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INVESTIGATING THE PRE-SERVICE TEACHERS' AWARENESS AND KNOWLEDGE FOR INTEGRATING ARTIFICIAL INTELLIGENCE (AI) TOOLS IN ENHANCING PRACTICAL COMPETENCE IN TEACHING ACROSS COLLEGES OF EDUCATION IN BAUCHI STATE

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Abstract

This study investigated pre-service teachers' preparedness for integrating artificial intelligence (AI) tools in teaching across Colleges of Education in Bauchi State. Three research objectives and three corresponding research questions guided the study. The descriptive survey research design was adopted. The population comprised all 356 NCE III pre-service teachers offering educationrelated courses in the three Colleges of Education in Bauchi State. Using Krejcie and Morgan's table for sample size determination, a sample of 186 pre-service teachers was selected to participate in the study. A structured questionnaire titled "Pre-Service Teachers' Awareness and Knowledge for AI Integration Questionnaire (PTAAIQ)" served as the main instrument for data collection in the study. The instrument was validated by experts in educational technology and measurement and evaluation. Data collected were analyzed using mean and standard deviation with the aid of SPSS version 23. Findings revealed that pre-service teachers demonstrated a high level of awareness of common AI tools for teaching. However, their knowledge of AI functionalities and pedagogical uses was found to be moderate. The study further showed that preservice teachers possessed low practical competence in using AI-based educational tools due to limited hands-on experience. The study concludes that although awareness of AI is relatively high, insufficient knowledge depth and weak practical skills limit effective integration into classroom instruction. It is recommended that Colleges of Education provide structured AI literacy courses, expand opportunities for hands-on practical training, and equip institutions with relevant AIsupported technologies to enhance pre-service teachers' preparedness for AI-driven teaching. Keywords: Artificial Intelligence (AI); Pre-service Teachers; Awareness; Knowledge; Practical Competence; AI Integration.

Introduction

The global shift toward digital transformation in education has positioned artificial intelligence (AI) as a powerful tool for improving instructional delivery, assessment, learner support, and administrative efficiency. Educational systems worldwide are progressively integrating AI applications such as adaptive learning systems, automated feedback tools, intelligent tutoring systems, and predictive analytics (Olarewaju, Moshood & Awoyemi, 2025). These innovations have redefined traditional teaching practices by promoting data-driven decision-making and learner-centered pedagogies. In teacher education environments, preparing pre-service teachers to effectively utilize AI tools has become essential for improving classroom innovation and enhancing learning outcomes. In Nigeria, particularly in Colleges of Education, the preparedness of pre-service teachers to integrate AI into teaching has not been adequately investigated. This study therefore examines the level of preparedness of pre-service teachers in Colleges of Education in Bauchi State to adopt AI tools in their future teaching practice.

AI-driven educational tools are increasingly used to support personalized learning, reduce teacher workload, and enhance efficiency. However, to effectively integrate these technologies, teachers must possess adequate knowledge, skills, positive attitudes, and institutional support. Pre-service teachers, who are the future workforce of the education sector, need to be trained to meet contemporary teaching demands and emerging digital competences. Despite global progress, teacher education programs in many developing contexts, including Nigeria, are still at the early stage of AI adoption (Bolaji & Ahmed, 2025). Understanding the preparedness of preservice teachers is therefore essential for informed curriculum planning, technological investment, and capacity-building interventions that will enable effective integration of AI in schools.

Although AI tools hold significant potential for transforming teaching and learning in Nigerian schools, their effective integration depends on the competence and readiness of teachers. Existing studies in Bauchi State have focused mainly on in-service teachers in secondary schools, while little empirical attention has been given to pre-service teachers in Colleges of Education (Zakariya & Umahaba, 2025). Observations within teacher preparation programs reveal limited exposure to AI-based instructional tools, inconsistent access to digital infrastructure, and inadequate training opportunities. Consequently, it is unclear whether pre-service teachers possess the necessary knowledge, skills, and confidence required for integrating AI tools in their future classrooms. This study seeks to address this gap by assessing their preparedness across Colleges of Education in Bauchi State.

Furthermore, as global educational standards continue to emphasize digital literacy and technological integration, Nigerian teacher education institutions face increasing pressure to align their programs with international best practices. AI literacy is becoming a core component of 21st-century teaching competencies, yet many pre-service teachers in local Colleges of Education may not be benefiting from structured AI-related training. Without a clear understanding of their level of preparedness, policymakers and curriculum developers may struggle to design effective interventions. Thus, this study provides timely evidence that can guide improvements in teacher training, promote equitable access to digital tools, and support Nigeria's broader goal of achieving quality education through technology-enhanced instruction.

