AI Readiness Among Pre-Service Teachers in Kaduna State: Awareness, Attitudes, and Motivating Factors for Curriculum Delivery

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Abstract
The global integration of artificial intelligence (AI) into educational systems has generated urgent questions about whether pre-service teachers are sufficiently prepared to harness these technologies for effective curriculum delivery. This study assessed AI readiness among pre-service teachers in Kaduna State: Awareness, attitudes, and motivating factors for curriculum delivery, investigating three critical dimensions: awareness of AI tools, attitudes toward AI adoption, and the factors motivating AI adoption. A descriptive survey research design was adopted, with a target population of approximately 2,500 final-year pre-service teachers drawn from three purposively selected tertiary institutions, that is, Ahmadu Bello University [ABU], Zaria, Kaduna State University (KASU) and Kaduna State College of Education (KSCOE) Gidan Waya. Using the Yamane (1967) formula, a sample of 348 respondents was obtained through stratified random sampling. Data were collected via a validated researcher-developed instrument, the Artificial Intelligence Readiness Assessment Questionnaire for Pre-Service Teachers (AIRAQPST), rated on a four-point Likert scale. The instrument yielded a Cronbach's Alpha reliability coefficient of 0.87. Descriptive statistics (means and standard deviations) addressed the research questions, while One-Way Analysis of Variance (ANOVA) tested the null hypotheses at a 0.05 significance level. Findings revealed a moderate level of AI tool awareness among pre-service teachers (cluster mean = 2.76), predominantly positive attitudinal orientations toward AI adoption (cluster mean = 3.29), and strong motivational dispositions underpinning AI adoption in curriculum delivery (cluster mean = 3.37). ANOVA results indicated no significant institutional difference in awareness levels [F(2, 345) = 1.48, p = .229], while significant inter-institutional differences were observed in attitudes [F(2, 345) = 3.74, p = .024] and motivating factors [F(2, 345) = 4.12, p = .017]. The study recommends systemic integration of AI literacy within teacher education curricula, targeted infrastructure investment, and robust institutional policy frameworks to advance effective AI adoption across tertiary institutions in Kaduna State. However, the findings are constrained by the study's cross-sectional design, reliance on self-report data, and focus on final-year students in three Kaduna-based institutions, which may limit generalizability.

Keywords: artificial intelligence, pre-service teachers, curriculum delivery, technology adoption, readiness

Introduction

The twenty-first century educational landscape is undergoing a profound and accelerating transformation driven by rapid advances in digital technologies, with artificial intelligence (AI) emerging as one of the most disruptive and pedagogically consequential innovations in recent educational history. AI-powered technologies, spanning generative language models,

intelligent tutoring systems, adaptive learning platforms, automated assessment tools, and natural language processing applications, are increasingly recognised as potent instruments for enhancing instructional effectiveness, personalising learning trajectories, and improving curriculum delivery outcomes at scale (Holmes et al., 2019; Luckin et al., 2016). The global momentum toward AI integration in education has attracted the attention of governments, international development organisations, and teacher education institutions, all of which have intensified their commitment to building AI-ready educational workforces as part of broader human capital and national development agendas (Miao et al., 2021; UNESCO, 2021).

The pedagogical potential of AI in education is substantial and well-documented. Zawacki-Richter et al. (2019), in a systematic review of 146 empirical studies, identified four primary applications of AI in higher education: profiling and prediction, intelligent tutoring systems, adaptive learning environments, and assessment and evaluation. Crompton and Burke (2023), in an updated review covering publications from 2016 to 2022, confirmed AI's expanding role in personalising student learning, improving academic performance prediction, and supporting instructional design. Popenici and Kerr (2017) further highlighted that AI tools are increasingly capable of performing cognitive tasks traditionally reserved for human educators—including feedback generation, learner analytics, and content sequencing—signalling a fundamental reconfiguration of the teacher's pedagogical role. These developments collectively underscore that AI is not a peripheral technological novelty but a central pillar of the emerging educational architecture.

In developing nations, however, the adoption of AI in education occurs against a backdrop of structural constraints that complicate both access and implementation. Egara and Mosimege (2024) demonstrated that while AI language models positively impacted student mathematics achievement in secondary schools, their adoption remained uneven due to infrastructural and resource disparities. Suleiman and Ifinedo (2021) similarly found that mobile learning adoption in Nigerian higher education was significantly hampered by inadequate internet infrastructure, limited institutional support, and insufficient digital literacy among educators. These findings converge to indicate that Sub-Saharan Africa, and Nigeria in particular, faces distinctive challenges in translating the theoretical promise of AI education into sustainable pedagogical practice. Nigeria, as the most populous nation in Africa with an educational system encompassing over 45,000 primary schools, 15,000 secondary schools, and more than 260 tertiary institutions, confronts the challenge of AI adoption on a massive and complex scale (Ayanwale et al., 2024). The quality and relevance of teacher preparation programmes remain central to whether AI tools become embedded in curriculum delivery or remain inaccessible aspirations.

Pre-service teachers—students currently enrolled in teacher education programmes at universities, colleges of education, and polytechnics—occupy a uniquely strategic position in the AI education transition. As the next generation of classroom practitioners, their AI readiness will directly determine the pace, depth, and equity of AI integration in Nigerian schools over the coming decades (Bautista et al., 2024; Guan et al., 2025). Research from diverse global contexts consistently demonstrates that pre-service teachers' awareness of AI tools, their attitudinal dispositions toward AI adoption, and the factors that motivate or inhibit adoption are critical predictors of their behavioural intentions to integrate technology into teaching practice (Chai et al., 2021; Kim & Lee, 2019). A pre-service teacher who enters the profession with informed AI awareness, positive attitudes, and strong intrinsic motivation is far more likely to leverage AI in curriculum delivery than one who lacks these readiness dimensions, regardless of the availability of tools (Li & Zhang, 2020).

