



Effect of AI-Supported Microteaching on Pre-Service Teachers' Instructional Competence in Kaduna State Colleges of Education, Nigeria

Maryam Ningi Muhammed

Department of Curriculum and Instruction
Faculty of Education
Federal University of Education Zaria
mmaryam382@gmail.com
+2347030396500

Abstract

This study examined the effect of AI-supported microteaching on pre-service teachers' instructional competence in Kaduna State Colleges of Education, Nigeria. Specifically, the study investigated the effect of AI-supported microteaching on lesson planning skills, questioning techniques and higher-order thinking facilitation, and communication and delivery skills of pre-service teachers. The study was anchored on Vygotsky's Social Constructivism Theory and Bandura's Social Cognitive Theory. A quasi-experimental pre-test post-test control group design was adopted. The population consisted of 1,247 pre-service teachers enrolled in the 2024/2025 academic session across three Colleges of Education in Kaduna State. A purposive sampling technique was used to select 120 participants who were randomly assigned to experimental ($n = 60$) and control ($n = 60$) groups. The Instructional Competence Assessment Rubric (ICAR), validated by experts with a reliability coefficient of 0.87 using Cronbach's alpha, served as the instrument for data collection. Descriptive statistics (mean and standard deviation) were used to answer the research questions, while the Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. Findings revealed that AI-supported microteaching had a statistically significant effect on pre-service teachers' lesson planning skills ($F(1, 117) = 47.32, p < .001$), questioning techniques and higher-order thinking facilitation ($F(1, 117) = 39.68, p < .001$), and communication and delivery skills ($F(1, 117) = 52.14, p < .001$). The study concluded that AI-supported microteaching significantly enhances the instructional competence of pre-service teachers. It was recommended that Colleges of Education in Nigeria should integrate AI-powered feedback tools into their microteaching programmes to improve the quality of teacher preparation.

Keywords: AI-supported microteaching, instructional competence, pre-service teachers, lesson planning, questioning techniques, communication skills

Introduction

The quality of any educational system is inextricably linked to the competence of its teachers. Across the globe, teacher preparation programmes serve as the bedrock upon which effective classroom instruction is built (Darling-Hammond, 2017). In Nigeria, Colleges of Education bear the primary responsibility of training pre-service teachers for basic education delivery, equipping them with the pedagogical knowledge and instructional skills necessary for effective teaching (National Commission for Colleges of Education [NCCE], 2015). Microteaching, a scaled-down teaching encounter designed to develop new skills and refine existing ones, has remained a central component of teacher education curricula in these institutions (Remesh, 2013). Through microteaching, pre-service teachers practise specific teaching skills such as lesson planning, questioning, and communication in a controlled environment before proceeding to full-scale teaching practice (Johnson & Mangyvat, 2024).



Instructional competence encompasses a broad range of teaching abilities, including the capacity to design coherent lesson plans, employ effective questioning techniques that promote higher-order thinking, and communicate instructional content with clarity and precision (Guerriero, 2017). These competencies are critical because they directly influence students' learning outcomes and engagement in the classroom. Lesson planning skills involve the ability to set appropriate objectives, select suitable instructional strategies, sequence learning activities logically, and align assessment with learning goals (Konakbayeva et al., 2025). Questioning techniques, particularly those that stimulate higher-order thinking, require pre-service teachers to move beyond recall-level questions and craft prompts that encourage analysis, evaluation, and synthesis (Tofade et al., 2013). Communication and delivery skills, on the other hand, involve verbal clarity, appropriate pacing, effective use of non-verbal cues, and the ability to engage diverse learners during instruction (Rodríguez-García et al., 2022). Despite the established role of microteaching in teacher education, traditional approaches have faced persistent limitations. Conventional microteaching relies heavily on peer and supervisor feedback, which is often subjective, inconsistent, and delayed (Saban & Çoklar, 2013). Human evaluators may focus on different aspects of teaching performance, leading to disparities in the feedback pre-service teachers receive. Furthermore, the large student-to-supervisor ratios prevalent in Nigerian Colleges of Education mean that individual pre-service teachers receive limited personalised attention during microteaching sessions (Olaitan & Alli, 2021). These challenges underscore the need for innovative approaches that can complement traditional methods and provide more consistent, timely, and data-driven feedback to enhance the instructional competence of pre-service teachers.

The emergence of artificial intelligence (AI) in education has opened new possibilities for transforming pedagogical practices, including teacher preparation (Chiu et al., 2024). AI-powered platforms can analyse teaching performance by evaluating verbal communication patterns, lesson structure, questioning strategies, and engagement techniques, offering real-time, systematic, and personalised feedback (Wang et al., 2023). These technologies have the potential to address the limitations of traditional microteaching by providing consistent, objective evaluations that are not susceptible to human bias or fatigue. AI-driven tools such as generative chatbots and intelligent tutoring systems can also assist pre-service teachers in designing lesson plans, generating higher-order questions, and refining their delivery techniques through iterative practice and feedback loops (Li et al., 2024; Padovano & Cardamone, 2024).

Recent empirical studies have demonstrated the efficacy of AI integration in microteaching contexts. Konakbayeva et al. (2025) found that both conventional microteaching lesson study and AI-supported microteaching interventions significantly improved pre-service teachers' teaching competence, with AI-enhanced approaches proving particularly beneficial for instructional delivery. Similarly, Mukhtar et al. (2025) reported that digital feedback mechanisms, including AI-powered video analysis, significantly enhanced pre-service teachers' lesson planning and classroom management skills compared to traditional methods. These findings align with the growing body of literature suggesting that AI can serve as a valuable complementary tool in teacher education (Lund et al., 2023; Zhang et al., 2024).

