

Mathematics-AI Integration in Nigerian Teacher Education: Skills for Technological Development

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ABSTRACT

Artificial intelligence (AI) is reshaping how mathematics is learned, taught and applied, yet Nigerian teacher education has been slow to prepare mathematics teachers for this shift. This study examined the integration of AI into mathematics teacher education in Nigeria, with emphasis on the skills needed for technological development. Four research questions and two null hypotheses guided the study. A descriptive survey design was adopted in the two public colleges of education in Enugu State. The sample comprised 265 respondents: all 48 mathematics lecturers and 217 Nigeria Certificate in Education (NCE) III mathematics preservice teachers selected by proportionate stratified random sampling. Data were collected with a validated 34-item Mathematics-AI Integration Skills Questionnaire (MAISQ; Cronbach's $\alpha = .87$). Mean and standard deviation answered the research questions, while the independentsamples t-test tested the hypotheses at the .05 level. Findings revealed low use of AI tools for mathematics teaching ($M = 2.21$) and low possession of AI-integration skills ($M = 2.18$), with prompt formulation, learner-analytics interpretation, coding and knowledge of the mathematics behind AI being weakest. Erratic power supply, costly internet, inadequate devices and absence of AI content in the NCE curriculum were major challenges. Lecturers possessed significantly higher AI-integration skills than pre-service teachers, $t(263) = 3.08$, $p = .002$, but gender differences were not significant. The study recommends embedding AI-in-mathematics modules in the NCE curriculum, sustained capacity building, and AI-ready infrastructure.

Keywords: artificial intelligence; mathematics education; teacher education; TPACK; technological development; Nigeria

Introduction

Mathematics is the language of technology. Every major technological advance of the past century, from telecommunications to computing and now artificial intelligence (AI), rests on

mathematical ideas such as algebra, calculus, probability, statistics and optimisation. A nation that aspires to technological development must therefore produce citizens who are not only numerate but able to use mathematics to model, analyse and solve real problems with modern tools. In Nigeria, the teachers who build this foundation at the basic and post-basic levels are largely trained in colleges of education, which award the Nigeria Certificate in Education (NCE), the minimum teaching qualification recognised by the National Policy on Education (Federal Republic of Nigeria, 2013). Artificial intelligence refers to computer systems that perform tasks normally requiring human intelligence, including reasoning, pattern recognition, language processing and decision-making (Luckin et al., 2016). In education, AI now appears in intelligent tutoring systems, adaptive learning platforms, automated assessment, learning analytics and, since late 2022, generative AI chatbots that can explain concepts, generate exercises and solve problems step by step (Holmes et al., 2019; Kasneci et al., 2023). Mathematics is one of the subjects most affected. Photo-solver applications can read a handwritten equation and return a worked solution in seconds, while large language models can produce lesson plans, practice items and explanations on demand (Wardat et al., 2023). These tools offer real opportunities for personalised practice and richer teaching, but they also create risks of over-reliance, inaccurate output and academic dishonesty. The relationship between mathematics and AI is two-directional. On one side, AI tools can support the teaching and learning of mathematics. On the other, mathematics is the engine of AI itself: linear algebra represents data, calculus drives the training of models, and probability and statistics underpin prediction and uncertainty (Hwang & Tu, 2021). A mathematics teacher prepared for the present era therefore needs two kinds of competence: the pedagogical skill to use AI tools well in the classroom, and enough understanding of the mathematics behind AI to help learners see why their subject matters to technological development. UNESCO's (2024) AI competency framework for teachers reflects this dual expectation, calling for teachers who can use AI ethically, design AI-supported learning and develop learners' foundational understanding of AI. Nigeria has signalled interest in AI through its draft National Artificial Intelligence Strategy (National Information Technology Development Agency [NITDA], 2024), which identifies human capital as central to national AI readiness. Yet policy ambition has not been matched by change in teacher preparation. The NCE

mathematics minimum standards were developed before generative AI emerged and give little attention to AI tools, computational thinking or the mathematics of data (National Commission for Colleges of Education [NCCE], 2012). Colleges of education also face long-standing constraints of power supply, internet access and laboratory equipment. Against this background, there is a need for empirical evidence on how far mathematics teacher education in Nigeria has integrated AI, what skills lecturers and pre-service teachers possess, and what must be done to close the gap. This study responds to that need, using public colleges of education in Enugu State as its setting.