Kaduna State, located in the north-western geopolitical zone of Nigeria, hosts a diverse array of tertiary institutions—including AhMADU Bello University [ABU], Zaria, Kaduna State University (KASU), and Kaduna State College of Education (KSCOE) Gidan Waya, that collectively produce thousands of pre-service teachers annually for deployment across the state and the wider northern region. The National Policy on Education (Federal Republic of Nigeria, 2014) and the Federal Government's National Digital Economy Policy and Strategy (2020–2030) provide an enabling policy framework for ICT and digital technology integration in educational delivery. Despite these policy signals, empirical evidence on the specific AI readiness profiles of pre-service teachers in Kaduna State's tertiary institutions remains conspicuously absent from the research literature. Agbo et al. (2023) provided preliminary evidence of moderate AI awareness among Nigerian pre-service teachers, but their study was not contextualised within the specific institutional and socio-cultural dynamics of Kaduna State. Similarly, while Nannim et al. (2025) documented the growing uptake of AI and robotics-based innovations in Nigerian Technical and Vocational Education and Training (TVET), the teacher education dimension in northern Nigerian states such as Kaduna remained unaddressed.

Existing studies in the global literature have also largely concentrated on pre-service teacher AI readiness in Asian, European, and North American educational contexts (Bautista et al., 2024; Guan et al., 2025; Li & Zhang, 2020), with comparatively limited attention to the specific institutional configurations, resource constraints, and cultural orientations of tertiary education in northern Nigeria. Furthermore, most Nigerian-based studies on educational technology have focused on in-service teachers or on southern Nigerian urban contexts (Isiaka, 2024), leaving a significant empirical gap regarding the AI readiness of pre-service teachers in Kaduna State's teacher-producing institutions. This study therefore addresses this critical gap by providing a comprehensive, empirical assessment of pre-service teachers' awareness of AI tools, their attitudinal orientations toward AI adoption, and the motivational factors underpinning their AI adoption decisions across three tertiary institutions in Kaduna State. The findings are anticipated to provide evidence-based insights for policymakers, curriculum designers, and institutional administrators seeking to strengthen AI integration within teacher education in Kaduna State and broader northern Nigeria. Specifically, the study seeks to:

1. Determine the level of awareness of artificial intelligence tools among pre-service teachers in tertiary institutions of Kaduna State.
2. Examine the attitudes of pre-service teachers towards the adoption of AI tools in curriculum delivery in Kaduna State.
3. Find out the factors that motivate pre-service teachers to adopt AI tools for curriculum delivery in Kaduna State.

The following research questions guided the study:

i. What is the level of awareness of artificial intelligence tools among pre-service teachers in tertiary institutions of Kaduna State?
ii. What are the attitudes of pre-service teachers towards the adoption of AI tools in curriculum delivery in Kaduna State?
iii. What factors motivate pre-service teachers to adopt AI tools for curriculum delivery in Kaduna State?

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

H_{01}: There is no significant difference in the level of awareness of artificial intelligence tools among pre-service teachers in tertiary institutions of Kaduna State.

H_{02}: There is no significant difference in the attitudes mean score of pre-service teachers towards the adoption of AI tools in curriculum delivery in Kaduna State.

H_{03}: There is no significant difference in the factors that motivate pre-service teachers to adopt AI tools for curriculum delivery in Kaduna State.

Theoretical Framework

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), originally proposed by Davis (1989) and subsequently validated and extended by Venkatesh et al. (2003), constitutes the primary theoretical lens of this study. TAM posits that an individual's behavioural intention to adopt a technology is fundamentally determined by two cognitive perceptions: perceived usefulness (PU)—the degree to which a person believes that using the technology will enhance their task performance—and perceived ease of use (PEOU)—the degree to which the technology is believed to be free of effort (Davis, 1989). These two constructs jointly predict attitude toward use, which in turn predicts behavioural intention and actual system use. In the educational context, TAM has been applied extensively to explain teachers' acceptance of digital tools, learning management systems, and, more recently, AI applications in instructional settings (Crompton & Burke, 2023; Teo, 2019).

Applied to the present study, TAM suggests that pre-service teachers who perceive AI tools as useful for enhancing curriculum delivery outcomes—such as through personalised feedback, automated grading, or adaptive lesson sequencing—and who find these tools relatively easy to operate within their pedagogical workflows will be more inclined to develop positive attitudes toward AI adoption and to express behavioural intentions to integrate these tools into classroom practice. Venkatesh et al.'s (2003) extension of TAM into the Unified Theory of Acceptance and Use of Technology (UTAUT) further incorporated social influence and facilitating conditions as determinants of technology adoption, dimensions that resonate strongly with the institutional and peer-influenced factors examined in this study. Recent empirical work applying TAM and its extensions to AI adoption in education has consistently confirmed the theory's explanatory power across diverse cultural and institutional contexts (Chai et al., 2021; Li & Zhang, 2020).