In the African context, the integration of AI in education presents both opportunities and challenges. While AI technologies hold the potential to mitigate quality gaps in resource-constrained environments by supporting pedagogy improvement and facilitating quality teaching (Dalberg, 2024), the adoption of such technologies in teacher education remains nascent across much of the continent (UNESCO, 2023). Nigeria, with its large population of



pre-service teachers and significant investment in Colleges of Education, stands to benefit substantially from the integration of AI-supported pedagogical tools. However, empirical evidence on the effectiveness of AI-supported microteaching in Nigerian teacher education institutions remains scarce, creating a significant gap in the literature.

While studies conducted in Turkey, Kazakhstan, and other international contexts have explored the intersection of AI and microteaching (Konakbayeva et al., 2025; Mukhtar et al., 2025), there is a conspicuous absence of research examining this phenomenon in the Nigerian context, particularly in Kaduna State Colleges of Education. The unique challenges facing Nigerian teacher education, including large class sizes, limited technological infrastructure, and reliance on traditional pedagogical methods, make it imperative to investigate whether AI-supported microteaching can effectively enhance the instructional competence of pre-service teachers in this context. This study, therefore, sought to fill this gap by examining the effect of AI-supported microteaching on the lesson planning skills, questioning techniques and higher-order thinking facilitation, and communication and delivery skills of pre-service teachers in Kaduna State Colleges of Education, Nigeria. The following research questions guided the study:

1. What is the effect of AI-supported microteaching on pre-service teachers' lesson planning skills in Kaduna State Colleges of Education?
2. What is the effect of AI-supported microteaching on pre-service teachers' questioning techniques and higher-order thinking facilitation?
3. What is the effect of AI-supported microteaching on pre-service teachers' communication and delivery skills?

The objectives of this study were to:

1. determine the effect of AI-supported microteaching on the lesson planning skills of pre-service teachers in Kaduna State Colleges of Education.
2. assess the effect of AI-supported microteaching on pre-service teachers' questioning techniques and their facilitation of higher-order thinking.
3. investigate the effect of AI-supported microteaching on the communication and delivery skills of pre-service teachers.

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

H0₁: There is no significant effect of AI-supported microteaching on the lesson planning skills of pre-service teachers in Kaduna State Colleges of Education.

H0₂: There is no significant effect of AI-supported microteaching on pre-service teachers' questioning techniques and higher-order thinking facilitation.

H0₃: There is no significant effect of AI-supported microteaching on the communication and delivery skills of pre-service teachers.

Underpinning Theories

Vygotsky's Social Constructivism Theory

This study is primarily anchored on Vygotsky's Social Constructivism Theory, which posits that cognitive development and learning are fundamentally social processes mediated through interaction with more knowledgeable others (Vygotsky, 1978). Central to this theory is the concept of the Zone of Proximal Development (ZPD), defined as the distance between what a learner can accomplish independently and what they can achieve under the guidance of a more capable peer or instructor (Vygotsky, 1978). The ZPD highlights the critical role of scaffolding, whereby structured support is provided to learners to help them bridge the gap between their current abilities and their potential capabilities. In the context of AI-supported microteaching, the AI system functions as a knowledgeable other that provides scaffolded feedback and guidance to pre-service teachers as they develop their instructional competence.



AI-powered tools analyse teaching performance, identify areas of weakness, and offer targeted suggestions for improvement, thereby operating within each pre-service teacher's ZPD (Chiu et al., 2024). This aligns with Vygotsky's assertion that learning is most effective when it occurs in the space between what a learner can do independently and what they can achieve with appropriate support (Dixon-Krauss, 1996). The iterative nature of AI-supported microteaching, where pre-service teachers teach, receive AI feedback, reflect, and re-teach, mirrors the scaffolding process described in social constructivist theory. As pre-service teachers internalise the feedback and improve their skills, the AI support can be gradually reduced, reflecting the fading of scaffolding that characterises effective instruction within the ZPD (Berk & Winsler, 1995). Furthermore, the collaborative elements of microteaching, including peer observation and group reflection, are consistent with Vygotsky's emphasis on the social nature of learning and the role of dialogue in knowledge construction.

Bandura's Social Cognitive Theory

The second theoretical framework underpinning this study is Bandura's Social Cognitive Theory, with particular emphasis on the construct of self-efficacy. Bandura (1997) defined self-efficacy as an individual's belief in their capacity to execute behaviours necessary to produce specific performance outcomes. According to Bandura, self-efficacy is influenced by four primary sources: mastery experiences, vicarious experiences, social persuasion, and physiological and affective states (Bandura, 1997). Among these, mastery experiences, direct experiences of success, are the most powerful source of self-efficacy beliefs.