Statement of the Problem

Nigerian students increasingly use AI applications to solve mathematics problems, often outside the guidance of their teachers. If teachers cannot use these tools purposefully, judge the accuracy of their output, or explain the mathematics behind them, AI may weaken rather than strengthen mathematical understanding. Mathematics teachers who lack these skills also cannot connect classroom mathematics to the data-driven and AI-driven economy that Nigeria's technological development depends on. Observation suggests that mathematics lecturers and pre-service teachers in colleges of education rely mostly on chalk-and-board methods, with limited and informal exposure to AI. The NCE mathematics curriculum provides little structured content on AI or computational thinking, and infrastructural constraints persist. However, there is scant empirical evidence from Nigerian colleges of education on the actual level of AI use, the specific AI-integration skills possessed, the barriers encountered, and the strategies stakeholders consider effective. Without such evidence, curriculum review, staff development and funding decisions are made on assumption. The problem of this study, therefore, is: to what extent has AI been integrated into mathematics teacher education in Nigeria, and what skills do mathematics lecturers and pre-service teachers possess for AI-driven technological development?

Purpose of the Study

The general purpose of the study was to examine mathematics-AI integration in Nigerian teacher education with emphasis on skills for technological development. Specifically, the study sought to determine: 1. the extent to which mathematics lecturers and pre-service teachers use AI tools in mathematics teaching and learning; 2. the AI-integration skills possessed by mathematics lecturers and pre-service teachers; 3. the challenges hindering the integration of AI into mathematics teacher education; and 4. the strategies for enhancing mathematics-AI integration in teacher education.

Research Questions

1. To what extent do mathematics lecturers and pre-service teachers use AI tools in

mathematics teaching and learning?

2. What AI-integration skills do mathematics lecturers and pre-service teachers possess?

3. What challenges hinder the integration of AI into mathematics teacher education?

4. What strategies can enhance mathematics-AI integration in teacher education?

Hypotheses

The following null hypotheses were tested at the .05 level of significance: • H_{01} : There is no significant difference between the mean ratings of mathematics lecturers and pre-service teachers on their possession of AI-integration skills.

• H_{02} : There is no significant difference between the mean ratings of male and female respondents on their possession of AI-integration skills.

Significance of the Study

The findings will help the NCCE and curriculum planners revise NCE mathematics minimum standards to include AI and computational thinking. College managements and the Tertiary Education Trust Fund (TETFund) will have evidence for targeting staff development and infrastructure interventions. Mathematics lecturers and pre-service teachers will gain a clear picture of the skills they need, while future researchers will have baseline data for comparative studies across other states and geopolitical zones.

Review of Related Literature

Conceptual Review

Artificial intelligence in mathematics education. AI applications in mathematics education fall into four broad groups: intelligent tutoring and adaptive practice systems, which adjust tasks to a learner's performance; automated assessment and feedback tools; computational and problemsolving engines, including photo-solvers and computer algebra systems; and generative AI assistants that converse in natural language (Hwang & Tu, 2021; Zawacki-Richter et al., 2019). Chen et al. (2020) note that these tools shift part of the routine work of instruction to machines, freeing teachers to focus on reasoning, discussion and higher-order tasks, provided teachers know how to orchestrate them. Mathematics-AI integration. In this study, mathematics-AI integration means the deliberate use of AI tools to support mathematics teaching, learning and assessment, together with the teaching of the mathematical foundations of AI. Drijvers (2015) found that digital technology improves mathematics learning only when it is tied to clear pedagogical goals and when the teacher plays an active role; simply making tools available rarely works. The same principle applies to AI. AI-integration skills for technological development. Ng et al. (2021) conceptualise AI literacy as the ability to know and understand AI, use and apply it, evaluate and create with it, and attend to its ethics. For mathematics teachers, this translates into concrete skills: formulating precise prompts for mathematical tasks, verifying and correcting AI-generated solutions, embedding AI tools in lesson plans, using learner analytics to differentiate instruction, basic algorithmic and coding skill, explaining the mathematics behind AI, and applying ethical guidelines on integrity and data privacy (Celik et al., 2022; UNESCO, 2024). These are skills for technological development because they prepare teachers to raise learners who can use, question and eventually build intelligent technologies.