Diffusion of Innovations Theory

Rogers' (2003) Diffusion of Innovations (DoI) Theory provides a complementary macro-level framework for understanding the spread of AI tool adoption within and across teacher education institutions. Rogers conceptualised innovation diffusion as a process through which a new idea, practice, or technology is communicated through certain channels over time among members of a social system. He identified five attributes of innovations that influence adoption rates: relative advantage (the degree to which the innovation is perceived as superior to existing alternatives), compatibility (alignment with current values and practices), complexity (perceived difficulty of use), trialability (opportunity to experiment before full commitment), and observability (the visibility of the innovation's results to others). Applied to AI adoption in teacher education, DoI theory posits that pre-service teachers are more likely to adopt AI tools for curriculum delivery when they perceive a clear relative advantage over conventional teaching approaches, find the tools compatible with existing curriculum frameworks, experience manageable complexity, can access hands-on trial opportunities, and observe successful AI adoption modelled by peers or faculty (Holmes et al., 2019; Nannim et al., 2025).

Rogers' (2003) typology of adopter categories—innovators, early adopters, early majority, late majority, and laggards—is particularly relevant to understanding the inter-institutional variation in AI adoption readiness observed in this study. Institutions with stronger digital cultures, more dynamic peer innovation networks, and higher levels of faculty AI modelling are likely to produce a higher proportion of innovators and early adopters among their pre-service teacher cohorts. DoI theory thus enriches this study's analytical framework by situating individual adoption decisions within their broader institutional and social ecology, rather than treating adoption as purely an individual cognitive decision (Ayanwale et al., 2024).

Technological Pedagogical Content Knowledge (TPACK) Framework

The TPACK framework, introduced by Mishra and Koehler (2006), offers a third theoretical pillar that is uniquely suited to the pedagogical dimensions of AI tool adoption examined in this study. TPACK conceptualises effective technology integration in teaching as requiring the dynamic, synergistic interaction of three knowledge domains: technological knowledge (TK), understanding of specific technologies and their operational principles; pedagogical knowledge (PK), knowledge of teaching methods, learning theories, and instructional design; and content knowledge (CK), mastery of the subject matter to be taught. The intersections of these domains, Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Pedagogical Content Knowledge (PCK), along with their unified intersection (TPACK), define the competency space within which effective technology-enhanced teaching occurs.

In the context of AI integration in curriculum delivery, Bautista et al. (2024) applied a TPACK-based readiness assessment with pre-service teachers and found that while many possessed adequate content knowledge and basic technological familiarity, their technological pedagogical knowledge—specifically, their ability to deploy AI tools in pedagogically purposeful, curriculum-aligned ways—remained underdeveloped. Chai et al. (2021) further extended the TPACK framework to AI-TPACK (also termed Intelligent-TPACK), which explicitly incorporates knowledge of AI's technical mechanisms, ethical dimensions, and pedagogical affordances as a distinct and integrated competency domain. This study employs the TPACK lens to interpret pre-service teachers' awareness levels not merely as familiarity with AI tool names and brands, but as a multi-dimensional construct encompassing the technical, pedagogical, and content-specific knowledge required for effective AI-supported curriculum delivery.

Conceptual Framework of the Study

The study integrates the Technology Acceptance Model (TAM), Diffusion of Innovations (DoI) Theory, and the TPACK/AI-TPACK framework into a unified conceptual model of pre-service teachers' AI readiness. Within this model, perceived usefulness and perceived ease of use (from TAM) shape pre-service teachers' attitudes and behavioural intentions toward AI adoption. DoI contributes system-level factors such as institutional culture, peer modelling, and perceived relative advantage, which influence both attitudes and motivating factors for adoption. The TPACK/AI-TPACK lens situates AI awareness not merely as tool familiarity, but as knowledge of how AI tools intersect with content and pedagogy to support curriculum delivery. In this framework, AI awareness, attitudes, and motivating factors are conceived as interrelated dimensions of AI readiness. AI awareness is influenced by exposure to AI tools and AI-related knowledge in teacher education programmes; attitudes are shaped by perceptions of usefulness and ease of use, as well as by institutional and social influences; and motivating factors arise from institutional support, professional development, policy

environment, and observable teaching/learning benefits. These three readiness dimensions are expected to vary across institutions due to differences in digital infrastructure, innovation culture, and policy implementation, thereby informing the three research questions and associated hypotheses.