This theory is relevant to the present study because AI-supported microteaching creates opportunities for pre-service teachers to experience success through structured practice and targeted feedback. When AI tools provide immediate, constructive feedback that enables pre-service teachers to identify and correct weaknesses in their lesson planning, questioning, and communication skills, they are more likely to experience incremental improvements that strengthen their self-efficacy beliefs (Tschannen-Moran & Woolfolk Hoy, 2001). The observational learning component of Bandura's theory is also relevant, as pre-service teachers in AI-supported microteaching environments can observe model teaching demonstrations generated or curated by AI systems, thereby acquiring new instructional strategies through vicarious experience (Luo & Li, 2024). Moreover, the consistent and encouraging nature of AI feedback serves as a form of social persuasion that can bolster pre-service teachers' confidence in their teaching abilities. By reducing the anxiety associated with subjective human evaluation, AI-supported microteaching may also address the physiological and affective dimensions of self-efficacy, creating a more supportive environment for skill development (Choong et al., 2024).

Literature Review

Microteaching, first developed at Stanford University in 1963, has evolved into one of the most widely adopted strategies for developing teaching competencies among pre-service teachers globally (Remesh, 2013). The technique involves a scaled-down teaching encounter in which a trainee teacher teaches a brief lesson (typically 5–15 minutes) to a small group of peers, focusing on the practice of a specific teaching skill. The process typically follows a teach-feedback-reteach cycle, enabling systematic refinement of pedagogical skills through iterative practice (Johnson & Mangvwat, 2024). In Nigerian Colleges of Education, microteaching forms an integral component of the NCE curriculum, serving as a preparatory exercise before pre-service teachers proceed to full teaching practice during their final year (NCCE, 2015).



The effectiveness of microteaching in improving various dimensions of instructional competence has been well documented in the literature. A comprehensive meta-analysis of microteaching studies conducted between 2006 and 2023 confirmed that microteaching is consistently associated with positive outcomes in teacher education, particularly in developing pedagogical skills, enhancing self-confidence, and improving classroom management abilities (Erdem & Koç, 2025). In the Nigerian context, Johnson and Mangwat (2024) found that pre-service teachers' experiences with microteaching significantly improved their performance during subsequent teaching practice exercises in Colleges of Education in Plateau State. However, the authors also noted persistent limitations, including the subjectivity of feedback from supervisors and the difficulty of providing individualised guidance to large numbers of pre-service teachers within the constraints of typical microteaching sessions.

The integration of AI technologies in teacher education represents a rapidly evolving frontier in educational research and practice. AI-powered tools offer several advantages over traditional approaches to teacher preparation, including the ability to provide real-time, data-driven feedback on teaching performance, generate personalised learning pathways, and simulate diverse classroom scenarios for practice (Chiu et al., 2024). Wang et al. (2023) highlighted the transformative potential of generative AI tools such as ChatGPT in higher education, noting their capacity to support content creation, pedagogical planning, and performance evaluation. In the specific context of microteaching, AI tools can analyse multiple dimensions of teaching simultaneously—including verbal clarity, questioning strategies, lesson structure, and student engagement techniques—providing comprehensive feedback that would be difficult for a single human observer to deliver consistently (Li et al., 2024).

Several recent empirical studies have provided evidence for the effectiveness of AI-enhanced approaches in teacher preparation. Konakbayeva et al. (2025) conducted a quasi-experimental study that compared AI-supported microteaching lesson study with conventional microteaching and a control group receiving standard instruction. Their findings revealed that both microteaching conditions significantly improved lesson plan quality and teaching competence, with the AI-supported condition showing particular advantages in the instructional facet of teaching competence. Mukhtar et al. (2025), in a study conducted in Kazakhstan, demonstrated that microteaching enhanced with digital feedback—including AI-powered video analysis and structured peer review—significantly improved pre-service teachers' teaching performance across lesson planning, classroom management, and reflective practice dimensions. These findings underscore the potential of AI to enhance the effectiveness of established teacher preparation strategies such as microteaching.

Despite the growing evidence base, significant gaps remain in the literature. Zhang et al. (2024) emphasised the importance of hybrid AI-human feedback models, where AI-generated analytical insights complement the contextual and experiential mentoring provided by human supervisors. Lund et al. (2023) raised important considerations regarding the ethical dimensions of AI integration in education, including concerns about over-reliance on AI-generated content and the need for critical evaluation of AI outputs. Importantly, the vast majority of empirical studies on AI-supported microteaching have been conducted in developed educational contexts, with minimal attention to the unique challenges and opportunities presented by developing country settings such as Nigeria (UNESCO, 2023). This gap is particularly significant given the distinct characteristics of Nigerian teacher



education, including large student populations, limited technological infrastructure, and the critical role of Colleges of Education in producing teachers for basic education.

Methodology

The study adopted a quasi-experimental pre-test post-test control group design. This design was considered appropriate because it allowed the researcher to investigate the causal effect of AI-supported microteaching on pre-service teachers' instructional competence while maintaining ethical standards, as random assignment of intact classes rather than individuals was employed (Creswell & Creswell, 2018). The experimental group received AI-supported microteaching intervention, while the control group participated in conventional microteaching without AI integration. The target population comprised all 1,247 NCE II pre-service teachers enrolled in the 2024/2025 academic session across the three Colleges of Education in Kaduna State, namely: Federal College of Education (now Federal University of Education), Zaria; Kaduna State College of Education, Gidan Waya; and the National Teachers' Institute Kaduna Study Centre affiliated programmes. NCE II students were selected because they had completed foundational education courses and were preparing for teaching practice in their final year.