Theoretical Framework

The study is anchored on the Technological Pedagogical Content Knowledge (TPACK) framework of Mishra and Koehler (2006). TPACK holds that effective teaching with technology emerges from the interplay of three knowledge bases: content knowledge, pedagogical knowledge and technological knowledge, and the intersections among them. Niess (2005)

applied the framework specifically to the preparation of mathematics and science teachers, arguing that teacher education must develop these forms of knowledge together rather than in separate courses. Mishra et al. (2023) extended TPACK to generative AI, noting that AI changes both the technology in use and the content itself, since what counts as essential mathematical knowledge shifts when machines can perform routine computation. TPACK is relevant here because AI-integration skills, as measured in this study, require mathematics content knowledge, pedagogical judgment and AI-related technological knowledge at once. The study is also informed by the Technology Acceptance Model (TAM) (Davis, 1989), which explains

technology use through perceived usefulness and perceived ease of use. TAM helps to interpret why lecturers and pre-service teachers may adopt or avoid AI tools, especially where infrastructure and training gaps reduce ease of use.

Empirical Review

Zawacki-Richter et al. (2019) systematically reviewed 146 studies on AI in higher education and found that most were conducted by computer scientists, with little involvement of educators or attention to pedagogy. Celik et al. (2022), reviewing research on AI and teachers, reported that AI can support planning, implementation and assessment, but that teachers' limited technical knowledge and the opacity of AI systems were persistent obstacles. Hwang and Tu (2021), in a bibliometric review of AI in mathematics education, found growing research on intelligent tutoring and adaptive learning but few studies focused on teacher preparation. Wardat et al. (2023) examined perceptions of ChatGPT for mathematics teaching and found that users valued its explanations but identified frequent errors in multi-step solutions and geometric reasoning, concluding that teachers must be able to verify AI output. Kasneci et al. (2023) similarly argued that large language models can enrich education only when teachers and learners develop the competence to use them critically. In the Nigerian context, empirical work on AI in teacher education is still emerging, and most available studies focus on general information and communication technology (ICT) use rather than AI. The literature consistently reports inadequate infrastructure, unstable electricity, high internet costs and limited staff training as barriers to technology integration in colleges of education. This study extends that literature by focusing specifically on AI, on mathematics, and on the skills that link mathematics teacher education to technological development.

Summary of Literature Review

The literature establishes that AI offers substantial benefits for mathematics education but that benefits depend on teacher competence. TPACK provides a lens for understanding the integrated knowledge required. International reviews point to a gap in research on teacher preparation for AI, and Nigerian studies have mostly addressed general ICT. There is therefore a gap in empirical evidence on mathematics-AI integration skills in Nigerian colleges of education, which this study fills.

Methodology

The study adopted a descriptive survey design, which is suitable for collecting data from a representative group in order to describe existing conditions, opinions and skill levels without manipulating variables. The study was carried out in Enugu State, South-East Nigeria, in the two public colleges of education offering NCE mathematics: Federal College of Education, EhaAmufu, and Enugu State College of Education (Technical), Enugu. Both institutions train teachers for basic and post-basic schools across the South-East. The population was 548, made up of 48 mathematics lecturers and 500 NCE III pre-service teachers offering mathematics as a single or double major in the 2025/2026 academic session. All 48 lecturers were studied because their number was manageable. For pre-service teachers, a sample of 217 was determined using the Krejcie and Morgan (1970) table and drawn by proportionate stratified random sampling, with institution and gender as strata. The total sample was 265 (139 male, 126 female). Data were collected with a researcher-developed instrument titled the Mathematics-AI Integration Skills Questionnaire (MAISQ). Section A captured respondents' status and gender. Section B contained 34 items in four clusters: use of AI tools (8 items), AI-integration skills (10 items), challenges (8 items) and strategies (8 items). Clusters A and B used a four-point scale of Very High Extent (4),