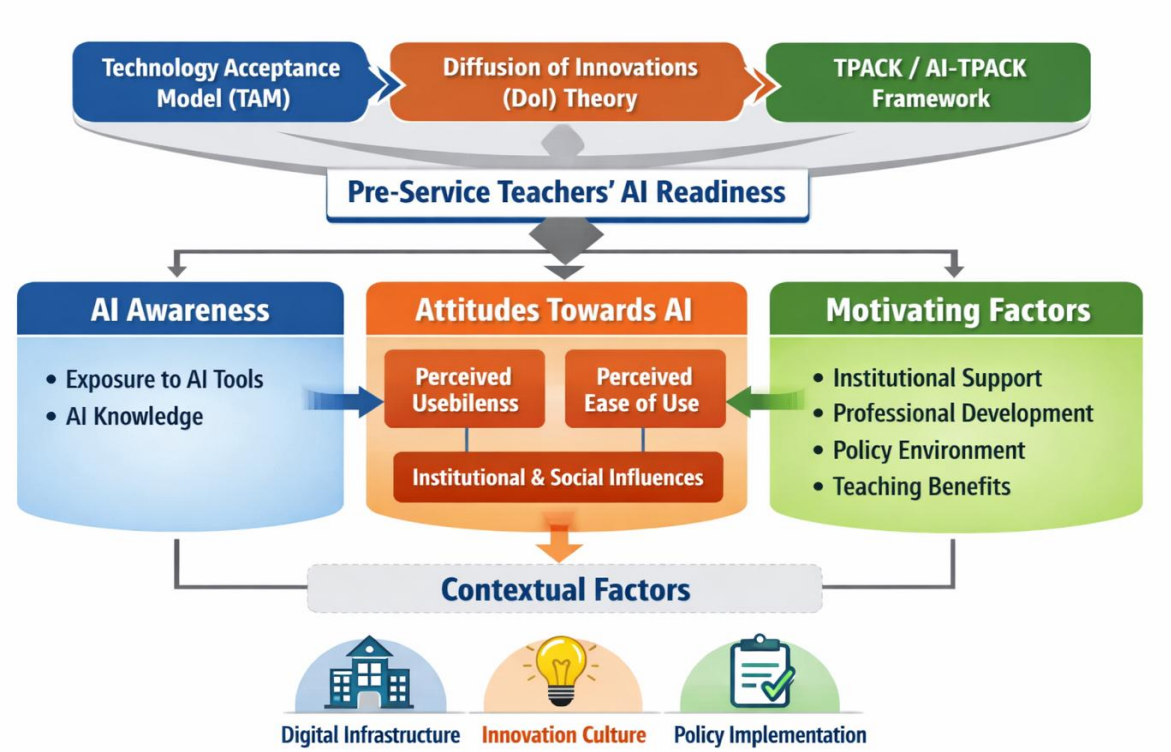

Figure 1: Conceptual Framework of the Study

Methodology

This study adopted a descriptive survey research design. This design was appropriate for the study's purpose of systematically gathering, describing, and analysing data on the awareness levels, attitudinal orientations, and motivational factors associated with AI tool adoption among pre-service teachers, without the experimental manipulation of variables (Creswell & Creswell, 2018). Descriptive survey methodology enables the researcher to collect numerical data from a representative sample and generalise findings to the broader population within specified confidence limits, making it well suited for educational readiness assessments in large, geographically distributed populations (Popenici & Kerr, 2017). The target population comprised all pre-service teachers enrolled in final-year education programmes at three purposively selected tertiary institutions in Kaduna State: Kaduna State University (KASU), Kaduna; Ahmadu Bello University [ABU], Zaria; and Kaduna State College of Education (KSCOE), Gidan Waya. These three institutions were deliberately selected to represent the three major institutional categories of teacher-producing tertiary institutions in Kaduna State, state universities, federal colleges of education, and state colleges of education, thereby ensuring typological diversity within the sample. Based on institutional records for the 2024/2025 academic session, the accessible population comprised approximately 2,500 final-year pre-service teachers distributed across the three institutions.

The sample size was determined using the Yamane (1967) sample size formula:

$$n = \frac{N}{1 + N(e^2)}$$

where N = 2,500 (population size) and e = 0.05 (margin of error). This yielded n = 344.8 ≈ 345. To compensate for anticipated non-responses and unusable questionnaires, 380 copies of the instrument were distributed. Following data collection, 348 questionnaires were returned fully completed and deemed suitable for analysis, representing a response rate of 91.6%. Stratified random sampling was employed to proportionately allocate participants across the three institutions based on their relative population sizes. This technique ensured that each institution was adequately represented and that the sample reflected the demographic composition of the target population with respect to gender, institutional type, and academic programme (Kim & Lee, 2019). The resulting institutional subsamples were: ABU, Zaria (n = 124), KASU (n = 118), and KSCOE Gidan Waya (n = 106).

The instrument for data collection was a researcher-developed questionnaire titled the *Artificial Intelligence Readiness Assessment Questionnaire for Pre-Service Teachers* (AIRAQPST). The questionnaire was structured into four sections. Section A elicited demographic information including gender, institution, programme of study, and level of study. Section B comprised eight items assessing the level of awareness of AI tools. Section C consisted of nine items measuring attitudes toward AI adoption in curriculum delivery. Section D contained eight items examining the motivating factors for AI adoption. Sections B, C, and D were rated on a four-point Likert scale: Strongly Agree = 4, Agree = 3, Disagree = 2, and Strongly Disagree = 1. A criterion mean of 2.50 was adopted as the decision threshold, with mean scores ≥ 2.50 interpreted as "Agreed" (positive response) and scores < 2.50 interpreted as "Disagreed" (negative response).

Content and face validity of the AIRAQPST were established through expert review conducted by three academic specialists in Educational Technology and Curriculum Studies at Federal University of Education, Zaria. Reviewers assessed each item for clarity, relevance to the construct being measured, and linguistic appropriateness for the target population. Recommendations from reviewers were incorporated before the instrument was pilot-tested. Instrument reliability was determined through a pilot study administered to 30 pre-service teachers from a non-sampled institution, that is, Saadatu Rimi College of Education, Kumbtoso, Kano state, selected on the basis of comparable institutional characteristics. Cronbach's Alpha reliability coefficients were computed for each subscale: AI Awareness (Section B) = 0.83, Attitudes (Section C) = 0.86, and Motivating Factors (Section D) = 0.89. The overall Cronbach's Alpha of 0.87 indicated a high level of internal consistency across the instrument, confirming its reliability as a research tool (Teo, 2019).

