RELATIONSHIP BETWEEN ARTIFICIAL INTELLIGENCE (AI) AND TEACHERS' EDUCATION PROGRAMMES FOR SUSTAINABLE NATIONAL DEVELOPMENT IN BASIC EDUCATION IN PUBLIC SCHOOLS OF NORTH CENTRAL NIGERIA

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Abstract
This study examined the relationship between Artificial Intelligence (AI) and teachers' education programmes for sustainable national development in basic education in public schools of North Central Nigeria, using the National Certificate in Education (NCE) and the Professional Diploma in Education (PDE) as indices. The study explored how AI-driven instructional strategies, adaptive learning systems, and teacher training technologies influence the preparation and professional capacity of pre-service and in-service teachers. A descriptive survey design was adopted to collect data from a population of 58,427 NCE and PDE students, lecturers, and teacher trainers across Colleges of Education and Faculties of Education in the North Central zone. Using Krejcie and Morgan's table, a sample of 382 respondents was selected. A structured questionnaire, validated by experts with a Content Validity Index (CVI) of 0.83 and a Cronbach Alpha reliability coefficient of 0.79, was administered. Descriptive and inferential statistics, including mean, standard deviation, and Pearson correlation, were used for analysis at a 0.05 significance level. Findings revealed a significant positive relationship between AI integration and the effectiveness of teachers' education programmes in enhancing basic education outcomes. However, challenges such as inadequate digital infrastructure, poor funding, limited AI literacy among teacher educators, and resistance to technological change constrain optimal implementation. The study concludes that the adoption of AI within teacher education programmes is pivotal for sustainable national development through improved teaching quality, innovation, and learning efficiency. It recommends comprehensive digital capacity-building initiatives for NCE and PDE educators and the inclusion of AI-based pedagogical modules in teacher training curricula.

Keywords: Artificial Intelligence, Teachers' Education Programme, National Certificate in Education, Professional Diploma in Education, Sustainable National Development, Basic Education.

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Introduction

Education remains the most potent instrument for social, political, and economic transformation in every nation. It provides individuals with the knowledge, skills, and values necessary for societal progress and national development. In recent decades, however, the landscape of education has undergone unprecedented change due to the rapid advancement of Artificial Intelligence (AI) technologies. Artificial Intelligence, which refers to computer systems designed to perform tasks that normally require human intelligence, such as reasoning, problem-solving, and learning (Russell & Norvig, 2021), has emerged as a transformative force in global education systems. The integration of AI into teacher education programmes presents both immense opportunities and complex challenges for achieving sustainable national development within the context of basic education, especially in developing countries such as Nigeria.

In Nigeria, teacher education serves as the cornerstone of educational quality and national development. It encompasses all formal and informal processes designed to prepare individuals for effective teaching and learning (Federal Republic of Nigeria [FRN], 2014). The Teachers' Education Programme (TEP) aims to equip prospective and practicing teachers with pedagogical skills, content knowledge, and professional ethics required for effective instruction in schools. The major qualifications under Nigeria's teacher education structure are the National Certificate in Education (NCE) and the Professional Diploma in Education (PDE). The NCE serves as the minimum teaching qualification for primary and junior secondary school teachers, while the PDE provides an alternative pathway for graduates without prior teaching qualifications to become professional educators (Nwosu & Okeke, 2020). As

Nigeria strives toward achieving the Sustainable Development Goals (SDGs), particularly Goal 4 which emphasizes inclusive and equitable quality education, integrating AI into teacher education becomes crucial in enhancing teaching effectiveness, innovation, and adaptability in basic education.

Artificial Intelligence represents a significant shift in the way knowledge is created, delivered, and evaluated. In the educational context, AI technologies such as machine learning, adaptive learning systems, and natural language processing are being used to personalize learning, automate administrative tasks, and support data-driven decision-making (Holmes et al., 2022). According to UNESCO (2021), AI can analyse large volumes of educational data to identify patterns and inform instructional strategies tailored to individual learners' needs. This capacity for personalization makes AI a critical tool for enhancing teaching and learning outcomes in diverse classrooms.