High Extent (3), Low Extent (2) and Very Low Extent (1). Clusters C and D used Strongly Agree (4), Agree (3), Disagree (2) and Strongly Disagree (1). Validity and reliability. The MAISQ was face- and content-validated by three experts: two in mathematics education and one in measurement and evaluation. Their corrections on item clarity and coverage were effected. The instrument was trial-tested on 30 NCE mathematics students and lecturers at a college of education outside the study area. Reliability was established with Cronbach's alpha (Cronbach, 1951), yielding coefficients of .84, .89, .81 and .83 for Clusters A to D, and .87 for the whole instrument. The researchers and two trained research assistants administered the questionnaire in person. All 265 copies were completed and retrieved, giving a 100% return rate. Mean and standard deviation were used to answer the research questions. A criterion mean of 2.50 was adopted: item means of 2.50 and above were interpreted as High Extent or Agree, and means below 2.50 as Low Extent or Disagree. The independent-samples t-test was used to test the null hypotheses at the .05 level of significance; a hypothesis was rejected where $p < .05$.

Results

Research Question 1: Extent of use of AI tools in mathematics teaching and learning

Table 1. Mean ratings on the extent of use of AI tools (N = 265)

S/N	Item	Mean	SD	Decision
1	Use AI photosolver apps (e.g., Photomath) to	3.04	0.81	High Extent

S/N Item Mean SD Decision

1 Use AI photo- 3.04 0.81 High Extent

solver apps (e.g.,

Photomath) to

S/N Item Mean SD Decision

check solutions

2 Use generative 2.86 0.88 High Extent AI chatbots

(e.g., ChatGPT) to explain mathematical concepts

3 Use adaptive 1.74 0.79 Low Extent

learning platforms for personalised mathematics practice

4 Use AI tools to 2.31 0.92 Low Extent

generate lesson notes and practice questions

5 Use 2.12 0.90 Low Extent

computational engines (e.g.,

Wolfram Alpha)

for algebra and calculus

6 Use dynamic 2.27 0.86 Low Extent

mathematics software with intelligent features (e.g.,

GeoGebra)

7 Use AI-based 1.58 0.74 Low Extent

assessment and auto-grading tools

8 Use AI data- 1.76 0.80 Low Extent

analysis tools in teaching

S/N Item Mean SD Decision

statistics Grand mean 2.21 0.84 Low Extent

Table 1 shows that respondents used AI photo-solvers ($M = 3.04$) and generative AI chatbots ($M = 2.86$) to a high extent.

S/N	Item	Mean	SD	Decision
1	check solutions			
2	Use generative AI chatbots (e.g. ChatGPT) to explain mathematical concepts	2.86	0.88	High Extent
3	Use adaptive learning platforms for personalised mathematics practice	1.74	0.79	Low Extent
4	Use AI tools to generate lesson notes and practice questions	2.31	0.92	Low Extent
5	Use computational engines (e.g. Wolfram Alpha) for algebra and calculus	2.12	0.90	Low Extent
6	Use dynamic mathematics software with intelligent features (e.g. GeoGebra)	2.27	0.86	Low Extent
7	Use AI-based assessment and auto-grading tools	1.58	0.74	Low Extent
8	Use AI data analysis tools in teaching	1.76	0.80	Low Extent

= 2.86) to a high extent. The remaining six tools were used to a low extent, with AI-based assessment lowest ($M = 1.58$). The grand mean of 2.21 indicates that AI tools are used to a low extent in mathematics teaching and learning.