Data were collected over a four-week period within the second semester of the 2023/2024 academic session. Research assistants at each institution received training on the study's purpose, ethical guidelines for participant engagement, and standardised questionnaire administration procedures. Informed written consent was obtained from all respondents prior to questionnaire administration. Participants were explicitly assured of the anonymity of their responses and the confidentiality of all personal information, and voluntary participation was emphasised throughout. Questionnaires were administered during scheduled non-lecture periods in classroom settings to minimise disruption and maximise response rates.

Data collected were coded, entered, and analysed using IBM SPSS Statistics Version 25. For the three research questions, descriptive statistical measures—specifically arithmetic means (M) and standard deviations (SD)—were computed to characterise the central tendency and variability of responses on each questionnaire item and across the instrument subscales as a whole. The criterion mean of 2.50 was used to make interpretive decisions on individual

items. To test the three null hypotheses, One-Way Analysis of Variance (ANOVA) was employed to compare mean scores across the three institutions at a significance level of $\alpha = 0.05$. Where ANOVA results indicated statistically significant differences, post-hoc pairwise comparisons were conducted using the Tukey Honestly Significant Difference (HSD) test to identify the specific institutional pairs responsible for the observed differences (Creswell & Creswell, 2018).

Results

Research Question 1: Level of Awareness of AI Tools Among Pre-Service Teachers

Table 1 presents the descriptive statistics on pre-service teachers' level of awareness of AI tools (n = 348).

Table 1: **Descriptive Statistics on the Level of Awareness of AI Tools (n = 348)**

S/N	Items	M	SD	Remark
1	Aware that ChatGPT is an AI tool that can be used for curriculum delivery	3.42	0.68	Agreed
2	Know that Google Gemini/Bard can assist teachers in lesson preparation	3.18	0.71	Agreed
3	Familiar with AI-based tutoring systems (e.g., Khan Academy AI features)	2.74	0.79	Agreed
4	Aware of AI tools designed for automatic grading and feedback generation	2.61	0.83	Agreed
5	Know that AI can be used to generate lesson plans and instructional materials	2.89	0.77	Agreed
6	Have knowledge of AI speech recognition tools applicable in classroom settings	2.48	0.81	Disagreed
7	Aware of AI tools designed for student performance analytics and prediction	2.43	0.85	Disagreed
8	Know that machine learning algorithms are applied in personalised learning platforms	2.31	0.88	Disagreed
Cluster Mean		**2.76**	**0.54**	**Agreed**

Note. Decision criterion: Mean ≥ 2.50 = Agreed; Mean < 2.50 = Disagreed. Scale: 4 = Strongly Agree, 3 = Agree, 2 = Disagree, 1 = Strongly Disagree.

Results in Table 1 indicate that the overall cluster mean of 2.76 (SD = 0.54) reflects a moderate level of AI tool awareness among pre-service teachers in Kaduna State. Items 1 through 5 recorded mean scores above the criterion value of 2.50, signifying that pre-service teachers are primarily aware of widely publicised AI tools such as ChatGPT (M = 3.42, SD = 0.68) and Google Gemini (M = 3.18, SD = 0.71), and recognise AI's application in lesson plan generation (M = 2.89, SD = 0.77). Conversely, items 6, 7, and 8, relating to AI speech recognition tools, student performance analytics, and machine learning-based personalisation platforms, recorded mean scores below the criterion value, indicating a notable deficit in awareness of technically sophisticated, specialised AI educational tools.

Research Question 2: Attitudes of Pre-Service Teachers Toward AI Adoption

Table 2 presents the descriptive statistics on pre-service teachers' attitudes toward the adoption of AI tools in curriculum delivery.

Table 2: **Descriptive Statistics on Attitudes Toward AI Adoption in Curriculum Delivery (n = 348)**

S/N	Items	M	SD	Remark
1	AI tools will enhance my effectiveness as a teacher during curriculum delivery	3.45	0.61	Agreed
2	Believe that AI tools can personalise learning experiences for students	3.52	0.58	Agreed
3	Willing to integrate AI tools into my lesson planning and delivery	3.38	0.65	Agreed
4	AI tools are compatible with the existing curriculum in Nigerian schools	2.89	0.74	Agreed
5	Feel confident in my ability to use AI tools for teaching purposes	2.73	0.79	Agreed
6	Using AI in curriculum delivery will improve students' academic engagement	3.41	0.63	Agreed
7	Believe that AI tools will reduce my workload as a pre-service teacher	3.27	0.69	Agreed
8	AI integration in curriculum delivery aligns with my professional development goals	3.33	0.64	Agreed
9	Open to receiving training on how to use AI tools in classroom settings	3.61	0.55	Agreed
Cluster Mean		**3.29**	**0.46**	**Agreed**

Note. Decision criterion: Mean ≥ 2.50 = Agreed; Mean < 2.50 = Disagreed.

Table 2 reveals that the cluster mean of 3.29 (SD = 0.46) indicates a predominantly positive attitudinal orientation among pre-service teachers toward AI adoption in curriculum delivery. All nine items recorded mean scores above the criterion value of 2.50, indicating broad attitudinal agreement across all dimensions measured. The item with the highest mean score was openness to AI training (M = 3.61, SD = 0.55), followed by belief in AI's potential to personalise student learning (M = 3.52, SD = 0.58) and conviction that AI tools will enhance teaching effectiveness (M = 3.45, SD = 0.61). The lowest-rated attitudinal item was self-confidence in using AI tools for teaching (M = 2.73, SD = 0.79), which, while above the criterion threshold, signals a persistent self-efficacy gap that warrants institutional attention.