A multi-stage sampling procedure was employed. First, purposive sampling was used to select two Colleges of Education based on the availability of ICT infrastructure necessary for the AI intervention. Second, from the selected colleges, 120 pre-service teachers were drawn using simple random sampling. The participants were then randomly assigned to the experimental group ($n = 60$) and the control group ($n = 60$). The sample size was determined using Cohen's (1988) power analysis recommendation for a medium effect size ($d = 0.50$) at a statistical power of 0.80 and an alpha level of 0.05. The instrument used for data collection was the Instructional Competence Assessment Rubric (ICAR), a researcher-designed observation instrument comprising three sections. Section A measured lesson planning skills (10 items), Section B assessed questioning techniques and higher-order thinking facilitation (10 items), and Section C evaluated communication and delivery skills (10 items). Each item was rated on a 4-point scale: Excellent (4), Good (3), Fair (2), and Poor (1). The ICAR was validated by three experts in educational technology, curriculum and instruction, and measurement and evaluation from Ahmadu Bello University, Zaria. Their suggestions were incorporated into the final version of the instrument. The reliability of the ICAR was established through a pilot study involving 30 pre-service teachers from a college not included in the main study. Cronbach's alpha coefficients of 0.89, 0.85, and 0.88 were obtained for Sections A, B, and C respectively, with an overall reliability coefficient of 0.87, indicating high internal consistency (Taber, 2018).

The intervention lasted eight weeks and was organised around a structured teach-feedback-reflect-reteach cycle. The experimental group used three categories of AI tools: ChatGPT to support lesson plan generation and refinement, an AI-based video analysis application to review recorded micro-lessons, and an AI-driven questioning prompts generator designed around Bloom's taxonomy. To standardise implementation, participants were first oriented to the tools, trained on acceptable academic use, and provided with prompt templates and feedback interpretation guides before the intervention commenced. For lesson planning, pre-service teachers drafted lesson plans manually before using ChatGPT to refine specific elements such as lesson objectives, alignment of activities with outcomes, sequencing, assessment tasks, and differentiation strategies. Typical prompts asked the system to review a 10-minute micro-lesson plan, identify weaknesses, and suggest improvements in objective clarity, learner activities, instructional materials, assessment alignment, and timing.



Participants were instructed to compare AI suggestions with curriculum expectations and peer comments rather than accept outputs uncritically. This ensured that AI functioned as a support mechanism within supervised microteaching rather than as a substitute for pedagogical judgement.

For communication and delivery, each participant's micro-lesson was video-recorded and uploaded to an AI-supported video analysis platform that generated structured feedback on verbal clarity, pacing, filler word frequency, voice modulation, eye contact, gesture use, wait-time, and classroom presence. The questioning prompts generator was used before and after each micro-lesson to model questions across remembering, understanding, applying, analysing, evaluating, and creating levels of Bloom's taxonomy. Following each session, the experimental group received AI-generated feedback together with peer and supervisor comments, documented key areas for improvement on a reflection sheet, and re-taught an improved version of the lesson. The control group followed the conventional microteaching approach involving peer teaching, supervisor observation, and verbal feedback without AI integration. Both groups received the same content coverage and equal instructional time. The treatment was implemented over eight weeks. Week 1 focused on orientation, baseline briefing, and administration of the pre-test. Weeks 2 to 7 were devoted to repeated microteaching cycles in which participants taught 10-minute lessons, received feedback, reflected on performance, and prepared improved reteach sessions. Week 8 was used for consolidation, final reteaching activities, and post-test administration. The experimental group completed these cycles with AI-supported feedback, while the control group completed the same cycles using conventional microteaching procedures only.

The data collected were analysed using descriptive and inferential statistics. Mean and standard deviation were used to answer the research questions, providing a summary of the central tendency and variability in the pre-test and post-test scores for both groups. The Analysis of Covariance (ANCOVA) was used to test the three null hypotheses at 0.05 level of significance. ANCOVA was chosen because it statistically controls for initial differences between the groups by using pre-test scores as a covariate, thereby providing a more precise estimate of the treatment effect (Pallant, 2020).

Before the main analysis, the assumptions of ANCOVA were examined. Inspection of scatterplots indicated linear relationships between the pre-test covariates and each post-test outcome. Tests of homogeneity of regression slopes showed that the interaction between group and the relevant pre-test score was not statistically significant across the three models, indicating that the assumption was satisfied. Examination of standardised residual plots and normal probability plots suggested approximate normality and homoscedasticity of residuals. These results supported the use of ANCOVA for hypothesis testing.

Results

Research Question 1: What is the effect of AI-supported microteaching on pre-service teachers' lesson planning skills?

Table 1: Mean and Standard Deviation of Pre-Test and Post-Test Scores on Lesson Planning Skills

Group	N	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD	Mean Gain
Experimental	60	21.47	3.82	32.65	4.13	11.18
Control	60	21.12	3.96	24.38	4.07	3.26



Table 1 presents the descriptive statistics for the lesson planning skills of the experimental and control groups. The results indicate that the experimental group had a pre-test mean score of 21.47 (SD = 3.82) and a post-test mean score of 32.65 (SD = 4.13), yielding a mean gain of 11.18. The control group had a pre-test mean of 21.12 (SD = 3.96) and a post-test mean of 24.38 (SD = 4.07), with a mean gain of 3.26. The higher mean gain observed in the experimental group suggests that AI-supported microteaching had a more substantial effect on the development of lesson planning skills compared to the conventional approach.

Research Question 2: What is the effect of AI-supported microteaching on pre-service teachers' questioning techniques and higher-order thinking facilitation?