Research Question 2: AI-integration skills possessed

Table 2. Mean ratings on AI-integration skills possessed ($N = 265$)

S/N	Item	Mean	SD	Decision
1	statistics			
	Grand mean	2.21	0.84	Low Extent

S/N Skill Mean SD Decision

1 Formulate 2.48 0.86 Low Extent

precise prompts for mathematical tasks in generative AI

2 Verify the 2.66 0.84 High Extent

accuracy of AI-generated mathematical solutions

3 Detect errors and 2.21 0.88 Low Extent

fabricated steps in AI mathematical output

4 Integrate AI 2.02 0.83 Low Extent

tools into lesson plans aligned with the NCE curriculum

5 Use AI to 1.94 0.81 Low Extent

differentiate instruction for learners of varying ability

6 Interpret learner 1.71 0.77 Low Extent

S/N Skill Mean SD Decision

analytics from

AI platforms

7 Apply basic 1.66 0.79 Low Extent

coding and algorithmic thinking (e.g.,

Python, Scratch)

8 Explain the 1.89 0.84 Low Extent

mathematics underlying AI (linear algebra, probability, optimisation)

9 Evaluate AI 2.37 0.87 Low Extent

tools for pedagogical suitability

10 Apply ethical 2.86 0.82 High Extent

guidelines on academic integrity and data privacy Grand mean 2.18 0.83 Low Extent

Table 2 shows that respondents possessed only two skills to a high extent: applying ethical

S/N	Skill	Mean	SD	Decision
1	Formulate precise prompts for mathematical tasks in generative AI	2.48	0.86	Low Extent
2	Verify the accuracy of AI-generated mathematical solutions	2.66	0.84	High Extent
3	Detect errors and fabricated steps in AI mathematical output	2.21	0.88	Low Extent
4	Integrate AI tools into lesson plans aligned with the NCE curriculum	2.02	0.83	Low Extent
5	Use AI to differentiate instruction for learners of varying ability	1.94	0.81	Low Extent
6	Interpret learner	1.71	0.77	Low Extent

guidelines (M = 2.86) and verifying AI-generated solutions (M = 2.66). Eight skills were possessed to a low extent; the weakest were coding and algorithmic thinking (M = 1.66), interpreting learner analytics (M = 1.71) and explaining the mathematics underlying AI (M = 1.89). The grand mean of 2.18 indicates low possession of AI-integration skills.

Research Question 3: Challenges hindering mathematics-AI integration

Table 3. Mean ratings on challenges hindering integration (N = 265)

S/N	Skill	Mean	SD	Decision
7	analytics from AI platforms Apply basic coding and algorithmic thinking (e.g., Python, Scratch)	1.66	0.79	Low Extent
8	Explain the mathematics underlying AI (linear algebra, probability, optimisation)	1.89	0.84	Low Extent

9	Evaluate AI tools for pedagogical suitability	2.37	0.87	Low Extent
10	Apply ethical guidelines on academic integrity and data privacy	2.86	0.82	High Extent
	Grand mean	2.18	0.83	Low Extent

S/N Challenge Mean SD Decision

1 Erratic power 3.58 0.62 Agree

supply

2 Poor and 3.51 0.66 Agree

expensive

S/N Challenge Mean SD Decision

internet connectivity

3 Inadequate 3.42 0.71 Agree

computers and devices in laboratories

4 Absence of AI 3.30 0.74 Agree

content in the

NCE

mathematics curriculum

5 Lack of training 3.27 0.76 Agree

and workshops on AI for lecturers

6 High cost of 3.11 0.82 Agree

premium AI tool subscriptions

7 Lack of 2.89 0.87 Agree

institutional policy on AI use

8 Fear that AI 2.84 0.91 Agree

encourages laziness and cheating Grand mean 3.24 0.76 Agree

Table 3 shows that respondents agreed with all eight challenges. Erratic power supply (M = 3.58),

S/N	Challenge	Mean	SD	Decision
1	Erratic power supply	3.58	0.62	Agree
2	Poor and expensive	3.51	0.66	Agree

poor and expensive internet (M = 3.51) and inadequate devices (M = 3.42) ranked highest.

