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Artificial Intelligence Literacy as a Predictor of Students' Learning Motivation and Academic Engagement in Selected Secondary Schools in Gusau Metropolis, Zamfara State

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ABSTRACT

This study examined the relationship between artificial intelligence (AI) literacy, learning motivation, and academic engagement among Senior Secondary School II (SS II) students in selected secondary schools in Gusau Metropolis, Zamfara State. A correlational research design was adopted to evaluate statistical associations without experimentally manipulating variables. From a target population of 4,250 SS II students across 22 public and private secondary schools, a sample of 300 SS II students was selected through a multistage stratified random sampling procedure. Data were collected using three structured instruments: the Artificial Intelligence Literacy Questionnaire (AILQ; alpha = .84), the Learning Motivation Scale (LMS; alpha = .82), and the Academic Engagement Scale (AES; alpha = .86). Out of 300 distributed questionnaires, 288 were fully completed and analyzed, yielding a 96.0% response rate. Data were analyzed using descriptive statistics (mean, standard deviation), Pearson product-moment correlation, and simple linear regression at the 0.05 level of significance. The findings indicated a significant positive relationship between AI literacy and learning motivation, $r = .47$, $p < .001$. AI literacy also had a significant positive relationship with academic engagement, $r = .51$, $p < .001$. Simple linear regression established that AI literacy statistically predicted learning motivation, $\beta = .47$, $R^2 = .22$, $F(1,298) = 83.91$, $p < .001$, and academic engagement, $\beta = .51$, $R^2 = .26$, $F(1,298) = 105.06$, $p < .001$. These findings indicate that higher AI literacy is significantly associated with elevated motivation and stronger academic engagement among secondary school students. The study recommends age-appropriate AI literacy integration into the secondary school curriculum, targeted teacher professional development, and the establishment of clear institutional policies for responsible educational AI adoption.

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Artificial intelligence, Literacy, Motivation, Engagement, Psychology, Generative AI

1. Introduction

Artificial intelligence (AI) has moved rapidly from the margins of technological innovation into the centre of contemporary educational discourse. The emergence of generative AI systems has accelerated this transformation by making sophisticated forms of machine-generated text, explanation, translation, problem-solving, and feedback available to ordinary users. According to Gambo et al., (2026) for secondary school students, AI is increasingly becoming part of the environment within which they search for information, complete assignments, prepare for examinations, and interact with educational content.

This transformation creates both opportunities and challenges. AI-supported learning can provide immediate feedback, personalised explanations, and access to learning resources. At the same time, students may encounter inaccurate information, algorithmic bias, fabricated references, privacy risks, and the temptation to substitute AI-generated answers for independent thinking (Gambo et al., 2026). UNESCO's AI Competency Framework for Students emphasises the need to prepare students to engage with AI safely and meaningfully, identifying core competencies across a human-centred mindset, ethics of AI, AI techniques and applications, and AI system design (UNESCO, 2024).

AI literacy is therefore broader than the ability to operate an AI application. Contemporary work conceptualises AI literacy as multidimensional, involving knowledge, practical engagement, critical evaluation, attitudes, and ethical understanding. Ng et al. (2024) developed and validated an AI Literacy Questionnaire for secondary students using affective, behavioural, cognitive, and ethical dimensions, establishing robust construct validity and reliability across diverse learning settings.

According to UNESCO (2024) this distinction between mere AI use and comprehensive AI literacy is particularly important in secondary education. A student may frequently use ChatGPT or another generative AI application without possessing the critical competence required to determine whether an AI-generated response is accurate, biased, incomplete, or ethically appropriate. An AI-literate student should be able to evaluate outputs, verify important claims, recognise technological limitations, and make responsible decisions about when AI assistance is appropriate. UNESCO similarly emphasizes critical judgement, human agency, ethical responsibility, and safe use as necessary pillars for digital citizenship.

From an educational psychology perspective, AI literacy may be directly relevant to students' perceptions of competence, control, and willingness to engage with learning tasks. Students who understand the strengths and limitations of AI may be better positioned to use technological resources for clarification, practice, feedback, and idea generation (Zhao, 2025). Conversely, students with limited AI literacy may avoid useful tools or use them uncritically, leading to passive learning habits. Thus, AI literacy may be systematically associated with key motivational and engagement processes (Abubakar et al., 2024).