Statement of the problem

Teaching and learning in Nigerian Colleges of Education is faced by myriad of challenges most especially when it comes to anything artificial intelligence tools for teahing. In a study by Kuzu (2025) affirmed that large bibliometric and empirical studies from 2024-2025 show rising general visibility of AI in teacher education programs, yet also document important gaps in what pre-service teachers actually know about AI's classroom affordances. These gaps imply that "awareness" is often superficial (tool familiarity) rather than pedagogical (knowing when and why to use a tool).

On practical competence, actual ability to design, run, and evaluate lessons using AI tools recent field studies and course evaluations (2023-2025) show promising but tentative gains when programs include applied AI coursework, scaffolded micro-teaching with AI, and reflective assessment tasks (Han, 2025). Controlled deployments report that structured practice (project work, micro-courses, and scaffolded lesson design) significantly improves pre-service teachers' confidence and task performance with AI tools, but these improvements are unevenly distributed and hinge on access to reliable infrastructure and instructor support. Where practical competence is low, common barriers noted are limited institutional training, weak mentorship, and lack of locally relevant exemplars.

Therefore, it is against this there is need to investigate and determine the pre-service teachers' awareness, knowledge and practical competences for integrating AI tools in teaching across colleges of education in Bauchi state

Aim and Objectives of the Study

The study aims to assess pre-service teachers' preparedness for integrating AI tools in teaching across Colleges of Education in Bauchi State. Specifically, the study intends to:

Determine the level of pre-service teachers' awareness of AI tools for teaching.

Find out the level of pre-service teachers' knowledge of AI tools for teaching.

Examine pre-service teachers' practical competence in using AI-based educational tools. Research Questions

What is the level of pre-service teachers' awareness of AI tools for teaching?

What is the level of pre-service teachers' knowledge of AI tools for teaching?

What are the pre-service teachers' practical competence in using AI-based educational tools?

Literature Review

Pre-service teachers' awareness of AI tools is increasingly reported as uneven, many teacher-education students recognize mainstream AI applications for instance (generative text/image tools, auto-grading, and learning analytics), but awareness of pedagogically useful AI features and of ethical/assessment issues remains limited. In a study by Kuzu (2025) affirmed that large bibliometric and empirical studies from 2024-2025 show rising general visibility of AI in teacher education programs, yet also document important gaps in what pre-service teachers actually know about AI's classroom affordances. These gaps imply that "awareness" is often superficial (tool familiarity) rather than pedagogical (knowing when and why to use a tool). Studies that measure knowledge (conceptual and procedural understanding) report mixed results, while many pre-service teachers possess basic digital literacy and can operate common AIpowered apps, they frequently lack deeper AI literacy understanding algorithmic limitations, data/ethical implications, and instructional design choices required for pedagogically sound integration. Bautista, Estrada, Jaravata, Mangaser, Narag, Soquila & Asuncion (2024) reported that research using the TPACK framework adapted for AI shows that technological knowledge alone does not predict effective integration; pedagogical and content knowledge about AI-enabled activities must be explicitly taught. This suggests teacher-education curricula must move beyond exposure to structured modules that build AI conceptual knowledge alongside hands-on practice. On practical competence, actual ability to design, run, and evaluate lessons using AI tools recent field studies and course evaluations (2023-2025) show promising but tentative gains when programs include applied AI coursework, scaffolded micro-teaching with AI, and reflective assessment tasks (Han, 2025). Controlled deployments report that structured practice (project work, micro-courses, and scaffolded lesson design) significantly improves pre-service teachers' confidence and

task performance with AI tools, but these improvements are unevenly distributed and hinge on access to reliable infrastructure and instructor support. Where practical competence is low, common barriers noted are limited institutional training, weak mentorship, and lack of locally relevant exemplars.

Contextual research from Nigeria and similar settings highlights locality-specific constraints and affordances: studies in Nigerian states show moderate awareness but limited readiness to use AI for assessment and pedagogy, with infrastructure, policy clarity, and professional development repeatedly named as limiting factors (Samaila, Samaila, Abdulfattah, Babatunde & Akindele, 2024). These regional findings are directly relevant to focus from Bauchi State pre-service teachers in such contexts frequently report interest in AI but cite gaps in formal coursework, mentoring, and ethical guidance as obstacles to moving from awareness to competent classroom use. Incorporating locally relevant case studies and low-bandwidth AI workflows in training can help close the gap between interest and practical capability.

Recent literature such as (Guan, Zhang & Gu, 2025) noted that three consistent themes emerge that map directly to the present studies objectives; awareness is necessary but not sufficient, conceptual AI knowledge must be paired with pedagogical design skills (TPACK-informed), and practical competence improves most when courses include applied, scaffolded experiences plus institutional support. Empirical work from 2024-2025 therefore recommends mixed-method measurement (surveys for awareness/knowledge plus performance-based tasks or microteaching for competence) and curriculum interventions that combine ethics, pedagogy, and hands-on practice an approach your study can adopt and evaluate within Bauchi's Colleges of Education.