Research Question 4: Strategies for enhancing mathematics-AI integration

Table 4. Mean ratings on strategies for enhancing integration (N = 265)

S/N	Challenge	Mean	SD	Decision
	internet connectivity			
3	Inadequate computers and devices in laboratories	3.42	0.71	Agree
4	Absence of AI content in the NCE mathematics curriculum	3.30	0.74	Agree
5	Lack of training and workshops on AI for lecturers	3.27	0.76	Agree

6	High cost of premium AI tool subscriptions	3.11	0.82	Agree
7	Lack of institutional policy on AI use	2.89	0.87	Agree
8	Fear that AI encourages laziness and cheating	2.84	0.91	Agree
	Grand mean	3.24	0.76	Agree

S/N Strategy Mean SD Decision

1 Regular 3.52 0.60 Agree

capacity- building workshops on AI

S/N Strategy Mean SD Decision

for mathematics lecturers

2 Modelling AI- 3.52 0.61 Agree

integrated lessons during teaching practice

3 Embedding AI- 3.46 0.64 Agree

in-mathematics modules in the

NCE curriculum

4 Campus-wide 3.44 0.66 Agree

Wi-Fi and

subsidised data for staff and students

5 Solar-backed, 3.41 0.68 Agree

AI-ready

mathematics laboratories

6 Institutional 3.29 0.73 Agree

guidelines on ethical AI use

7 Partnership with 3.22 0.77 Agree

technology hubs and EdTech firms

8 Introduction of 3.18 0.79 Agree

basic coding and computational thinking courses Grand mean 3.38 0.69 Agree

Table 4 shows agreement with all eight strategies (grand mean = 3.38), led by capacity-building

S/N	Strategy	Mean	SD	Decision
1	Regular capacity building workshops on AI	3.52	0.60	Agree

workshops and AI-integrated lessons during teaching practice (M = 3.52 each).

Hypothesis 1

Table 5. t-test of lecturers' and pre-service teachers' mean ratings on AI-integration skills

S/N	Strategy	Mean	SD	Decision
	for mathematics lecturers			
2	Modelling AI integrated lessons during teaching practice	3.52	0.61	Agree
3	Embedding AI in mathematics modules in the NCE curriculum	3.46	0.64	Agree

4	Campus-wide Wi-Fi and subsidised data for staff and students	3.44	0.66	Agree
5	Solar-backed, AI-ready mathematics laboratories	3.41	0.68	Agree
6	Institutional guidelines on ethical AI use	3.29	0.73	Agree
7	Partnership with technology hubs and EdTech firms	3.22	0.77	Agree
8	Introduction of basic coding and computational thinking courses	3.18	0.79	Agree
	Grand mean	3.38	0.69	Agree

Group N Mean SD df t p Decision Lecturers 48 2.41 0.52 263 3.08 .002 Rejected Pre- 217 2.13 0.58 service teachers

Table 5 shows that $t(263) = 3.08$, $p = .002$. Since $p < .05$, H_{01} was rejected. Lecturers

Group	N	Mean	SD	df	t	p	Decision
Lecturers	48	2.41	0.52	263	3.08	.002	Rejected
Preservice teachers	217	2.13	0.58				

possessed significantly higher AI-integration skills than pre-service teachers, although both group means fell below the 2.50 criterion.

Hypothesis 2

Table 6. t-test of male and female respondents' mean ratings on AI-integration skills

Group	N	Mean	SD	df	t	p	Decision
Male	139	2.21	0.57	263	0.84	.402	Not rejected
Female	126	2.15	0.59				

Group N Mean SD df t p Decision Male 139 2.21 0.57 263 0.84 .402 Not rejected Female 126 2.15 0.59

Table 6 shows that $t(263) = 0.84$, $p = .402$. Since $p > .05$, H_{02} was not rejected. There was no significant gender difference in AI-integration skills.

Discussion of Findings

Use of AI tools. The study found that AI tools are used to a low extent in mathematics teacher education, except for photo-solvers and generative AI chatbots. These two tools are free, run on smartphones and need no institutional support, which explains their popularity. In TAM terms, they score high on perceived ease of use (Davis, 1989). Tools that require institutional subscriptions, laboratories or deliberate pedagogical planning, such as adaptive platforms and AI-based assessment, were rarely used. The pattern suggests that AI use in colleges of education is informal and learner-driven rather than planned and curriculum-driven. This agrees with Zawacki-Richter et al. (2019), who observed that AI in higher education has advanced faster in technology than in pedagogy. AI-integration skills. Respondents possessed AI-integration skills to a low extent. The relatively high ratings for ethical awareness and solution verification are encouraging, but they sit alongside weak skills in detecting AI errors, lesson integration and differentiation. Verifying a correct answer is easier than diagnosing a subtly wrong one, a gap that Wardat et al. (2023) also highlighted. The weakest skills were coding, learner analytics and the mathematics underlying AI. These are precisely the skills that connect mathematics teaching