Research Question 3: Factors That Motivate Pre-Service Teachers to Adopt AI Tools
Table 3 presents the descriptive statistics on the motivating factors for AI tool adoption in curriculum delivery.

Table 3: **Descriptive Statistics on Motivating Factors for AI Adoption (n = 348)**

S/N	Items	M	SD	Remark
1	Institutional support and adequate infrastructure motivate me to use AI tools	3.31	0.67	Agreed
2	Peer collaboration and shared experiences encourage AI adoption in my teaching	3.25	0.69	Agreed
3	The perceived usefulness of AI tools for improving learning outcomes motivates me	3.58	0.59	Agreed
4	Government policies promoting AI in education motivate me to adopt AI tools	3.14	0.73	Agreed
5	Professional development workshops on AI tools increase my motivation to adopt them	3.52	0.61	Agreed
6	Positive student outcomes observed from AI-enhanced lessons motivate AI adoption	3.47	0.63	Agreed
7	Availability of free or low-cost AI tools motivates me to integrate them in teaching	3.43	0.65	Agreed
8	Role models among experienced teachers using AI inspire me to adopt AI tools	3.29	0.68	Agreed
Cluster Mean		**3.37**	**0.44**	**Agreed**

Note. Decision criterion: Mean ≥ 2.50 = Agreed; Mean < 2.50 = Disagreed.

Table 3 shows that all eight items measuring motivating factors for AI adoption yielded means above the criterion value of 2.50, with a cluster mean of 3.37 (SD = 0.44). The leading motivating factor was the perceived usefulness of AI tools in improving student learning outcomes (M = 3.58, SD = 0.59), closely followed by access to professional development workshops (M = 3.52, SD = 0.61) and observation of positive student outcomes from AI-enhanced lessons (M = 3.47, SD = 0.63). The availability of free or low-cost AI tools (M = 3.43, SD = 0.65) and institutional support (M = 3.31, SD = 0.67) were also identified as prominent motivating factors, reflecting the economic and infrastructural constraints characteristic of higher education in northern Nigeria. Government policy emerged as the least potent motivating factor (M = 3.14, SD = 0.73), suggesting that top-down policy directives alone are insufficient to drive AI adoption in the absence of operational support.

Testing of Null Hypotheses

H_{01}: Awareness of AI Tools Across Institutions

Table 4: **One-Way ANOVA Results for Differences in AI Awareness Levels Across Institutions (n = 348)**

Source of Variation	SS	df	MS	*F*	*p*-value	Decision
Between Groups	0.891	2	0.446	1.48	.229	Retain H_{01}
Within Groups	103.989	345	0.301			
Total	**104.880**	**347**				

Note. α = 0.05. ABU, Zaria (*n* = 124), KASU (*n* = 118), and KSCOE Gidan Waya (*n* = 106).

The ANOVA result in Table 4 yielded $F(2, 345) = 1.48$, $p = .229 > .05$. The null hypothesis H_{01} is therefore **retained**. There is no statistically significant difference in the level of awareness of AI tools among pre-service teachers across the three tertiary institutions in Kaduna State.

H_{02}: Attitudes Toward AI Adoption Across Institutions

Table 5: **One-Way ANOVA Results for Differences in Attitudes Toward AI Adoption Across Institutions (n = 348)**

Source of Variation	SS	df	MS	*F*	*p*-value	Decision
Between Groups	1.471	2	0.736	3.74	.024	Reject H_{02}
Within Groups	67.834	345	0.197			
Total	69.305	347				

Note. α = 0.05. KASU *M* = 3.41, ABU Zaria *M* = 3.31, KSCOE Gidan Waya *M* = 3.16. Tukey HSD post-hoc: KASU vs. KSCOE Gidan Waya *p* = .019.

Table 5 reveals $F(2, 345) = 3.74$, $p = .024 < .05$. The null hypothesis H_{02} is therefore **rejected**. A statistically significant difference exists in the attitudinal mean scores of pre-service teachers toward AI adoption across the three institutions. Tukey HSD post-hoc analysis localised the significant difference primarily to the KASU–KSCOE Gidan Waya pairing ($p = .019$), with KASU pre-service teachers demonstrating more positive attitudes (M = 3.41) compared to their counterparts at KSCOE Gidan Waya (M = 3.16).

H_{03}: Motivating Factors for AI Adoption Across Institutions

Table 6: **One-Way ANOVA Results for Differences in Motivating Factors Across Institutions (n = 348)**

Source of Variation	SS	df	MS	*F*	*p*-value	Decision
Between Groups	1.561	2	0.781	4.12	.017	Reject H_{03}
Within Groups	65.333	345	0.189			
Total	66.894	347				

Note. α = 0.05. KASU *M* = 3.49, ABU Zaria *M* = 3.38, KSCOE Gidan Waya *M* = 3.22. Tukey HSD post-hoc: KASU vs. KSCOE Gidan Waya *p* = .013.

Table 6 shows $F(2, 345) = 4.12$, $p = .017 < .05$. The null hypothesis H_{03} is accordingly **rejected**. There is a statistically significant difference in the motivating factors for AI adoption among pre-service teachers across the three institutions. Post-hoc Tukey HSD analysis confirmed that the significant difference was concentrated in the KASU–KSCOE Gidan Waya contrast ($p = .013$), with KASU recording the strongest motivational scores (M = 3.49) and KSCOE Gidan Waya the weakest (M = 3.22), while ABU Zaria occupied an intermediate position (M = 3.38).