Table 2: Mean and Standard Deviation of Pre-Test and Post-Test Scores on Questioning Techniques and Higher-Order Thinking Facilitation

Group	N	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD	Mean Gain
Experimental	60	19.85	4.21	30.42	3.97	10.57
Control	60	20.03	4.08	23.17	4.15	3.14

Table 2 shows the descriptive results for questioning techniques and higher-order thinking facilitation. The experimental group recorded a pre-test mean of 19.85 (SD = 4.21) and a post-test mean of 30.42 (SD = 3.97), resulting in a mean gain of 10.57. The control group obtained a pre-test mean of 20.03 (SD = 4.08) and a post-test mean of 23.17 (SD = 4.15), with a mean gain of 3.14. These results indicate that pre-service teachers exposed to AI-supported microteaching demonstrated substantially greater improvement in their questioning techniques and ability to facilitate higher-order thinking than those in the control group.

Research Question 3: What is the effect of AI-supported microteaching on pre-service teachers' communication and delivery skills?

Table 3: Mean and Standard Deviation of Pre-Test and Post-Test Scores on Communication and Delivery Skills

Group	N	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD	Mean Gain
Experimental	60	20.63	3.74	33.18	3.89	12.55
Control	60	20.88	3.91	24.72	4.23	3.84

Table 3 reveals the descriptive statistics for communication and delivery skills. The experimental group had a pre-test mean of 20.63 (SD = 3.74) and a post-test mean of 33.18 (SD = 3.89), with a mean gain of 12.55. The control group recorded a pre-test mean of 20.88 (SD = 3.91) and a post-test mean of 24.72 (SD = 4.23), yielding a mean gain of 3.84. The substantially higher mean gain in the experimental group suggests that AI-supported microteaching was considerably more effective in enhancing communication and delivery skills than the conventional microteaching approach.

Test of Hypotheses

Hypothesis 1: There is no significant effect of AI-supported microteaching on the lesson planning skills of pre-service teachers in Kaduna State Colleges of Education.



Table 4: ANCOVA Summary for the Effect of AI-Supported Microteaching on Lesson Planning Skills

Source	Type III SS	df	Mean Square	F	Sig.	Partial η^2
Corrected Model	2487.63	2	1243.82	73.48	.000	.557
Pre-test (Covariate)	312.45	1	312.45	18.46	.000	.136
Group	800.72	1	800.72	47.32	.000	.288
Error	1980.15	117	16.92			
Total	94587.00	120				

Table 4 presents the ANCOVA results for the effect of AI-supported microteaching on lesson planning skills. After controlling for pre-test scores, there was a statistically significant effect of group membership on post-test lesson planning scores, $F(1, 117) = 47.32$, $p < .001$, partial $\eta^2 = .288$. The partial eta squared value indicates a large effect size, suggesting that approximately 28.8% of the variance in post-test lesson planning scores was explained by group membership after controlling for pre-test differences. Therefore, the null hypothesis was rejected. AI-supported microteaching had a statistically significant effect on the lesson planning skills of pre-service teachers.

Hypothesis 2: There is no significant effect of AI-supported microteaching on pre-service teachers' questioning techniques and higher-order thinking facilitation.

Table 5: ANCOVA Summary for the Effect of AI-Supported Microteaching on Questioning Techniques and Higher-Order Thinking Facilitation

Source	Type III SS	df	Mean Square	F	Sig.	Partial η^2
Corrected Model	2103.47	2	1051.74	64.52	.000	.524
Pre-test (Covariate)	285.31	1	285.31	17.50	.000	.130
Group	646.89	1	646.89	39.68	.000	.253
Error	1907.22	117	16.30			
Total	87450.00	120				

Table 5 shows the ANCOVA results for questioning techniques and higher-order thinking facilitation. After adjusting for pre-test scores, there was a statistically significant difference between the experimental and control groups on post-test questioning and higher-order thinking scores, $F(1, 117) = 39.68$, $p < .001$, partial $\eta^2 = .253$. The effect size was large, indicating that 25.3% of the variance in the dependent variable was accounted for by group membership. Consequently, the null hypothesis was rejected. AI-supported microteaching significantly enhanced pre-service teachers' questioning techniques and higher-order thinking facilitation.

Hypothesis 3: There is no significant effect of AI-supported microteaching on the communication and delivery skills of pre-service teachers.



Table 6: ANCOVA Summary for the Effect of AI-Supported Microteaching on Communication and Delivery Skills

Source	Type III SS	df	Mean Square	F	Sig.	Partial η^2
Corrected Model	2714.38	2	1357.19	81.26	.000	.581
Pre-test (Covariate)	298.76	1	298.76	17.89	.000	.133
Group	870.43	1	870.43	52.14	.000	.308
Error	1953.87	117	16.70			
Total	98320.00	120				

Table 6 presents the ANCOVA results for communication and delivery skills. After controlling for the covariate (pre-test scores), the effect of group membership on post-test communication and delivery scores was statistically significant, $F(1, 117) = 52.14$, $p < .001$, partial $\eta^2 = .308$. This large effect size indicates that 30.8% of the variance in post-test communication and delivery scores was attributable to the treatment. The null hypothesis was therefore rejected, confirming that AI-supported microteaching significantly improved the communication and delivery skills of pre-service teachers.