to technological development. In TPACK terms (Mishra & Koehler, 2006), respondents' content and pedagogical knowledge are not yet joined with AI-related technological knowledge, and the content dimension itself has not expanded to include the mathematics of AI, as Mishra et al. (2023) argue it must.

Challenges. Respondents agreed that infrastructural deficits, especially power, internet and devices, are the greatest barriers. These findings mirror the long-standing constraints reported for ICT integration in Nigerian education and confirm that AI integration inherits the same structural problems. The absence of AI content in the NCE curriculum (NCCE, 2012) and the lack of staff training are equally important: even where infrastructure exists, lecturers cannot teach what the curriculum does not require and what they have not been trained to do. Celik et al. (2022) similarly identified teachers' limited technical knowledge as a key barrier internationally. **Strategies.** Respondents strongly endorsed capacity building, modelling AI-integrated lessons during teaching practice and curriculum reform. The high rating for teaching practice is significant because pre-service teachers tend to teach as they were taught; seeing AI used well during practicum builds both skill and confidence, consistent with Niess's (2005) argument for integrated rather than separate technology preparation. Endorsement of solar-backed laboratories reflects a practical response to Nigeria's power challenge. Differences by status and gender. Lecturers had significantly higher AI-integration skills than pre-service teachers, likely owing to greater teaching experience and exposure to conferences and staff development. However, both groups fell below the criterion mean, showing that lecturers are not yet equipped to model the skills they are expected to pass on. The absence of a gender difference suggests that AI-integration skill gaps are systemic rather than gender-based, so interventions can target all staff and students without gender-specific design, while still monitoring access to devices and training.

Conclusion

Mathematics-AI integration in Nigerian teacher education is at an early and largely informal stage. Lecturers and pre-service teachers use a few free, smartphone-based AI tools but possess low levels of the skills that matter most for technological development: integrating AI into planned instruction, interpreting learner data, coding, and understanding the mathematics behind AI. Infrastructure deficits and an outdated curriculum are the main barriers. Although lecturers are ahead of their students, neither group has yet reached an adequate level. Unless teacher education is deliberately reoriented, Nigerian classrooms will continue to consume AI without producing teachers who can help learners understand, question and build it.

Recommendations

1. The NCCE should review the NCE mathematics minimum standards to include

compulsory modules on AI tools in mathematics teaching, computational thinking and the mathematical foundations of AI (linear algebra, probability, statistics and optimisation).

2. College managements, with TETFund support, should run regular hands-on capacity-

building workshops on AI integration for mathematics lecturers, with emphasis on lesson design, error detection and learner analytics.

3. Supervisors of teaching practice should require and assess at least one AI-integrated

mathematics lesson per pre-service teacher.

4. Government and college managements should provide solar-backed, internet-enabled

mathematics laboratories and campus-wide Wi-Fi to address power and connectivity barriers.

5. Each college should develop an institutional policy on the ethical use of AI in teaching,

learning and assessment.

6. Colleges should partner with technology hubs and EdTech firms for internships, tool

access and co-developed training content.

Implications for Technological Development

The findings imply that Nigeria's AI ambitions depend partly on its colleges of education. Teachers trained today will shape the mathematical foundation of learners who join the workforce over the next three decades. Equipping mathematics teachers with AI-integration skills is therefore not only a pedagogical reform but an investment in national technological capacity.

Limitations and Suggestions for Further Studies

The study was limited to two public colleges of education in one state and relied on self-reported ratings, which may overstate actual skill. Further studies should cover colleges across the six geopolitical zones, include universities' faculties of education, use performance-based skill assessments, and test the effect of AI-integration training programmes through experimental designs.

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