Discussion

The finding of a moderate level of AI tool awareness among pre-service teachers in Kaduna State's tertiary institutions (cluster mean = 2.76) is consistent with the broader trajectory of AI awareness research in Sub-Saharan African teacher education contexts. Agbo et al. (2023), in a study of Nigerian pre-service teachers, reported moderate familiarity with commercially visible AI tools, particularly those with pronounced social media presence, while noting significant knowledge deficits in relation to specialised AI educational applications. The present study corroborates these findings precisely—awareness was highest for ChatGPT (M = 3.42) and Google Gemini (M = 3.18), tools whose visibility has been amplified by mass media discourse, viral social media engagement, and commercial marketing, while awareness of technically sophisticated tools such as AI speech recognition (M = 2.48), performance analytics platforms (M = 2.43), and machine learning-based personalisation systems (M = 2.31) remained notably low.

This pattern of surface-level AI familiarity concentrated in popular generative tools, at the expense of deeper pedagogically relevant AI knowledge, aligns with findings documented in international literature. Guan et al. (2025), investigating pre-service teachers' AI preparedness within a social cognitive framework, found that participants' AI awareness was predominantly constituted by informal, experiential familiarity rather than structured knowledge acquired through formal teacher education programmes. Similarly, Bautista et al. (2024), applying a TPACK-based readiness framework, found that pre-service teachers' technological knowledge of AI was shaped more by social networks and peer discovery than by institutional curricula, a dynamic that the Nigerian context is likely to amplify given the near-complete absence of dedicated AI literacy modules from teacher education degree programmes (Nannim et al., 2025). The theoretical interpretation offered by the AI-TPACK framework (Chai et al., 2021) is instructive here: awareness of AI tool brand names and general functionalities is insufficient for curriculum-aligned adoption; what is required is an integrated, pedagogically grounded technological knowledge that teacher education programmes in Kaduna State are currently not providing.

The retention of the null hypothesis H_{01} [$F(2, 345) = 1.48$, $p = .229$]—indicating no significant inter-institutional difference in AI awareness—is a finding of considerable practical significance. It suggests that the moderate awareness ceiling identified is a systemic characteristic of the Kaduna State teacher education landscape rather than a feature of any individual institution. This finding resonates with Crompton and Burke's (2023) observation that in the absence of standardised AI literacy curricula within national teacher education frameworks, AI awareness profiles across institutions tend to converge at uniformly low to moderate levels. The policy implication is clear: raising AI awareness requires system-wide curricular reform rather than institution-specific interventions.

The predominantly positive attitudinal orientation of pre-service teachers toward AI adoption in curriculum delivery (cluster mean = 3.29) is an encouraging finding that signals a fertile

ground for AI integration initiatives in Kaduna State's teacher education institutions. This result is consistent with a growing body of empirical evidence from diverse international contexts documenting generally favourable attitudes toward AI among pre-service and early-career teachers. Kim and Lee (2019), in a study of pre-service teachers across teacher training programmes, found that technology-related training experiences were positively associated with both self-efficacy and attitudinal openness toward educational technology, including AI-enhanced tools. Li and Zhang (2020) similarly reported that pre-service teachers who had received structured exposure to digital technologies in their programmes exhibited more consistently positive attitudes toward AI adoption compared to those with limited formal exposure.

Particularly notable in the present study is the strong attitudinal endorsement of openness to AI training (M = 3.61, SD = 0.55) and belief in AI's capacity to personalise student learning (M = 3.52, SD = 0.58). These findings align closely with the conclusions of Chai et al. (2021), who identified perceived usefulness in addressing learner diversity as a primary attitudinal driver of AI adoption among pre-service teachers, and with Pedro et al. (2019), who argued that the promise of AI-enabled personalisation is a particularly compelling attitudinal motivator in large, heterogeneous classroom contexts typical of developing country educational systems. The statistically significant inter-institutional difference in attitudinal scores [$F(2, 345) = 3.74$, $p = .024$], with KASU pre-service teachers exhibiting more positive attitudes (M = 3.41) than their KSCOE Gidan Waya counterparts (M = 3.16), is attributable to the differential digital environments of these institutions. KASU, as a comprehensive state university with broader technological infrastructure, exposure to e-learning platforms, and a more innovation-oriented faculty culture, is likely to foster a more digitally affirming institutional climate (Suleiman & Ifinedo, 2021). Colleges of education, historically constrained by limited ICT infrastructure and characterised by more conservative pedagogical traditions, may cultivate more cautious attitudinal dispositions toward emerging technologies, even where general technological interest exists (Ayanwale et al., 2024).

The relatively lower self-confidence score in AI tool usage (M = 2.73, SD = 0.79) emerges as a nuanced but practically important finding. Within the TAM framework (Davis, 1989; Venkatesh et al., 2003), perceived ease of use, which is conceptually related to self-efficacy in technology use—is a co-determinant of technology acceptance attitudes. Low self-efficacy in AI tool use thus functions as a psychological inhibitor that may prevent even positively oriented pre-service teachers from translating favourable attitudes into actual practice. Holmes et al. (2019) cautioned that attitudinal positivity unsupported by competence development and hands-on experiential learning creates a "readiness gap", a discrepancy between expressed willingness and actual adoption capability. This gap, which appears to characterise the Kaduna State pre-service teacher population, reinforces the urgency of practical, hands-on AI skill-building within teacher education programmes.