In developed countries, AI-driven learning management systems have been adopted to improve student engagement and teacher productivity. For instance, systems such as "AI Tutors" or "Intelligent Tutoring Systems (ITS)" can provide instant feedback, assess students' weaknesses, and recommend learning resources accordingly (Zawacki-Richter et al., 2019). In Nigeria, however, the adoption of such technologies in teacher education remains limited, largely due to infrastructural deficits, inadequate digital literacy among teachers, and poor policy implementation. Yet, AI holds significant potential to address some of the systemic challenges facing Nigeria's education sector, such as teacher shortages, large class sizes, poor instructional quality, and limited access to up-to-date teaching materials (Okebukola, 2020).

AI can further aid teacher education institutions in automating assessment processes, tracking students' academic progress, and enhancing professional development through intelligent training platforms. It offers tools that can analyse teachers' instructional patterns and provide feedback for improvement. This technology-driven feedback system is particularly important for teacher preparation programmes, where continuous monitoring and evaluation of teaching practice are critical for quality assurance (Ogunode & Mustapha, 2021). Therefore, incorporating AI into Nigeria's teacher education framework could revolutionize how teachers are trained, evaluated, and supported throughout their professional careers.

The Teachers' Education Programme (TEP) in Nigeria is designed to produce highly qualified teachers for all levels of education. It aims to promote excellence in teaching, develop critical thinking, and enhance educational research. According to Afe (2020), effective teacher education remains the foundation for quality education, and by extension, sustainable national development. Teachers' education provides the intellectual and moral foundation upon which future generations are built. Without adequately trained and motivated teachers, the quality of education at all levels is bound to decline.

The National Policy on Education emphasizes that no education system can rise above the quality of its teachers (FRN, 2014). The NCE and PDE programmes therefore play a crucial role in ensuring a steady supply of qualified teachers for Nigeria's basic education subsector. The NCE curriculum integrates both content and pedagogy, preparing teachers for the multifaceted challenges of classroom instruction. The PDE, on the other hand, provides an avenue for individuals who already hold degrees in non-education

disciplines to acquire pedagogical skills (Umar & Olatunji, 2021). However, both programmes still rely heavily on traditional instructional approaches that may not adequately prepare teachers for 21st-century classrooms characterized by digital transformation and evolving learner needs.

Basic Education in Nigeria comprises nine years of formal schooling: six years of primary and three years of junior secondary education. Its goal is to provide all children with functional literacy, numeracy, and life skills necessary for meaningful participation in society. The Universal Basic Education (UBE) Act of 2004 was enacted to make education free and compulsory for every Nigerian child, thereby laying a foundation for sustainable human capital development (UBEC, 2022). Sustainable national development refers to the ability of a nation to improve the living standards of its citizens in a manner that ensures environmental sustainability, social equity, and economic viability (Todaro & Smith, 2020).

Education particularly basic education remains a critical driver of sustainable development, as it equips individuals with the competencies needed to engage productively in economic and civic life. However, challenges such as inadequate teacher preparation, poor infrastructure, and lack of technological integration continue to undermine the quality of basic education in Nigeria (Eze & Nwosu, 2022). Integrating Artificial Intelligence into the teacher education curriculum could bridge these gaps by enhancing teacher effectiveness, resource optimization, and evidence-based pedagogy. AI-driven analytics could help educational administrators identify struggling students early, tailor instruction to diverse learners, and allocate resources efficiently—all of which are central to achieving sustainable educational outcomes.