Learning motivation is a central educational psychology construct because it influences the direction, intensity, and persistence of learning behaviour. Dada & Quadir, (2026) Motivated students are more likely to set academic goals, invest effort, persist when tasks become difficult, and seek strategies for understanding challenging material. If AI literacy enables students to use technological resources strategically, it may be associated with stronger motivational patterns.

Academic engagement is another critical educational outcome, commonly operationalized across behavioural, emotional, and cognitive dimensions. Behavioural engagement concerns participation and effort; emotional engagement encompasses interest, belonging, and emotional responses to learning; and cognitive engagement involves concentration, strategic thinking, and self-regulated learning investment. AI tools can influence all three dimensions: immediate clarification can support behavioral persistence, interactive brainstorming can stimulate emotional curiosity, and critical evaluation of AI responses requires high cognitive engagement (UNESCO, 2024).

The relationship between AI literacy and psychological learning outcomes has begun to receive empirical attention. Yaşar and Karagücük (2024) investigated AI literacy and English language learning motivation among university students and reported a significant positive relationship. Zhao (2025) examined learners' AI literacy and resilience in relation to engagement and motivation in AI-based settings from an achievement goal theory perspective. However, empirical literature within the sub-Saharan African context, particularly focusing on secondary school students in Northern Nigeria, remains scarce.

The Nigerian educational context presents unique parameters. Students' experiences with digital technologies are shaped by structural variations in access to devices, electricity, internet connectivity, teacher digital preparedness, and institutional infrastructure. Recent studies (Abubakar et al., 2024; Dada & Quadir, 2026; Gambo et al., 2026) highlight growing student awareness of AI alongside critical gaps in formal training, ethical orientation, and equitable access. Existing African empirical studies concentrate predominantly on tertiary education, leaving a distinct gap regarding secondary school learners who are actively forming lifelong academic habits.

Secondary school students deserve targeted investigation because their cognitive development, academic self-regulation, and technological habits differ substantially from tertiary undergraduates. SS II students represent a critical cohort preparing for senior school certificate examinations, where academic motivation and cognitive engagement directly dictate academic trajectories. The present study addresses this empirical gap by evaluating AI literacy in relation to learning motivation and academic engagement among SS II students in Gusau Metropolis, Zamfara State.

2. Theoretical Framework

The study is anchored in Achievement Goal Theory (AGT) developed by Nicholls (1984) and Ames (1992). Achievement Goal Theory posits that learners' underlying goals and competence perceptions drive their academic motivation, strategic effort, cognitive investment, and behavioral engagement. AGT distinguishes between mastery goals (focused on skill acquisition, understanding, and self-improvement) and performance goals (focused on demonstrating ability relative to others).

Within AI-supported learning environments, AI literacy serves as a critical personal resource that influences goal orientation. Students who possess high AI literacy specifically in understanding, applying, evaluating, and ethically managing AI are equipped to deploy generative AI tools for mastery-oriented purposes (Gambo et al., 2026). They use AI to decompose complex subjects, obtain corrective feedback, generate self-assessment prompts, and master challenging concepts. Conversely, students lacking AI literacy are more prone to performance-avoidance behaviors or superficial completion of tasks without conceptual mastery.

The theoretical application of AGT to digital learning spaces is reinforced by Zhao (2025), who demonstrated that learners' AI literacy directly interacts with task perception, buffering academic frustration and fostering sustained cognitive engagement. AGT provides a robust explanatory framework for understanding why students' technological competence in handling AI relates directly to their internal drive (learning motivation) and active participation (academic engagement) in classroom tasks.

3. Statement of the Problem

The widespread accessibility of generative AI platforms presents a transformative challenge for secondary education within Gusau Metropolis, Zamfara State. Secondary school students increasingly turn to automated systems to complete homework, summarize textbooks, translate texts, and solve mathematical problems. While these technologies possess the capacity to enhance learning, uncritical reliance on AI threatens to foster academic dishonesty, passive learning, reduced cognitive effort, and superficial retention.

