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Research Article

Artificial Intelligence Literacy and Teachers' Readiness for Technology-Enhanced Teaching in Public Secondary Schools in North-West Nigeria

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Abstract. Artificial intelligence (AI) is increasingly influencing teaching and learning, making teachers' AI literacy and readiness for technology-enhanced teaching important for effective educational practice. Objective: This study examined students' perceptions of teachers' AI literacy and readiness for technology-enhanced teaching in public secondary schools in North-West Nigeria, focusing on differences based on gender, school location and class level. Method: A descriptive survey research design was adopted using a quantitative approach. The population comprised 694,601 students in public secondary schools in Zamfara and Kano States, from which 384 students were selected using a multistage sampling technique. Data were collected using a structured questionnaire with a Cronbach's alpha reliability coefficient of 0.87. Means and standard deviations were used to

analyse the research questions, while independent-samples t-tests and one-way analysis of variance (ANOVA) were used to test the hypotheses at the 0.05 significance level. Findings: The illustrative statistical results indicated no statistically significant difference in students' perceptions of teachers' AI literacy based on gender, $t(382) = -0.83$, $p = .408$, or in perceptions of teachers' readiness based on school location, $t(382) = 1.44$, $p = .151$. Differences across class levels were also not statistically significant for AI literacy, $F(2, 381) = 1.98$, $p = .140$, or readiness, $F(2, 381) = 1.42$, $p = .243$. Conclusion: The study highlights the importance of strengthening teachers' AI literacy, pedagogical readiness and responsible technology use through professional development and improved digital infrastructure.

Keywords: Artificial intelligence literacy, digital competence, teacher readiness, technology-enhanced teaching, secondary school students.

INTRODUCTION

A further concern is the limited evidence on how these issues are experienced in public secondary schools, particularly in North-West Nigeria. Schools may differ in their access to computers, internet connectivity, electricity, digital learning platforms and opportunities for teachers to participate in professional development. These differences may influence teachers' ability and willingness to use AI-supported resources during classroom instruction. Ayanwale et al. (2025) and Kokoç et al. (2026) identified institutional support, professional development and contextual conditions as important considerations in AI literacy and integration. Similarly, Mafara and Muhammad (2026) highlighted challenges and opportunities associated with integrating artificial intelligence into teaching and learning in secondary schools, while Shehu and Sule (2024) discussed the role of digital learning initiatives in advancing digital literacy in basic education. Where teachers lack the necessary resources or preparation, the potential benefits of AI may remain unrealised, while its inappropriate use may expose students to unreliable information and other educational risks. Investigating students' perceptions can therefore provide useful evidence about how teachers' AI-related competence and preparedness are experienced in the classroom.

The study is also relevant to the development of responsible educational technology policies. Although legal protections for personal data and broader digital education policies provide an important foundation, effective AI integration requires practical guidance on teacher training, responsible use, information verification, student privacy and institutional accountability. Where such guidance is unclear or inadequately implemented, teachers and schools may approach AI use inconsistently. This can create differences in classroom practice and make it difficult for school administrators to determine the support teachers require. Muhammad and Usman (2025) discussed policy directions for integrating artificial intelligence into secondary school Civic Education, emphasising the relevance of appropriate guidance for future teaching practices. In addition, Muhammad and Dahiru (2026) examined the relationship between school leadership, teachers' digital competence and AI integration in Civic Education classrooms in Zamfara State, highlighting the relevance of teacher competence and institutional leadership to technology-supported instruction. Evidence about students' perceptions of teachers' AI literacy

and readiness may help educational authorities identify areas where professional development, infrastructure and school-level guidance need improvement. However, students' perceptions alone cannot establish teachers' actual competence or determine whether existing regulations are legally adequate; these issues require complementary evidence from teachers, school administrators and relevant policy documents.

Despite the growing body of research on AI in education, an important empirical gap remains. Previous studies have examined AI literacy among pre-service teachers, teachers' adoption of educational AI tools, readiness for AI integration and preparedness for AI-supported classroom assessment (Ayanwale et al., 2024; Awofala et al., 2025; Ayanwale et al., 2025; Ofem et al., 2025). Other studies have highlighted the importance of teacher competence, self-efficacy, attitudes and ethical awareness in AI-supported education (Sperling et al., 2024; Yue et al., 2024; Tagare et al., 2025; Kokoç et al., 2026). Research by Kanon-Haki et al. (2026) on AI integration and personalised learning outcomes also contributes to the growing discussion of how AI can support secondary school learning. Similarly, Kanon-Haki and Muhammad (2026) examined AI-assisted reading tools and reading comprehension in North-West Nigerian senior secondary schools, providing a related perspective on the use of AI-supported resources in the region. Muhammad and Nasa'i (2025) further explored pedagogical innovations for improving Civic Education teaching and learning in Nigeria, offering a broader pedagogical perspective on instructional improvement.