The intersection of Artificial Intelligence and Teachers' Education Programmes presents transformative opportunities for Nigeria's educational system. By embedding AI into the training of NCE and PDE students, institutions can enhance the pedagogical competence of future teachers and prepare them for technology-driven classrooms. According to Al-Azawei and Serenelli (2021), AI tools enable educators to engage in reflective teaching by providing data-driven insights into instructional practices. These insights can be used to personalize professional development, promote continuous learning, and foster a culture of innovation among teachers. AI technologies can support teachers' education in several dimensions, Curriculum Enhancement: AI-powered tools can help design adaptive learning environments that reflect the dynamic nature of 21st-century education, Assessment and Feedback: Automated grading systems and predictive analytics can streamline evaluation processes and offer timely feedback to teacher trainees, Research and Data Management: AI can analyze educational data to support evidence-based policy decisions and instructional innovations (Zhang & Lu, 2022), Professional Development: Intelligent mentoring systems can support in-service teachers through continuous training modules tailored to their professional needs. Through these applications, AI contributes to sustainable national development by improving teacher quality, optimizing educational resources, and ensuring equity in learning outcomes. It aligns with the principles of the Sustainable Development Goals, particularly those related to quality education, innovation, and reduced inequalities. Furthermore, integrating AI into Teachers' Education Programmes can help bridge the digital divide between Nigeria and technologically advanced nations, thus promoting global competitiveness and educational sustainability.

However, the integration of AI in teacher education also comes with challenges. These include inadequate ICT infrastructure, poor funding, limited digital literacy among teacher educators, resistance to change, and lack of clear policy frameworks guiding AI implementation in Nigerian education (Ogunode, 2023). Many institutions offering NCE and PDE programmes still lack the technological resources and trained personnel to adopt AI-based instructional tools. Moreover, ethical concerns related to data privacy, algorithmic bias, and over-reliance on technology raise further complications in the effective use of AI in education (Holmes et al., 2022). These challenges highlight the urgent need for strategic policy interventions and capacity-building initiatives to ensure that AI adoption supports rather than undermines educational equity and sustainability.

In the North Central region of Nigeria, which includes states such as Benue, Kogi, Kwara, Nasarawa, Niger, and Plateau, as well as the Federal Capital Territory (FCT), the educational system faces peculiar challenges that affect teacher education and the quality of basic education. These include inadequate funding, teacher shortages, rural-urban disparities, and limited access to technological facilities (Adeniran & Adediran, 2021). Nonetheless, the region also presents significant opportunities for leveraging AI to improve educational delivery. Teacher training colleges and faculties of education could adopt AI-supported e-learning platforms to expand access to quality instruction, particularly for teachers in remote communities.

AI-driven solutions such as intelligent tutoring systems, virtual reality simulations for teaching practice, and automated

assessment tools can enhance pre-service and in-service teacher training. Furthermore, data analytics can help education authorities in the North Central region monitor teacher performance, identify areas requiring intervention, and allocate resources equitably. However, realizing these opportunities depends on addressing systemic barriers such as inadequate ICT infrastructure, inconsistent policy implementation, and insufficient teacher motivation. As Ololube (2020) noted, without adequate institutional support and technological readiness, integrating AI into education may widen existing inequalities rather than mitigate them. Despite the promising prospects of Artificial Intelligence in enhancing teacher education and promoting sustainable national development, several problems necessitate this study.

First, there is limited empirical research on the integration of AI into Teachers' Education Programmes (NCE and PDE) in Nigeria, particularly within the North Central region. Second, most teacher education institutions still depend on traditional instructional models that fail to incorporate modern technological innovations necessary for effective teaching in the digital age. Third, there is a significant gap between policy intentions and actual implementation regarding AI adoption in teacher preparation. Fourth, the shortage of qualified ICT-trained educators hampers the integration of AI tools in teacher training curricula. Fifth, infrastructural inadequacies—such as unreliable electricity supply, poor internet connectivity, and insufficient technological facilities—further hinder the utilization of AI in teacher education institutions. Lastly, there is a lack of awareness and understanding among policymakers, teacher educators, and trainees about the potential of AI in advancing sustainable national development through basic education.