The core problem is not merely the adoption of AI applications by students, but the evident gap in AI literacy required to navigate these tools critically, ethically, and productively. Many secondary school students lack formal training in identifying AI hallucinations, recognizing algorithmic bias, or understanding ethical academic boundaries. Without adequate AI literacy, students risk accepting erroneous information or substituting AI output for independent cognitive processing.

While international research has begun exploring AI constructs, empirical evidence regarding the relationship between AI literacy, learning motivation, and academic engagement among secondary school students in Zamfara State remains non-existent. Without empirical data, educators, guidance counsellors, and policymakers in Gusau Metropolis lack actionable insights

to guide instructional technology policies. Therefore, this study empirically investigated whether AI literacy predicts learning motivation and academic engagement among senior secondary school students in Gusau Metropolis, Zamfara State.

Objectives of the Study

1. To determine the relationship between artificial intelligence literacy and students' learning motivation in Gusau Metropolis, Zamfara State.

2. To determine the relationship between artificial intelligence literacy and students' academic engagement in Gusau Metropolis, Zamfara State.

3. To determine the extent to which artificial intelligence literacy predicts students' learning motivation and academic engagement among secondary school students in Gusau Metropolis, Zamfara State.

Research Questions

1. What relationship exists between artificial intelligence literacy and students' learning motivation in Gusau Metropolis, Zamfara State?

2. What relationship exists between artificial intelligence literacy and students' academic engagement in Gusau Metropolis, Zamfara State?

3. To what extent does artificial intelligence literacy predict students' learning motivation and academic engagement in Gusau Metropolis, Zamfara State?

Research Hypotheses

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

H01: There is no significant relationship between artificial intelligence literacy and students' learning motivation in Gusau metropolis, Zamfara state.

H02: There is no significant relationship between artificial intelligence literacy and students' academic engagement in Gusau metropolis, Zamfara state.

H03: There is no significant prediction of students' learning motivation and academic engagement by artificial intelligence literacy in Gusau Metropolis, Zamfara State.

4. Methodology

Research Design

A correlational research design was employed for this study. The design was appropriate because it allowed the researchers to quantitatively evaluate the direction, strength, and predictive capability of the associations between AI literacy (independent variable), learning motivation, and

academic engagement (dependent variables) in their natural school settings without experimental manipulation.

Population of the Study

The target population comprised 4,250 Senior Secondary School II (SS II) students enrolled across 22 government-approved public (14) and private (8) secondary schools in Gusau Metropolis, Zamfara State (Ministry of Education, Zamfara State, Secondary School Inspectorate Division Data, 2025/2026 Academic Session). SS II students were selected because they have established secondary school academic routines and represent the primary cohort undergoing preparation for national terminal examinations.

Sample Size and Sampling Procedure

A sample of 300 SS II students was selected using a multistage stratified random sampling procedure. Stage 1 (Stratification by School Ownership): The 22 secondary schools in Gusau Metropolis were stratified into public schools (14) and private schools (8). Stage 2 (Selection of Schools): Simple random sampling via balloting was used to select 6 public secondary schools and 4 private secondary schools, yielding 10 participating secondary schools. Stage 3 (Proportional Student Allocation): A proportional allocation technique was applied based on school enrollment to select 30 SS II students from each of the 10 selected schools (10 \times 30 = 300). Stage 4 (Selection of Respondents): Within each selected school, 30 students were drawn from SS II registers using systematic random sampling with a interval of k = N/30.

Instruments for Data Collection

Data were collected using three structured psychological scales formatted on a 5-point Likert response scale ranging from Strongly Disagree (1) to Strongly Agree (5). Artificial Intelligence Literacy Questionnaire (AILQ): Adapted from the multi-dimensional framework of Ng et al. (2024). The AILQ comprises 16 items measuring four dimensions: Affective (4 items), Behavioural/Application (4 items), Cognitive/Knowledge (4 items), and Ethical Awareness (4 items). Total scores range from 16 to 80. Learning Motivation Scale (LMS): Adapted from academic motivation scales developed for secondary learners. The LMS contains 12 items assessing intrinsic interest, goal orientation, persistence, and academic self-efficacy. Total scores range from 12 to 60. Academic Engagement Scale (AES): Adapted from standard student engagement instruments. The AES consists of 15 items spanning Behavioral Engagement (5 items), Emotional Engagement (5 items), and Cognitive Engagement (5 items). Total scores range from 15 to 75.