The strong motivational orientation toward AI adoption (cluster mean = 3.37), with all eight items exceeding the criterion mean, confirms that pre-service teachers in Kaduna State harbour substantive and multi-dimensional motivational drivers for AI integration in their future teaching practice. The identification of perceived usefulness (M = 3.58) as the leading motivating factor strongly validates TAM's central proposition—that perceptions of performance enhancement constitute the primary cognitive engine of technology adoption behaviour (Davis, 1989; Venkatesh et al., 2003). This finding is also consistent with Zawacki-Richter et al.'s (2019) systematic review conclusion that instructional efficiency and the

prospect of improved student learning outcomes represent the most compelling motivational grounds upon which educators across institutional contexts make AI adoption decisions.

The high salience of professional development opportunities (M = 3.52) as a motivating factor communicates a clear message: pre-service teachers in Kaduna State perceive a significant gap between their current AI competence and the competence required for effective AI-enhanced curriculum delivery, and they are actively motivated by the prospect of structured learning to bridge this gap. This finding resonates with Miao et al.'s (2021) UNESCO policy framework, which identifies structured teacher professional development as the most critical institutional investment for advancing AI adoption in educational systems, particularly in developing country contexts characterised by inadequate pre-service AI preparation. The significant role of positive student outcomes as a motivating factor (M = 3.47) further reflects the outcome-oriented, pragmatic disposition of pre-service teachers who are motivated by visible, student-centred evidence of AI's pedagogical value—a pattern congruent with Rogers' (2003) observability criterion in the DoI framework, wherein the visibility of an innovation's benefits significantly accelerates its diffusion.

The significant inter-institutional variation in motivating factors [$F(2, 345) = 4.12$, $p = .017$], with KASU recording the highest motivational scores (M = 3.49) and KSCOE Gidan Waya the lowest (M = 3.22), likely reflects the cumulative effect of institutional resource differentials, peer network dynamics, and the presence or absence of faculty models of AI adoption. Rogers' (2003) DoI theory is instructive in explaining this variation: institutions that expose pre-service teachers to observable examples of successful AI use, provide opportunities for low-risk experimentation with AI tools, and embed AI integration within a culture of pedagogical innovation are likely to generate stronger and more diverse motivational profiles for adoption. Conversely, institutions characterised by infrastructural scarcity, limited peer modelling, and weaker institutional AI culture—conditions more characteristic of state colleges of education in northern Nigeria—tend to produce more constrained motivational ecologies, as documented by Ayanwale et al. (2024) in their analysis of AI adoption barriers in Nigerian TVET institutions.

Conclusion

The study revealed a moderate level of AI tool awareness among pre-service teachers in the three sampled institutions in Kaduna State, with higher familiarity for widely publicised generative AI tools and lower awareness of specialised educational AI applications. Attitudes toward AI adoption in curriculum delivery were generally positive, and motivational factors for AI use were strong, particularly in relation to perceived usefulness, professional development opportunities, and observed student benefits. While no significant institutional differences emerged in awareness, significant variations were observed in attitudes and motivational factors, with KASU pre-service teachers recording more favourable scores than their KSCOE Gidan Waya counterparts.

The readiness profile identified suggests that teacher education institutions in Kaduna State can leverage pre-service teachers' positive attitudes and high motivation by systematically embedding AI literacy and AI-TPACK development into their curricula and professional development programmes. Policy-makers and institutional leaders should prioritise investments in AI-related digital infrastructure, create opportunities for hands-on AI experimentation, and strengthen institutional cultures that visibly model pedagogically sound AI use.

The study's reliance on self-reported, cross-sectional survey data from a geographically bounded sample limits the generalisability and causal interpretability of the findings. Future research should incorporate qualitative components to unpack the reasons underlying observed institutional differences, explore the role of gender and programme specialisation more deeply, and employ longitudinal or experimental designs to examine how targeted AI capacity-building interventions influence pre-service teachers' readiness over time.

Recommendations

Based on the findings and conclusions of this study, the following recommendations are advanced:

1. The National Commission for Colleges of Education (NCCE) and National Universities Commission (NUC) should mandate the incorporation of dedicated AI literacy and AI-TPACK modules within teacher education programmes across all institutional types in Kaduna State, covering the technical operations, pedagogical applications, and ethical dimensions of AI tools in curriculum delivery.
2. The Kaduna State Government, through the State Ministry of Higher Education and Science and Technology, should prioritise investment in digital infrastructure, including reliable broadband internet connectivity, well-equipped ICT laboratories, and institutional subscriptions to licensed AI educational platforms—in colleges of education and polytechnics, which currently lag significantly behind universities in ICT resource provision.
3. The tertiary institutions in the state should establish regular, hands-on AI professional development workshops for pre-service teachers, facilitated by both internal faculty and external technology partners, including tech companies offering free or subsidised access to educational AI tools, with a specific focus on building AI self-efficacy and practical pedagogical application skills.
4. The Kaduna State Ministry of Higher Education should collaborate with teacher education institutions to conduct periodic assessments of AI readiness among pre-service teacher cohorts, using validated instruments such as the AIRAQPST developed in this study, to generate longitudinal data that track readiness trends, evaluate the impact of interventions, and inform adaptive policy responses to the rapidly evolving AI educational landscape.

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