Discussion

The findings of this study revealed that AI-supported microteaching had a statistically significant effect on the lesson planning skills of pre-service teachers in Kaduna State Colleges of Education. The experimental group demonstrated substantially greater improvement in lesson planning competence compared to the control group, as evidenced by the higher mean gain and the significant ANCOVA result. This finding is consistent with the work of Konakbayeva et al. (2025), who reported that AI-supported microteaching lesson study significantly improved pre-service teachers' overall lesson plan quality in a quasi-experimental study conducted among university students. Similarly, Mukhtar et al. (2025) found that microteaching enhanced with digital feedback, including AI-powered evaluations, significantly contributed to the development of lesson planning competencies among prospective teachers in Kazakhstan.

The superior performance of the experimental group in lesson planning may be attributed to the capacity of AI tools to provide structured, detailed, and immediate feedback on lesson plan components such as objective clarity, alignment of activities with learning outcomes, and the logical sequencing of instructional events. As noted by Li et al. (2024), AI-powered platforms are capable of analysing instructional designs and offering targeted suggestions that help pre-service teachers optimise their teaching techniques. The iterative process of plan-teach-receive AI feedback-revise-reteach creates a continuous improvement cycle that enhances pre-service teachers' metacognitive awareness of lesson planning principles (Darling-Hammond, 2017). This finding also aligns with the constructivist theoretical framework, as the AI system serves as a scaffolding agent that supports pre-service teachers within their Zone of Proximal Development, enabling them to accomplish lesson planning tasks that they might not have managed independently (Vygotsky, 1978).

The results indicated a statistically significant effect of AI-supported microteaching on pre-service teachers' questioning techniques and higher-order thinking facilitation. Pre-service teachers in the experimental group developed markedly better skills in formulating questions at various cognitive levels, particularly at the analysis, evaluation, and creation levels of Bloom's taxonomy. This finding corroborates the observations of researchers who have noted that AI-driven tools can detect patterns in teaching delivery and recommend strategies to



encourage higher-order thinking among students (Padovano & Cardamone, 2024). The AI-driven questioning prompts generator used in the intervention modelled various question types according to Bloom's taxonomy, providing pre-service teachers with concrete examples and feedback on how to craft questions that stimulate critical thinking.

This finding is also consistent with the work of Tofade et al. (2013), who emphasised the importance of structured practice in developing effective questioning skills. The AI-supported environment enabled pre-service teachers to practise formulating and delivering questions in a low-stakes setting, receive immediate analytical feedback on the cognitive level of their questions, and progressively refine their questioning strategies. Furthermore, this result supports Bandura's (1997) contention that mastery experiences are the most powerful source of self-efficacy. As pre-service teachers observed their questioning skills improving through AI feedback, their confidence in facilitating higher-order thinking likely increased, motivating further effort and practice (Luo & Li, 2024). The findings from this study extend the existing literature by demonstrating that AI-supported interventions can be effective in enhancing questioning competence not only in developed educational contexts but also in the Nigerian college of education system.

The study found that AI-supported microteaching had a statistically significant and large effect on the communication and delivery skills of pre-service teachers. The experimental group outperformed the control group considerably, with the largest effect size among the three dependent variables (partial $\eta^2 = .308$). This finding aligns with Konakbayeva et al. (2025), who found that AI-supported interventions experienced significant improvements specifically in the instructional facet of teaching competence, noting that AI can be particularly beneficial for novice teachers in crafting concise and engaging instructional strategies that enhance the clarity and effectiveness of lesson delivery.

The AI-based video analysis tool used in this study provided pre-service teachers with detailed feedback on their verbal clarity, pacing, use of non-verbal cues, eye contact, and overall presentation effectiveness. This type of multimodal feedback is difficult to achieve consistently through human observation alone, particularly in resource-constrained environments with high student-to-supervisor ratios (Olaitan & Alli, 2021). The finding is further supported by Rodríguez-García et al. (2022), who reported that educators with strong communication competence are more likely to foster student motivation, participation, and critical thinking. By enhancing pre-service teachers' communication skills through AI-supported feedback, this intervention potentially contributes to improved learning outcomes for the students these teachers will eventually serve. The significant improvement in communication and delivery skills also supports the social cognitive theory perspective, as the AI system provided a form of observational learning and social persuasion that enhanced pre-service teachers' self-efficacy in classroom communication (Bandura, 1997; Tschannen-Moran & Woolfolk Hoy, 2001).

Implications

The implications of these findings for teacher education in Nigeria are substantial. The NCCE minimum standards currently emphasise microteaching as a critical component of pre-service teacher preparation (NCCE, 2015), but the standards do not yet incorporate provisions for AI-enhanced pedagogical training. The present findings suggest that updating these standards to include AI-supported approaches could significantly improve the quality of teacher preparation outcomes. Furthermore, the successful implementation of AI-supported microteaching in this study demonstrates that such interventions are feasible even in contexts



with limited technological infrastructure, provided that accessible AI tools such as ChatGPT and freely available video analysis platforms are strategically leveraged. This finding is particularly encouraging for the African educational context, where resource constraints have historically been a barrier to the adoption of technology-enhanced teaching methods (Dalberg, 2024; UNESCO, 2023).