Validity of the Instruments

Content, face, and construct validities of the adapted instruments were established through expert judgment. The draft instruments were reviewed by three experts: two senior lecturers in Educational Psychology and one expert in Educational Measurement and Evaluation from Usmanu

Danfodiyo University, Sokoto. The experts evaluated item clarity, cultural appropriateness for Nigerian secondary students, alignment with objectives, and content relevance. Recommendations regarding phrasing and contextual adaptation were incorporated. A Content Validity Index (CVI) was calculated, yielding CVI values of .88 for AILQ, .85 for LMS, and .89 for AES, confirming high content validity.

Pilot Study and Reliability

A pilot study was conducted using 40 SS II students from two secondary schools in Bungudu Local Government Area (outside the study area) possessing similar characteristics to the sample. The data collected were subjected to internal consistency analysis using Cronbach's alpha. The overall instrument reliability achieved was \alpha = .81. The subscale reliability coefficients were:

1. Artificial Intelligence Literacy Questionnaire (AILQ): alpha = .84
2. Learning Motivation Scale (LMS): alpha = .82
3. Academic Engagement Scale (AES): alpha = .86

All coefficients exceeded the .70 benchmark, confirming high instrument reliability.

Procedure for Data Collection

Data collection was conducted over a three-week period by the primary researchers assisted by two trained research assistants. Questionnaires were administered directly to students during dedicated study periods in their respective classrooms. Instructions were verbally explained, and students completed the instruments independently. Out of 300 distributed questionnaires, 288 were retrieved completely filled and free of procedural errors, representing an effective response rate of 96.0%. Twelve (12) questionnaires were discarded due to incomplete entries or uniform response patterns. Data were screened and analyzed using IBM SPSS Statistics Version 25.0. Descriptive statistics (frequencies, percentages, means, standard deviations, minimum and maximum values) were generated. Pearson product-moment correlation was utilized to test Hypotheses 1 and 2. Simple linear regression analyses were conducted to test Hypothesis 3. All statistical tests were conducted at the 0.05 level of significance.

5. Results

Demographic Characteristics of Respondents

Table 1 presents the demographic characteristics of the 288 participating SS II students in terms of gender, age range, and school ownership.

Table 1: Demographic Distribution of Respondents (N = 288)

Demographic Variable	Category	Frequency (f)	Percentage (%)
Gender	Male	156	54.2
Gender	Female	132	45.8
Age Range	14-15 years	68	23.6
Age Range	16-17 years	184	63.9
Age Range	18 years and above	36	12.5
School Ownership	Public	172	59.7
School Ownership	Private	116	40.3
Total		**288**	**100.0**

Table 1 shows the demographic characteristics of the 288 respondents who participated in the study. In terms of gender**,** 156 respondents (54.2%) were male**, while** 132 respondents (45.8%) were female**.** This indicates that male students constituted a slightly larger proportion of the respondents than female students. Regarding age, the majority of the respondents, 184 (63.9%)**,** were between 16 and 17 years of age. This was followed by 68 respondents (23.6%) who were between 14 and 15 years**,** while 36 respondents (12.5%) were 18 years and above**.** Thus, most participants were within the typical age range for SS II students. With respect to school ownership, 172 respondents (59.7%) were from public schools**,** whereas 116 respondents (40.3%) were from private schools. This indicates that respondents from public schools constituted the larger proportion of the sample. Overall, the table indicates that the study sample comprised students from both genders, different age categories, and both public and private schools, thereby providing representation across the demographic characteristics considered in the study.

Descriptive Statistics of Major Variables

Table 2 presents the mean, standard deviation, minimum score, maximum score, and theoretical range of the three major variables investigated in the study, namely AI Literacy, Learning Motivation, and Academic Engagement.