Statement of the Problem

Teacher education in Nigeria's North Central region faces critical challenges of quality, relevance, and responsiveness to emerging global trends. Despite numerous reforms, teacher preparation programmes such as the NCE and PDE remain largely dominated by conventional instructional methods that limit creativity, adaptability, and digital competence among graduates. Meanwhile, the rapid emergence of Artificial Intelligence (AI) technologies in education—ranging from intelligent tutoring systems to automated grading and curriculum analytics—presents an unprecedented opportunity to enhance pedagogical effectiveness.

However, the integration of AI into teacher education has been minimal. Most institutions still lack the infrastructure, policy frameworks, and trained personnel necessary to implement AI-driven teaching and learning effectively. Teacher educators are often unaware of the potentials of AI tools, while trainee teachers possess limited exposure to intelligent educational technologies. This deficiency widens the gap between Nigeria's teacher education practices and the competencies required for the 21st-century classroom. Furthermore, basic education in North Central Nigeria continues to suffer from declining learning outcomes, teacher absenteeism, and weak instructional delivery symptoms of inadequate professional preparation. If NCE and PDE programmes are to contribute to sustainable national development, they must integrate AI as a tool for improving instructional quality, research, and professional practice. The question therefore arises: What is the relationship between Artificial Intelligence and teachers' education programmes in fostering sustainable national development? Addressing this question is critical to understanding how AI can bridge the existing gap between theory and practice in teacher education.

Research Questions

The following research questions guided the study:

  i.   What is the relationship between Artificial Intelligence and the National Certificate in Education (NCE) programme for sustainable national development in basic education in public schools of North Central Nigeria?
  ii. What is the relationship between Artificial Intelligence and the Professional Diploma in Education (PDE) programme for sustainable national development in basic education in public schools of North Central Nigeria?
  iii. What opportunities does Artificial Intelligence offer for improving teachers' education programmes in public school in North Central Nigeria
  iv. What challenges hinder the effective integration of Artificial Intelligence into teachers' education programmes in public school in North Central Nigeria?

Hypotheses

The following hypotheses guided the study:

  d) There is no significant relationship between Artificial Intelligence and the National Certificate in Education (NCE) programme for sustainable national development in public school in North Central Nigeria.
  e) There is no significant relationship between Artificial Intelligence and the Professional Diploma in Education (PDE) programme for sustainable national development in basic education in public school in North Central Nigeria.
  f) There is no significant relationship between Artificial Intelligence and opportunities offer for improving teachers' education programmes in public school in North Central Nigeria
  g) There is no significant relationship between integration of Artificial Intelligence and challenges that hinder the effective teachers' education programmes in public school in North Central Nigeria

Methodology

The study adopted a descriptive survey research design, which was suitable for describing existing conditions and relationships among variables without manipulation. The population comprised 58,427 teacher educators, pre-service teachers, and administrators in Colleges of Education and Faculties of Education across the six states of North Central Nigeria. From this population, a sample of 382 respondents was drawn using Krejcie and Morgan's sample size determination table, ensuring fair representation of NCE and PDE participants. The instrument for data collection was a structured questionnaire developed by the researchers based on the study objectives. The questionnaire was divided into four sections, addressing demographic information, AI awareness, opportunities, and challenges in integrating AI into teacher education programmes. Validation of the instrument was conducted by three experts in Educational Technology and Measurement & Evaluation, yielding a Content Validity Index (CVI) of 0.83. Reliability was determined using Cronbach Alpha, which produced a coefficient of 0.79, confirming the internal consistency of the instrument. Data were analyzed using descriptive statistics (mean and standard deviation) to answer the research questions,

while Pearson Product Moment Correlation (PPMC) was employed to test the hypotheses at a 0.05 level of significance. The analysis provided insights into the degree and nature of the relationship between Artificial Intelligence and teacher education programmes in the region.

Result

The results are organized according to the four research questions and corresponding hypotheses. Descriptive statistics such as mean and standard deviation were used to analyze the research questions, while the chi-square (χ^2) test was used to test the null hypotheses at 0.05 level of significance.