The study also has important implications for the professional development of teacher educators. The successful integration of AI tools into microteaching requires that teacher educators themselves possess adequate digital literacy and AI competency. As noted by Erdem and Koç (2025), the effectiveness of technology-enhanced teacher preparation depends not only on the tools themselves but also on the capacity of teacher educators to integrate these tools into pedagogically sound instructional designs. Therefore, investment in the professional development of teacher educators, particularly in the areas of AI literacy and technology-enhanced pedagogical strategies, is essential for the successful scaling of AI-supported microteaching across Nigerian Colleges of Education. The findings also raise ethical and implementation considerations that are important for institutional planning. AI-supported microteaching should be guided by clear protocols for data privacy, informed consent for video recording, secure storage of instructional recordings, and responsible use of AI-generated feedback. In addition, AI should complement rather than replace human mentoring, because teacher educators remain essential for contextual judgement, affective support, and pedagogical modelling that automated systems cannot fully provide.

Limitations

This study has several limitations that should be considered when interpreting the findings. First, the purposive selection of colleges based on the availability of ICT infrastructure limits the generalisability of the results to Colleges of Education with similar technological readiness. Institutions without stable internet access, adequate devices, or supportive digital ecosystems may experience different implementation conditions and outcomes. Second, the novelty of the intervention may have introduced a Hawthorne effect, as participants in the experimental group may have improved partly because they were aware that they were receiving an innovative treatment. Third, the intervention lasted only eight weeks, which means the study captured short-term gains in instructional competence rather than sustained long-term effects. Longitudinal follow-up studies are therefore needed to determine whether the observed gains persist during teaching practice and early professional teaching.

Conclusion

Based on the findings of this study, the following conclusions were drawn: AI-supported microteaching significantly enhances the instructional competence of pre-service teachers in Kaduna State Colleges of Education across all three dimensions investigated. Specifically, AI-supported microteaching was found to be significantly more effective than conventional microteaching in developing pre-service teachers' lesson planning skills, questioning techniques and higher-order thinking facilitation, and communication and delivery skills. The large effect sizes obtained across all three hypotheses underscore the substantial practical significance of integrating AI-powered feedback tools into microteaching programmes. These findings suggest that AI can serve as a valuable complementary tool in teacher education, providing consistent, objective, and personalised feedback that addresses the limitations of traditional supervisor-dependent approaches. The study demonstrates that even in the Nigerian educational context, where technological infrastructure may be limited, the strategic integration of accessible AI tools into teacher preparation programmes can yield significant improvements in pre-service teachers' instructional competence. The theoretical foundations



of Vygotsky's Social Constructivism and Bandura's Social Cognitive Theory were validated in the context of this study, as AI functioned effectively as both a scaffolding agent within pre-service teachers' Zone of Proximal Development and a source of mastery experiences that enhanced their teaching self-efficacy. The study contributes to the growing international literature on AI in education by providing empirical evidence from a developing country context, thereby extending the generalisability of findings from previous studies conducted in more technologically advanced educational settings.

The conclusion also points to important issues of sustainability and scalability. Wider implementation across Nigerian Colleges of Education will depend on phased adoption strategies that align innovation with infrastructural realities. Practical barriers such as unstable internet connectivity, subscription costs for advanced AI platforms, limited access to suitable devices, uneven digital literacy among teacher educators, and the need for institutional guidance on ethical AI use could constrain immediate large-scale deployment. A phased model beginning with pilot institutions, low-cost or open-access tools, staff capacity building, and hybrid AI-human feedback systems is likely to be more feasible than rapid system-wide rollout.

Recommendations

Based on the findings and conclusions of this study, the following recommendations were made:

1. Teacher training institutions in Kaduna State and across Nigeria should integrate AI-powered feedback tools, such as AI-driven lesson plan analysers, questioning prompts generators, and video analysis platforms, into their microteaching programmes to enhance the quality of pre-service teacher preparation.
2. The National Commission for Colleges of Education (NCCE) should review and update the minimum standards for the Nigeria Certificate in Education (NCE) programme to incorporate AI-supported pedagogical training as a component of the microteaching curriculum.
3. State and federal governments should invest in ICT infrastructure in Colleges of Education, including reliable internet connectivity and access to AI-powered educational platforms, to facilitate the adoption of technology-enhanced teacher preparation methods.
4. Teacher educators and supervisors in Colleges of Education should be trained on the effective use of AI tools for providing feedback during microteaching sessions, ensuring a hybrid model that combines AI-generated insights with human mentoring expertise.
5. Pre-service teachers should be encouraged to actively engage with AI-powered tools as part of their reflective practice, using AI feedback to set personal improvement goals and track their progress in developing instructional competence.
6. Institutions adopting AI-supported microteaching should establish ethical guidelines covering informed consent, privacy of recorded teaching sessions, secure data storage, and transparent use of AI-generated recommendations.

References

- Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman and Company.
- Berk, L. E., & Winsler, A. (1995). *Scaffolding children's learning: Vygotsky and early childhood education*. National Association for the Education of Young Children.
- Chiu, T. K. F., Moorhouse, B. L., Chai, C. S., & Ismailov, M. (2024). Teacher support and guidance for AI-enhanced education: A review of the literature. *Educational*