Table 2: Descriptive Statistics of Major Study Variables (N = 288)

Variable	Mean	Standard Deviation (SD)	Minimum Score	Maximum Score	Theoretical Range
AI Literacy	52.41	9.85	22.00	76.00	16-80
Learning Motivation	41.18	7.62	18.00	58.00	12-60

Variable	Mean	Standard Deviation (SD)	Minimum Score	Maximum Score	Theoretical Range
Academic Engagement	50.35	8.94	21.00	72.00	15-75

Table 2 indicates that the respondents obtained a mean score of 52.41 (SD = 9.85) on AI Literacy, with observed scores ranging from 22.00 to 76.00, compared with the theoretical range of 16 to 80**.** This suggests that, on average, the respondents demonstrated a relatively high level of AI literacy. For Learning Motivation, the respondents recorded a mean score of 41.18 (SD = 7.62)**,** with observed scores ranging from 18.00 to 58.00, against a theoretical range of 12 to 60**.** The mean score is relatively high in relation to the possible range, suggesting that the respondents generally reported a relatively high level of learning motivation. Similarly, the respondents recorded a mean score of 50.35 (SD = 8.94) for Academic Engagement. The observed scores ranged from 21.00 to 72.00**,** while the theoretical range was 15 to 75**.** The mean score indicates a relatively high level of academic engagement among the respondents. Generally, the descriptive results suggest that the participating students had relatively high levels of AI literacy, learning motivation, and academic engagement.

Testing of Hypothesis One

H_{o1}: There is no significant relationship between artificial intelligence literacy and students' learning motivation in Gusau Metropolis, Zamfara State.

Table 3: Pearson Correlation between AI Literacy and Learning Motivation (N = 288)

Variables	N	Pearson r	Sig. (2-tailed)	Decision
AI Literacy	288	.47**	< .001	Reject H01
Learning Motivation	288			

p < .01.

Table 3 shows a statistically significant moderate positive relationship between AI literacy and learning motivation, r = .47, p < .001. Since the p-value is less than the 0.05 level of significance, the null hypothesis is rejected. This indicates that students with higher AI literacy tend to report higher levels of learning motivation.

Testing of Hypothesis Two

H_{o2}: There is no significant relationship between artificial intelligence literacy and students' academic engagement in Gusau Metropolis, Zamfara State.

Table 4: Pearson Correlation between AI Literacy and Academic Engagement (N = 288)

Variables	N	Pearson r	Sig. (2-tailed)	Decision
AI Literacy	288	.51**	< .001	Reject H02
Academic Engagement	288			

p < .01.

Table 4 shows a statistically significant positive relationship between AI literacy and academic engagement, r = .51, p < .001**.** Since the p-value is less than the 0.05 level of significance, the null hypothesis is rejected. This indicates that students with higher AI literacy tend to demonstrate higher levels of academic engagement.

Testing of Hypothesis Three

H_{03}: There is no significant prediction of students' learning motivation and academic engagement by artificial intelligence literacy in Gusau Metropolis, Zamfara State.

Table 5: Simple Linear Regression Models for AI Literacy Predicting Learning Motivation and Academic Engagement (N = 288)

Dependent Variable	R	R^2	Adjusted R^2	F	df	β	B	SE(B)	t	p-value	Decision
Learning Motivation	.47	.221	.218	80.67	1, 286	.47	0.364	0.041	8.98	< .001	Reject H_{03}
Academic Engagement	.51	.260	.257	100.48	1, 286	.51	0.463	0.046	10.02	< .001	Reject H_{03}

Table 5 indicates that AI literacy significantly predicted both learning motivation and academic engagement. For learning motivation, AI literacy produced R = .47 and R^2 = .221**,** indicating that AI literacy explained approximately 22.1% of the variance in learning motivation**.** The regression model was statistically significant, F(1, 286) = 80.67, p < .001**.** The standardized regression coefficient was β = .47**,** with B = 0.364**,** SE(B) = 0.041**,** and t = 8.98, p < .001**.** Therefore, AI literacy significantly predicted learning motivation, and the null hypothesis was rejected. For academic engagement, AI literacy produced R = .51 and R^2 = .260, indicating that AI literacy explained approximately 26.0% of the variance in academic engagement**.** The regression model was statistically significant, F(1, 286) = 100.48, p < .001**.** The standardized regression coefficient was β = .51**,** with B = 0.463**,** SE(B) = 0.046**,** and t = 10.02, p < .001**.** Thus, AI literacy significantly predicted academic engagement, and the null hypothesis was rejected. The results therefore

indicate that AI literacy was a significant positive predictor of both learning motivation and academic engagement among the participating SS II students.

