather than a support tool, it bypasses the cognitive effort and social interaction necessary for meaningful learning. While AI has the potential to enhance education, over-dependence poses a serious threat to the development of 21st-century skills required of graduates in Nigeria. Given the increasing penetration of AI tools in Nigerian tertiary institutions, there is an urgent need for deliberate policies and digital literacy programs to promote responsible AI use. Without such interventions, the gains of technology in education may be offset by declines in critical thinking, creativity, independence, and interpersonal competence.

This study contributes to the limited empirical literature on AI and education in the Nigerian context, and specifically provides baseline data for Plateau State. It is recommended that stakeholders treat AI literacy not just as a technical skill, but as a pedagogical and ethical imperative.

Recommendations

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

1. To the National Universities Commission [NUC] and NBTE: Develop a National Policy on Responsible AI Use in Tertiary Institutions.

The NUC and NBTE should issue guidelines on ethical and pedagogical use of AI. The policy should mandate AI literacy modules in General Studies [GST] and differentiate between "AI-assisted" and "AI-generated" work. This will help institutions set clear boundaries and prevent over-dependence.

2. To University and Polytechnic Management in Plateau State: Integrate AI Literacy and Critical Thinking into the Curriculum.

Institutions should establish Digital Literacy Centers to train students on how to use AI as a "thinking partner" rather than a replacement. Workshops should focus on prompt engineering, fact-checking AI outputs, and metacognitive skills. Management should also provide alternative learning resources to reduce sole dependence on AI due to data costs.

3. To Lecturers and Course Instructors: Redesign Assessments to Test Process, Not Just Product.

Lecturers should move beyond take-home assignments that AI can easily complete. They should adopt oral defenses, in-class problem solving, project-based learning, and peer-review tasks. This aligns with Cognitive Load Theory and Social Constructivism by ensuring students still engage cognitively and socially. Lecturers should also model responsible AI use by showing students how to critique AI-generated content.

4. To Students: Practice Balanced and Reflective Use of AI Tools.

Students should be encouraged to use AI for brainstorming, explanation, and feedback, but not for full substitution of thinking. A "20-minute rule" is recommended: attempt the task independently first, then use AI to compare and improve. Student bodies and clubs should organize study groups to preserve human interaction and collaborative learning.

5. To Parents, PTA and Stakeholders: Support Access to Non-Digital Learning Resources.

Given infrastructure challenges in Plateau State, stakeholders should support libraries, reading culture, and mentorship programs. This will provide alternatives when AI access is unavailable and reduce over-reliance.

6. To Researchers: Conduct Longitudinal and Experimental Studies.

Future studies should use experimental designs to test AI literacy interventions and track students over time. Qualitative studies are also needed to understand how students in rural areas of Plateau State experience AI dependence.
If implemented, these recommendations will help tertiary institutions in Plateau State harness the benefits of AI while mitigating its risks. The goal is not to ban AI, but to produce graduates who are digitally competent, critically minded, creative, independent, and socially intelligent.

Operational definition of keywords

For the purpose of this study, the following keywords are defined operationally:

1. Artificial Intelligence [AI]:

In this study, Artificial Intelligence refers to digital tools and applications such as ChatGPT, Gemini, Grammarly, and other generative AI platforms that students use to generate text, answer questions, summarize content, and complete academic tasks.

2. AI Over-dependence:

AI Over-dependence refers to the excessive reliance of students on AI tools to perform academic tasks that they are capable of doing independently. In this study, it was measured by 10 items on the AIOSLOQ assessing frequency of use, inability to function without AI, and preference for AI over human effort. A high mean score indicates high over-dependence.

3. Critical Thinking:

Critical thinking is the ability of students to analyze information, evaluate arguments, solve problems, and make reasoned judgments. In this study, it was operationalized as students' self-reported capacity to question AI outputs, think logically, and justify answers without AI help, measured by 8 items on the AIOSLOQ.

4. Creativity:

Creativity is the ability of students to generate original ideas, think divergently, and produce novel solutions to academic problems. In this study, it was measured by 8 items on the AIOSLOQ that assess originality, imagination, and ability to generate ideas without copying AI-generated content.

5. Independent Learning:

Independent learning refers to the capacity of students to take responsibility for their own learning through self-regulation, initiative, persistence, and ability to study without external aid. In this study, it was measured by 8 items on the AIOSLOQ assessing self-study habits and reduced reliance on AI for learning.

6. Human Interaction:

Human interaction refers to the extent to which students engage in academic discussions, collaboration, and communication with peers and lecturers. In this study, it was operationalized as participation in study groups, asking lecturers questions, and preference for human help over AI, measured by 8 items on the AIOSLOQ.

7. Learning Outcomes:

Learning outcomes in this study refer to the measurable changes in students' critical thinking, creativity, independent learning, and human interaction as a result of AI use. It is the combined score of the four dependent variables.

8. Tertiary Institutions:

Tertiary institutions in this study refer to all accredited universities, polytechnics, and colleges of education in Plateau State, Nigeria that admit students after secondary school education.

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