Methodology

A descriptive survey research design was adopted for the purpose of this study. The descriptive survey design was considered appropriate because it enabled the researcher to collect quantitative data on the current status of pre-service teachers' preparedness for integrating artificial intelligence (AI) tools in teaching, particularly in terms of their awareness, knowledge, and practical competence. According to Creswell (2012), survey research designs are procedures in quantitative research in which investigators administer a survey to a sample or the entire population to describe attitudes, opinions, behaviors, or characteristics of a population. This design was suitable for the study since data were collected directly from respondents using a questionnaire to capture their perceptions and self-reported competencies regarding AI integration in teaching. The population of the study comprised all 356 NCE III pre-service teachers offering education-related courses in the three Colleges of Education in Bauchi State. These students were selected because they are at the final stage of their training and are expected to possess sufficient exposure to instructional methods and educational technologies relevant to classroom practice.

Using Krejcie and Morgan's (1970) table for sample size determination, a sample size of 186 preservice teachers was obtained. A stratified proportional random sampling technique was employed to select the respondents. Each College of Education constituted a stratum, and the number of respondents selected from each institution was proportionate to its population size to ensure fair representation. Within each stratum, simple random sampling was used to select the respondents. The main instrument for data collection was a structured questionnaire titled "Pre-Service Teachers' Awareness and Knowledge for AI Integration Questionnaire (PTAAIQ)". The questionnaire was developed by the researcher based on relevant literature and aligned with the objectives of the study. The instrument consisted of four sections: Section A: Demographic information of respondents; Section B: Items measuring pre-service teachers' awareness of AI tools for teaching;

Section C: Items assessing pre-service teachers' knowledge of AI tools and their pedagogical applications; Section D: Items measuring pre-service teachers' practical competence in using AIbased educational tools. The questionnaire items were structured on a 5-point Likert scale with response options scored as follows: Strongly

Agree (5), Agree (4), Neutral (3), Disagree (2), and Strongly Disagree (1).

To ensure the validity of the instrument, the PTAAIQ was submitted to experts in educational technology and measurement and evaluation for face and content validation. Their suggestions and corrections were incorporated to improve the clarity, relevance, and appropriateness of the items. A pilot study was conducted using 30 NCE III pre-service teachers from a College of Education outside the study area to avoid contamination of the main sample. The data obtained from the pilot study were analyzed using Cronbach's Alpha method to determine the reliability of the instrument. The reliability coefficient obtained was 0.84, indicating that the instrument was reliable and suitable for the study. Data for the main study were collected through the administration of the questionnaire to the selected respondents with the assistance of trained research assistants. Completed questionnaires were retrieved and screened for completeness. The data collected were analyzed using mean and standard deviation to answer the research questions. Decision rules were based on the mean score ranges to determine the levels of awareness, knowledge, and practical competence. All statistical analyses were carried out using Statistical Package for the Social Sciences (SPSS) version 23.

Results

The presentation of the analyzed data was done in line with the three (3) research objectives and three (3) research questions that guided the study. Data were analyzed using mean and standard deviation to determine the levels of pre-service teachers' awareness, knowledge, and practical competence in integrating AI tools for teaching.

Research Question One: What is the level of pre-service teachers' awareness of AI tools for teaching?

Table 1: Mean Response and Standard Deviation of Pre-service Teachers' Awareness of AI Tools for Teaching in Colleges of Education in Bauchi State.

S/N

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Source: Field Survey, 2025

Table 1 shows the mean responses and standard deviations of pre-service teachers' awareness of AI tools for teaching. The mean scores ranged from 3.44 to 3.95. Item 5 fell within the Neutral (N) decision range, while all other items fell within the Agree (A) range. The grand mean of 3.74, which falls within the decision range of Agree (3.50-4.49), indicates that preservice teachers in Colleges of Education in Bauchi State have a high level of awareness of AI tools for teaching.

Source: Field Survey, 2025

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S/N

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Source: Field Survey, 2025

Table 2 indicates that the mean scores for pre-service teachers' knowledge of AI tools ranged from 3.28 to 3.61. Most items fell within the Neutral (N) range, with only a few items in the Agree (A) range. The grand mean of 3.44, which falls within the Neutral decision range, suggests that pre-service teachers possess a moderate level of knowledge of AI tools for teaching.

Research Question Three: What is the pre-service teachers' practical competence in using AIbased educational tools?

Table 3: Mean Response and Standard Deviation of Pre-service Teachers' Practical Competence in Using AI-based Educational Tools.

S/N

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Source: Field Survey, 2025

Table 3 shows that the mean scores for practical competence ranged from 2.68 to 2.96.