6. Discussion of Findings

The first finding established a significant moderate positive relationship between AI literacy and learning motivation ($r = .47$, $p < .001$), with AI literacy accounting for 22.1% of the variance in motivation. This demonstrates that secondary school students who possess a stronger understanding of AI systems, practical applications, critical limitations, and ethical boundaries display higher internal drive, goal orientation, and academic self-efficacy. This finding aligns with Yaşar and Karagücük (2024), who observed that digital literacy skills specifically tailored to AI platforms enhanced motivation among language learners. The empirical result also mirrors observations by Woo et al. (2024), who reported that structured AI integration elevated students' intrinsic desire to master complex learning tasks. From an educational psychology perspective, this relationship is well explained by Achievement Goal Theory (Nicholls, 1984; Ames, 1992). When students gain critical AI literacy, technology ceases to be an opaque or intimidating phenomenon. Instead, literate students perceive AI tools as actionable cognitive scaffolding. This perception enhances self-efficacy, encouraging students to set mastery goals, persist through challenging assignments, and maintain elevated intrinsic motivation.

The second finding revealed a statistically significant positive relationship between AI literacy and academic engagement ($r = .51$, $p < .001$), with AI literacy predicting 26.0% of the variance in engagement. Students with higher AI literacy demonstrated greater behavioral participation, emotional connection, and cognitive investment in school tasks. This result accords with Zhao (2025), who found that AI literacy buffers digital frustration, fostering elevated cognitive resilience and engagement within modern technology-supported classrooms. This outcome reflects the multidimensional nature of academic engagement. AI-literate students do not merely copy outputs; they interact with AI tools to brainstorm ideas, check reasoning, seek immediate clarification, and draft study outlines. This active operationalization fosters behavioral persistence and intellectual curiosity. However, as noted in recent African empirical studies (Aiyebelehin et al., 2025; Gambo et al., 2026), unguided AI access without literacy leads to cognitive passivity. Hence, critical AI literacy is the active ingredient that transforms digital access into meaningful academic engagement.

The regression models confirmed that while AI literacy is a statistically significant predictor (explaining 22.1% and 26.0% of variance), substantial proportions of variance in motivation (77.9%) and engagement (74.0%) are determined by exogenous factors. These findings align with broader Nigerian studies (Abubakar et al., 2024; Essien et al., 2024; Yakubu et al., 2025) emphasizing that psychological learning outcomes remain grounded in teacher quality, institutional infrastructure, socioeconomic status, and home environment. Therefore, AI literacy represents a crucial, modern cognitive tool within a larger ecosystem of educational determinants.

7. Conclusion

This study demonstrated that artificial intelligence literacy is a statistically significant positive predictor of learning motivation and academic engagement among senior secondary school students in Gusau Metropolis, Zamfara State. Students who understand AI principles, critically evaluate machine outputs, and apply AI tools ethically display greater intrinsic motivation, academic persistence, and classroom engagement. These findings affirm that AI literacy is a critical contemporary educational psychology construct. In an era where generative AI access is becoming ubiquitous, educational outcomes are dictated not by access alone, but by student competence in critically evaluating, interpreting, and ethically directing digital tools. Fostering AI literacy empowers secondary students to utilize technology as cognitive scaffolding for deep learning rather than a substitute for independent thought.

8. Recommendations

1. The Ministry of Education, Zamfara State, alongside school administrators, should incorporate age-appropriate AI literacy modules into the senior secondary school curriculum, supported by teacher professional development workshops that emphasize prompt engineering, critical evaluation, and ethical technology adoption to directly enhance students' learning motivation.

2. Secondary school authorities, guidance counselors, and educators should establish clear institutional policy guidelines and structured digital study routines that define responsible AI usage, promote critical cross-verification of AI outputs against standard textbooks, and foster sustained cognitive and behavioral academic engagement.

3. Educational stakeholders and future researchers should implement and empirically monitor structured AI literacy programs across diverse demographic contexts using longitudinal and experimental designs to evaluate their long-term predictive impact on student motivation, engagement, and academic performance.

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