- Technology Research and Development*, 72(3), 1289-1315.
<https://doi.org/10.1007/s11423-024-10345-3>
- Choong, P. Y., Lee, M. F., & Lim, S. C. (2024). Self-efficacy in microteaching: A systematic review of pre-service teachers' development. *Teaching and Teacher Education*, 139, 104437. <https://doi.org/10.1016/j.tate.2023.104437>
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum Associates.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage Publications.
- Dalberg. (2024). *Transforming classrooms: The growing impact of artificial intelligence in African education* (Dalberg Research Report). <https://dalberg.com/our-ideas/transforming-classrooms-the-growing-impact-of-artificial-intelligence-in-african-education/>
- Darling-Hammond, L. (2017). Teacher education around the world: What can we learn from international practice? *European Journal of Teacher Education*, 40(3), 291-309. <https://doi.org/10.1080/02619768.2017.1315399>
- Dixon-Krauss, L. (1996). *Vygotsky in the classroom: Mediated literacy instruction and assessment*. Longman.
- Erdem, C., & Koç, M. (2025). Microteaching on pre-service teachers' education: A literature review and meta-analysis. *Frontiers in Education*, 10, 1562975. <https://doi.org/10.3389/feduc.2025.1562975>
- Guerriero, S. (2017). *Pedagogical knowledge and the changing nature of the teaching profession*. OECD Publishing. <https://doi.org/10.1787/9789264270695-en>
- Johnson, B. Y., & Mangwat, K. (2024). Comparative study of micro-teaching and teaching practice achievement of students in Colleges of Education in Plateau State, Nigeria. *Greener Journal of Educational Research*, 14(1), 12-22. <https://doi.org/10.15580/GJER.2024.1.012624017>
- Konakbayeva, U., Baltasheva, P., Kuanysheva, B., Dauletova, I., Kydyrbayeva, G., & Karataeva, T. (2025). Artificial intelligence in microteaching lesson study: Enhancing pre-service teachers' confidence and instructional quality. *Educational Process: International Journal*, 15(1), e2025127. <https://doi.org/10.22521/edupij.2025.15.127>
- Li, X., Chen, Y., & Wang, F. (2024). Generative AI for personalised feedback in teacher education: A systematic review. *Computers & Education: Artificial Intelligence*, 6, 100198. <https://doi.org/10.1016/j.caeai.2024.100198>
- Lund, B. D., Wang, T., Mannuru, N. R., Nie, B., Shimray, S., & Wang, Z. (2023). ChatGPT and a new academic reality: AI-written research papers and the ethics of the large language models in scholarly publishing. *Journal of the Association for Information Science and Technology*, 74(5), 570-581. <https://doi.org/10.1002/asi.24750>
- Luo, Z., & Li, H. (2024). Competence, preparation, and relaxation: Contributing factors to EFL student teachers' self-efficacy and teaching performance in microteaching training. *Heliyon*, 10(4), e26216. <https://doi.org/10.1016/j.heliyon.2024.e26216>
- Mukhtar, A., Serik, M., Tulegenova, M., & Kozhakhmetova, A. (2025). Enhancing teaching skills through digital feedback in microteaching. *International Journal of Information and Education Technology*, 15(9), 1458-1467. <https://doi.org/10.18178/ijiet.2025.15.9.2383>
- National Commission for Colleges of Education. (2015). *Minimum standards for Nigeria Certificate in Education (NCE)* (5th ed.). NCCE.
- Olaitan, S. O., & Alli, O. I. (2021). Challenges of microteaching practice in Nigerian Colleges of Education: Implications for quality teacher production. *Journal of Education and Practice*, 12(18), 45-54.



- Padovano, A., & Cardamone, P. (2024). AI-driven tools for pedagogical refinement and real-time performance feedback in teacher education. *Journal of Educational Technology & Society*, 27(2), 134-149.
- Pallant, J. (2020). *SPSS survival manual: A step-by-step guide to data analysis using IBM SPSS* (7th ed.). Open University Press.
- Remesh, A. (2013). Microteaching, an efficient technique for learning effective teaching. *Journal of Research in Medical Sciences*, 18(2), 158-163.
- Rodríguez-García, A. M., Moreno-Guerrero, A. J., & López-Belmonte, J. (2022). Communication competence and its relationship with teaching effectiveness: A systematic review. *Education Sciences*, 12(4), 267. <https://doi.org/10.3390/educsci12040267>
- Saban, A., & Çoklar, A. N. (2013). Pre-service teachers' opinions about the microteaching method in teaching practice classes. *Turkish Online Journal of Educational Technology*, 12(2), 234-247.
- Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, 48(6), 1273-1296. <https://doi.org/10.1007/s11165-016-9602-2>
- Tofade, T., Elsner, J., & Haines, S. T. (2013). Best practice strategies for effective use of questions as a teaching tool. *American Journal of Pharmaceutical Education*, 77(7), 155. <https://doi.org/10.5688/ajpe777155>
- Tschannen-Moran, M., & Woolfolk Hoy, A. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education*, 17(7), 783-805. [https://doi.org/10.1016/S0742-051X\(01\)00036-1](https://doi.org/10.1016/S0742-051X(01)00036-1)
- UNESCO. (2023). *AI and education: Guidance for policy-makers*. UNESCO Publishing.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.
- Wang, T., Lund, B. D., Marengo, A., Pagano, A., Mannuru, N. R., Teel, Z. A., & Pange, J. (2023). Exploring the potential impact of artificial intelligence (AI) on international students in higher education: Generative AI, chatbots, analytics, and international student success. *Applied Sciences*, 13(11), 6716. <https://doi.org/10.3390/app13116716>
- Zhang, Y., Li, M., & Chen, R. (2024). Hybrid AI-human feedback systems in teacher education: Combining structured analytics with contextual mentoring. *British Journal of Educational Technology*, 55(2), 678-695. <https://doi.org/10.1111/bjet.13389>