Items 5 and 8 fell within the Disagree (D) range, while the remaining items fell within the Neutral (N) range. The grand mean of 2.84, which falls within the Neutral-to-Disagree range, indicates that pre-service teachers in Colleges of Education in Bauchi State have low practical competence in using AI-based educational tools.

Summary of Findings

The results reveal that while pre-service teachers demonstrate a high level of awareness of AI tools for teaching

Their knowledge is moderate, and

Their practical competence is low, largely due to limited hands-on experience and insufficient structured training in AI integration.

Discussion of Findings

The findings presented in Table 1 reveal that pre-service teachers in Colleges of Education in Bauchi State generally demonstrate a high level of awareness of artificial intelligence (AI) tools for teaching. With a grand mean of 3.74, which falls within the "Agree" category (3.50-4.49), the results indicate that most pre-service teachers are familiar with common AI tools and are aware of their potential applications in lesson planning, assessment, personalized learning, and student engagement. Out of the ten items assessed, nine were rated "Agree", while only one item awareness of ethical issues related to AI use fell within the "Neutral" category. This suggests that awareness is largely surface-level, focusing more on tool familiarity than on deeper ethical and professional considerations.

This finding aligns with earlier studies which reported that pre-service teachers often have high general awareness of AI tools but limited understanding of their broader pedagogical and ethical implications (Kuzu, 2025; Samaila et al., 2024). The high awareness observed in this study may be attributed to increased exposure to AI through digital media, mobile applications, and informal learning platforms. However, the neutrality expressed toward ethical awareness suggests a gap in formal training, reinforcing the need for structured AI literacy components within teacher education programs.

The findings in Table 2 show that pre-service teachers possess a moderate level of knowledge of AI tools for teaching. The grand mean of 3.44, which falls within the "Neutral" category, indicates that while respondents have some conceptual understanding of AI and its instructional benefits, they lack sufficient depth in areas such as pedagogical integration, tool selection, and ethical application. Most items in this section were rated "Neutral", with only a few items reaching the "Agree" category, particularly those related to general pedagogical benefits and assessment support.

This result supports the findings of Bautista et al. (2024), who reported that pre-service teachers often possess basic technological knowledge but lack the pedagogical and contextual understanding required for effective AI integration. The moderate knowledge level observed in this study suggests that AI-related content in Colleges of Education may be implicit or fragmented, rather than systematically embedded in the curriculum. As a result, pre-service teachers may understand what AI tools are but remain uncertain about how and when to use them effectively in classroom contexts.

The findings in Table 3 indicate that pre-service teachers exhibit low practical competence in using AI-based educational tools. With a grand mean of 2.84, which falls within the Neutral-toDisagree range, the results suggest that most respondents lack hands-on experience and confidence in applying AI tools during lesson preparation, classroom teaching, assessment, and feedback. Two items receiving hands-on training and experience during micro-teaching were rated "Disagree", highlighting a clear deficiency in practical exposure.

This finding is consistent with previous studies (Han, 2025; Guan, Zhang & Gu, 2025), which emphasized that practical competence in AI integration remains low where teacher education programs do not provide scaffolded, experiential learning opportunities. The low level of competence observed may be attributed to inadequate institutional infrastructure, limited access to AI-supported technologies, and the absence of practical AI-focused coursework in Colleges of Education in Bauchi State.

Conclusion

This study investigated pre-service teachers' preparedness for integrating artificial intelligence (AI) tools in teaching across Colleges of Education in Bauchi State. The findings revealed that pre-service teachers generally possess a high level of awareness of AI tools and their potential applications in teaching and learning. However, despite this high awareness, their knowledge of AI functionalities and pedagogical integration was found to be moderate, while their practical competence in using AI-based educational tools was relatively low.

The results indicate that although pre-service teachers recognize the relevance and importance of AI for future teaching practice, limited exposure to structured AI-related coursework and hands-on training restricts their ability to effectively integrate these tools into classroom instruction. Consequently, the study concludes that awareness alone is insufficient for effective AI integration; rather, adequate knowledge depth and practical competence are essential for meaningful adoption of AI in teaching.

Recommendations

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

Colleges of Education should provide regular hands-on training, workshops, and microteaching opportunities in order to maintain and improve on the level of awareness preservice teachers has on integrating AI tools for teaching.

Colleges of Education should integrate structured AI literacy and pedagogical AI modules into teacher education programs to strengthen pre-service teachers' conceptual knowledge and instructional application of AI tools.

Colleges of Education in Bauchi State should invest in adequate digital infrastructure, including reliable internet connectivity, functional computer laboratories, and access to relevant AI-supported educational technologies in order to boost pre-service teachers' practical competences for integrating AI tools for teaching.

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