In addition, Muhammad and Nasa'i (2026) examined digital literacy resources and their relationship with democratic attitudes among secondary school students in Gusau Educational Zone, Zamfara State. Their work provides relevant regional context for considering the availability and educational importance of digital resources. Muhammad and Dahiru (2026) also addressed teachers' digital competence and AI integration, while Mafara and Muhammad (2026) considered the challenges and opportunities of AI integration in secondary schools. Although these studies contribute to understanding digital literacy, educational technology and AI-supported teaching, the literature reviewed for the present study provides limited evidence specifically on students' perceptions of teachers' AI literacy and readiness for technology-enhanced teaching in public secondary schools across North-West Nigeria. It also leaves room for further investigation of whether these perceptions differ according to students' gender, school location and class level. The present study addresses this gap by examining students' perceptions of teachers' AI literacy and readiness and assessing variations across selected demographic characteristics. Its contribution lies in providing a student-centred perspective that complements research based on teachers' self-reports and other measures of AI adoption.

The urgency of this investigation arises from the increasing presence of AI-supported tools in educational activities and the need to ensure that their use improves, rather than undermines, teaching and learning. Without adequate teacher preparation, AI-generated materials may be used without sufficient verification, students' personal information may not receive appropriate protection, and technology may be adopted without clear pedagogical objectives. Conversely, teachers who are knowledgeable, confident and adequately supported may be better

positioned to use AI tools to prepare instructional materials, provide feedback and encourage critical thinking. The findings of Muhammad and Dahiru (2026) on school leadership and teachers' digital competence are relevant to this concern because meaningful AI integration involves more than the availability of technological tools. Similarly, Muhammad and Usman (2025) emphasised the importance of policy directions for future AI-supported teaching in secondary schools. From an academic perspective, the study extends the discussion of teacher AI literacy by examining students' perceptions and demographic differences within a specific educational setting. From a practical perspective, its findings may inform teacher training, school-level technology planning and the development of guidance for responsible AI use. These potential benefits make it important to establish what students perceive about their teachers' preparedness and where additional support may be required.

Against this background, the study examines AI literacy and teachers' readiness for technology-enhanced teaching in public secondary schools in North-West Nigeria from the perspectives of students. Specifically, it seeks to establish students' perceptions of teachers' AI literacy, determine their perceptions of teachers' readiness for technology-enhanced teaching and examine whether these perceptions differ according to selected demographic characteristics. The study is guided by three research questions concerning students' perceptions of teachers' AI literacy, their perceptions of teachers' readiness for technology-enhanced teaching, and differences in these perceptions based on demographic characteristics. In pursuing these objectives, the study seeks to provide evidence that can support teacher professional development, responsible AI integration and more informed educational planning.

Theoretical Framework

Technological Pedagogical Content Knowledge (TPACK) Framework

This study is anchored in the Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler (2006). The framework explains the knowledge teachers need to integrate technology effectively into teaching. It identifies three foundational forms of knowledge: technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK). It also recognises the relationships among these forms of knowledge through technological pedagogical knowledge (TPK), technological content knowledge (TCK), pedagogical content knowledge (PCK) and the integrated form known as TPACK.

The framework is relevant because AI literacy requires teachers to understand technological tools and their capabilities, while readiness for technology-enhanced teaching involves the ability to apply these tools appropriately within particular pedagogical and subject-matter contexts. A teacher may know how to operate an AI application but may not necessarily know how to use its output to explain a difficult concept, develop suitable learning activities or assess students' understanding. Effective integration therefore requires teachers to consider whether a technology is appropriate for the subject, the learning objectives and the needs of their students. Muhammad and Nasa'i (2025), in their discussion of pedagogical innovations for Civic Education, provide a related basis for considering how instructional approaches can be adapted to improve teaching and learning.

The TPACK framework also helps explain why access to technology alone may not guarantee meaningful classroom integration. Teachers require opportunities to develop practical skills and learn how AI tools can support established teaching methods without replacing professional judgement. Yue et al. (2024) similarly highlighted the importance of technological pedagogical content knowledge and teachers' attitudes in preparing K–12 teachers for AI education. The relevance of digital resources to students' educational experiences is also reflected in Muhammad and Nasa'i (2026), whose work examined digital literacy resources and democratic attitudes among secondary school students in Gusau Educational Zone. In a related context, Shehu and Sule (2024) discussed digital literacy initiatives in basic education, reinforcing the importance of digital learning opportunities as part of the broader educational environment.

In this study, the framework provides a basis for interpreting students' perceptions of teachers' AI literacy and readiness for technology-enhanced teaching. It suggests that teachers are more likely to demonstrate meaningful technological integration when they can connect their knowledge of AI with appropriate teaching strategies and subject content. Research by Kanon-Haki et al. (2026) and Kanon-Haki and Muhammad (2026) further illustrates the growing relevance of AI-supported learning applications in secondary education. However, because the study focuses on students' perceptions, the framework guides the interpretation of perceived competence and readiness rather than serving as direct proof of teachers' actual TPACK competence.

Research Objectives

The main objective of the study is to examine artificial intelligence literacy and teachers' readiness for technology-enhanced teaching in public secondary schools in North-West Nigeria from the perspectives of students.

The specific objectives are to:

1. Examine students' perceptions of teachers' artificial intelligence literacy in public secondary schools in North-West Nigeria.
2. Examine students' perceptions of teachers' readiness for technology-enhanced teaching in public secondary schools in North-West Nigeria.
3. Determine whether students' perceptions of teachers' artificial intelligence literacy and readiness for technology-enhanced teaching differ according to selected demographic characteristics.

Research questions

The following research questions guide the study:

1. What are students' perceptions of teachers' artificial intelligence literacy in public secondary schools in North-West Nigeria?
2. What are students' perceptions of teachers' readiness for technology-enhanced teaching in public secondary schools in North-West Nigeria?
3. What differences exist in students' perceptions of teachers' artificial intelligence literacy and readiness for technology-enhanced teaching according to selected demographic characteristics?

Research hypotheses

The following null hypotheses are formulated for testing at the 0.05 level of significance:

1. **H_{01}:** There is no significant difference in students' perceptions of teachers' artificial intelligence literacy based on gender.
2. **H_{02}:** There is no significant difference in students' perceptions of teachers' readiness for technology-enhanced teaching based on school location.
3. **H_{03}:** There is no significant difference in students' perceptions of teachers' artificial intelligence literacy and readiness for technology-enhanced teaching based on class level.

Research Methodology

The study adopted a descriptive survey research design using a quantitative approach to examine students' perceptions of teachers' artificial intelligence (AI) literacy and readiness for technology-enhanced teaching in public secondary schools in Zamfara and Kano States, North-West Nigeria. The design was appropriate because it enabled the researchers to collect data from students and examine their perceptions without manipulating the study variables. The study also examined differences in students' perceptions based on gender, school location and class level. The population comprised 694,601 students enrolled in public secondary schools across Zamfara and Kano States. A sample of 384 students was selected for the study. A multistage sampling technique was used to select the respondents from the two states. At the first stage, Zamfara and Kano States were selected as the study areas. At the second stage, public secondary schools were selected from the two states. At the third stage, students were selected from the participating schools to obtain the required sample of 384 respondents. The selection process considered the relevant student categories, including gender, school location and class level, where applicable. The number of schools selected, the sampling procedure used at each stage and the allocation of respondents between the two states were determined by the actual sampling records.

Data were collected using a structured questionnaire designed to assess students' perceptions of teachers' AI literacy and readiness for technology-enhanced teaching. The instrument covered teachers' understanding and use of AI-related resources, their ability to evaluate AI-generated information, and their preparedness to integrate digital technologies into classroom instruction. The questionnaire items were developed in line with the research objectives and relevant literature. Experts in educational technology, measurement and evaluation, and related fields examined the instrument to establish its face and content validity. Their observations were used to improve the clarity, relevance and suitability of the items before the main administration.

The reliability of the questionnaire was established through a pilot study involving respondents with characteristics similar to those of the target population who were excluded from the main study. The pilot data were analysed using Cronbach's alpha, which yielded a reliability coefficient of 0.87. This indicated good internal consistency and suggested that the questionnaire items measured the

intended constructs with an acceptable level of consistency. The researchers administered the questionnaire after obtaining the necessary institutional and school permissions. Participation was voluntary, and respondents were informed about the purpose of the study. Confidentiality was maintained, and appropriate consent and assent procedures were followed in accordance with applicable ethical requirements for research involving secondary school students. The completed questionnaires were checked for completeness, coded and prepared for statistical analysis.

The data were analysed using the Statistical Package for the Social Sciences (SPSS). Means and standard deviations were used to summarise students' perceptions of teachers' AI literacy and readiness for technology-enhanced teaching. Independent-samples t-tests were used to examine differences based on gender and school location, while one-way analysis of variance (ANOVA) was used to examine differences across SS I, SS II and SS III. All null hypotheses were tested at the 0.05 level of significance. The data were checked for completeness and relevant statistical assumptions before the inferential analyses were conducted. The findings were interpreted as evidence of students' perceptions rather than direct measurements of teachers' objectively assessed AI competence.

RESULTS

Hypothesis One: There is no significant difference in students' perceptions of teachers' artificial intelligence literacy based on gender.

Table 1: Independent-Samples t-Test of Students' Perceptions of Teachers' AI Literacy Based on Gender (N = 384)

Gender	N	Mean	SD	df	t	Sig. (2-tailed)	Decision
Male	192	3.48	0.61				
Female	192	3.53	0.58	382	-0.83	0.408	Not Significant

The illustrative results indicate that female students reported a slightly higher mean perception of teachers' AI literacy (M = 3.53, SD = 0.58) than male students (M = 3.48, SD = 0.61). However, the difference was not statistically significant, t(382) = –0.83, p = .408. Therefore, the null hypothesis would not be rejected under these assumed results. This suggests that gender was not associated with a statistically significant difference in students' perceptions of teachers' AI literacy in this example.

Hypothesis Two: There is no significant difference in students' perceptions of teachers' readiness for technology-enhanced teaching based on school location.

Table 2: Independent-Samples t-Test of Students' Perceptions of Teachers' Readiness Based on School Location (N = 384)

Gender	N	Mean	SD	df	t	Sig. (2-tailed)	Decision
Urban	200	3.51	0.60				
Rural	184	3.42	0.63	382	1.44	0.151	Not Significant

The illustrative results show that students in urban schools reported a higher mean perception of teachers' readiness for technology-enhanced teaching (M = 3.51, SD = 0.60) than students in rural schools (M = 3.42, SD = 0.63). However, the

difference was not statistically significant, t(382) = 1.44, p = .151. Accordingly, the null hypothesis would not be rejected under these assumed results. Although the urban group had a slightly higher mean, the evidence in this example is insufficient to conclude that perceived teacher readiness differed significantly by school location.

Hypothesis Three: There is no significant difference in students' perceptions of teachers' AI literacy and readiness for technology-enhanced teaching based on class level.

Table 3: One-Way ANOVA of Students' Perceptions of Teachers' AI Literacy and Readiness by Class Level (N = 384)

Outcome	Source of Variation	SS	df	MS	F	P - Value
AI Literacy	Between Groups	1.44	2	0.72	1.98	.140
	Within Groups	138.43	381	0.3633		
	Total	**139.87**	**383**			
Readiness	Between Groups	1.08	2	0.54	1.42	.243
	Within Groups	144.88	381	0.3803		
	Total	**145.96**	**383**			

The illustrative ANOVA results indicate that students' perceptions of teachers' AI literacy did not differ significantly across SS I, SS II and SS III, F(2, 381) = 1.98, p = .140. Similarly, the difference in perceptions of teachers' readiness for technology-enhanced teaching across the three class levels was not statistically significant, F(2, 381) = 1.42, p = .243. Both p-values exceeded the .05 significance level; therefore, the null hypotheses would not be rejected under these assumed results. The example suggests that students' class level was not associated with statistically significant differences in either outcome.

Discussion of Findings

The illustrative results showed that female students reported a slightly higher mean perception of teachers' artificial intelligence (AI) literacy (M = 3.53, SD = 0.58) than male students (M = 3.48, SD = 0.61). However, the difference was not statistically significant, t(382) = −0.83, p = .408. This suggests that students' gender was not associated with a significant difference in their perceptions of teachers' AI literacy. Nevertheless, the result concerns students' perceptions rather than teachers' objectively assessed competence. Ayanwale et al. (2024), Sperling et al. (2024), and Biagini (2025) emphasised that AI literacy involves technical knowledge, critical evaluation, practical application and ethical awareness. These competencies are closely related to teachers' professional preparation and classroom practices. Similarly, Muhammad and Bayero (2026) examined gender differences in digital literacy among secondary school students in Gusau Educational Zone, providing a relevant Nigerian perspective, although digital literacy is not identical to AI literacy. Chiu et al. (2025) and Delcker et al. (2025) further highlighted the importance of systematically assessing teachers' AI competence. Their work reinforces the need to distinguish students' perceptions from teachers' actual skills.

The illustrative findings indicated that urban students reported a slightly higher perception of teachers' readiness for technology-enhanced teaching (M = 3.51, SD = 0.60) than rural students (M = 3.42, SD = 0.63). However, the difference was not statistically significant, $t(382) = 1.44$, $p = .151$. Thus, the illustrative analysis did not provide sufficient evidence of a difference based on school location. Ayanwale et al. (2025) and Awofala et al. (2025) examined teachers' readiness for and adoption of educational AI, highlighting the importance of preparedness for successful technology integration. Zhao (2024) investigated differences in ICT competencies between rural and urban secondary school teachers, offering a useful perspective on the digital divide. However, school location alone may not explain readiness, as teachers' competence, available resources and institutional support may also be important. Cheah et al. (2025) and Filiz et al. (2025) examined teachers' preparedness, barriers and factors influencing AI integration in K–12 education. Ofem et al. (2025) also highlighted the roles of technological readiness, attitudes and pedagogical beliefs in teachers' preparedness for AI-supported assessment. Similarly, Yue et al. (2024) emphasised technological pedagogical content knowledge and attitudes towards AI education. Collectively, these studies suggest that readiness depends on more than location; it also requires relevant skills, suitable infrastructure and professional support.

The illustrative ANOVA results showed no statistically significant differences across SS I, SS II and SS III in perceptions of teachers' AI literacy, $F(2, 381) = 1.98$, $p = .140$, or readiness for technology-enhanced teaching, $F(2, 381) = 1.42$, $p = .243$. Since both p-values exceeded .05, the null hypothesis would not be rejected for either outcome. This suggests that class level was not associated with significant differences in students' perceptions in the illustrative analysis. Liu and Zhong (2024), Yim and Su (2025), and Zhang et al. (2025) examined AI literacy and AI education, highlighting the importance of developing relevant knowledge and skills within educational settings. Kohnke et al. (2025) and Lucas et al. (2025) explored educator preparation and readiness for AI integration, while Mikeladze (2024) reviewed AI competence frameworks for educators. Younis (2025) also developed an AI literacy scale for teachers. These studies highlight the importance of defining, assessing and developing teachers' AI competencies systematically.

The finding can also be interpreted through the Technological Pedagogical Content Knowledge (TPACK) framework of Mishra and Koehler (2006), which emphasises the integration of technological, pedagogical and content knowledge. Yue et al. (2024) similarly examined teachers' readiness and attitudes towards AI education. These perspectives suggest that effective technology-enhanced teaching requires teachers to combine technological skills with appropriate teaching methods and subject knowledge. Furthermore, Kokoç et al. (2026) reviewed empirical studies on in-service teachers' AI literacy, while Tagare et al. (2025) emphasised ethical competencies in AI literacy for K–12 teachers. Awofala et al. (2025) and Ofem et al. (2025) also provide relevant perspectives on teachers' AI adoption and preparedness. Together, these studies underline the importance of professional development, pedagogical competence and responsible AI use across educational levels.

CONCLUSION

The study examined students' perceptions of teachers' artificial intelligence (AI) literacy and readiness for technology-enhanced teaching in public secondary schools in North-West Nigeria, considering gender, school location and class level. The illustrative results indicated no statistically significant differences in students' perceptions based on these characteristics. These results suggest that students' demographic characteristics may not necessarily determine how they perceive their teachers' AI competence and preparedness. However, the conclusions must be verified using the actual data collected from the 384 respondents. The study highlights the importance of strengthening teachers' AI literacy, technological and pedagogical competencies, and ethical awareness. Therefore, educational authorities should promote inclusive professional development, improve access to digital resources and establish appropriate guidelines for the responsible integration of AI into secondary school teaching.

Recommendations

Based on the study's objectives and the issues examined, the following recommendations are proposed:

1. Regular professional development: The Federal and State Ministries of Education, in collaboration with relevant teacher education institutions, should organise regular training programmes to improve secondary school teachers' AI literacy, including their ability to use, evaluate and critically assess AI-generated information.
2. Improved digital infrastructure: Government and school administrators should provide reliable electricity, internet connectivity, digital devices and appropriate educational software to support technology-enhanced teaching in public secondary schools, particularly in underserved communities.
3. Integration of AI into teacher education: Colleges of education and universities should incorporate AI literacy, digital pedagogy and responsible AI use into teacher preparation and continuing professional development programmes.
4. Ethical and responsible AI use: Education authorities should develop and implement clear guidelines on the responsible use of AI in teaching and assessment, addressing data privacy, accuracy, bias, academic integrity and the protection of students' information.
5. Continuous monitoring and further research: School administrators and education policymakers should periodically assess teachers' AI competence and readiness to identify professional development needs. Further research should use verified empirical data and, where appropriate, include teachers' assessments, classroom observations and comparisons across school locations to provide a more comprehensive understanding of AI integration in secondary education.

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