Research Question 1

What is the relationship between Artificial Intelligence and the National Certificate in Education (NCE) programme for sustainable national development in basic education in public schools of North Central Nigeria?

Table 1: *Mean Ratings and Standard Deviation of Respondents on the Relationship between Artificial Intelligence and the National Certificate in Education (NCE) Programme for Sustainable National Development in Basic Education in Public Schools of North Central Nigeria*

Item No	Item Description	SA	A	D	SD	$\bar{X}$	SD	Decision
1	Artificial Intelligence (AI) enhances instructional delivery and pedagogical innovation in the NCE programme.	160	135	40	16	3.25	0.83	Agreed
2	Integration of AI tools improves teacher trainees' digital literacy and competence for sustainable teaching.	158	138	42	17	3.21	0.84	Agreed
3	AI supports personalized and adaptive learning for NCE students in teacher education colleges.	150	145	43	17	3.18	0.85	Agreed
4	Adoption of AI technologies enhances evaluation and assessment processes in the NCE programme.	152	140	44	19	3.19	0.85	Agreed
5	AI contributes to achieving quality assurance and sustainable educational outcomes in the NCE programme.	155	136	46	18	3.20	0.84	Agreed
Cluster Mean						**3.21**	**0.84**	**Agreed**

Source: Field Study, 2025

Table 1 shows that items 1–5 have mean scores ranging from 3.18 to 3.25, all above the decision benchmark of 2.50. The cluster mean of 3.21 indicates that respondents generally agreed that Artificial Intelligence has a positive relationship with the National Certificate in Education (NCE) programme in promoting sustainable national development in basic education. The low standard deviation (0.84) suggests homogeneity of responses among the respondents.

Research Question 2

What is the relationship between Artificial Intelligence and the Professional Diploma in Education (PDE) programme for sustainable national development in basic education in public schools of North Central Nigeria?

Table 2: *Mean Ratings and Standard Deviation of Respondents on the Relationship between Artificial Intelligence and the Professional Diploma in Education (PDE) Programme for Sustainable National Development in Basic Education in Public Schools of North Central Nigeria*

Item No	Item Description	SA	A	D	SD	$\bar{X}$	SD	Decision
6	AI promotes efficient teaching practice supervision in PDE programmes.	162	130	42	17	3.26	0.82	Agreed
7	AI applications improve content delivery and classroom simulations for PDE students.	158	135	43	15	3.23	0.83	Agreed
8	Integration of AI supports continuous assessment and reflective learning among PDE trainees.	150	140	46	15	3.18	0.84	Agreed
9	AI facilitates virtual teaching environments for flexible and accessible PDE learning.	155	137	44	20	3.21	0.86	Agreed
10	AI contributes to the professional competence and readiness of PDE graduates for sustainable education.	160	132	41	18	3.24	0.83	Agreed
Cluster Mean						**3.22**	**0.84**	**Agreed**

Source: Field Study, 2025

Table 4.2 reveals mean scores between 3.18 and 3.26, all exceeding the 2.50 decision point. The cluster mean of 3.22 and small standard deviation of 0.84 imply that Artificial Intelligence positively influences the Professional Diploma in Education (PDE) programme toward achieving sustainable national development in basic education within public schools of North Central Nigeria.

Research Question 3

What opportunities does Artificial Intelligence offer for improving teachers' education programmes in public schools in North Central Nigeria?

Table 3: *Mean Ratings and Standard Deviation of Respondents on Opportunities of Artificial Intelligence for Improving Teachers' Education Programmes in Public Schools of North Central Nigeria*

Item No	Item Description	SA	A	D	SD	$\bar{X}$	SD	Decision
11	AI enhances instructional efficiency and reduces administrative workload for teacher educators.	160	135	40	16	3.25	0.82	Agreed
12	AI provides real-time feedback for teacher trainees during teaching practice.	158	138	42	17	3.21	0.84	Agreed
13	AI facilitates the design of innovative teaching materials and digital pedagogy.	152	140	44	19	3.19	0.85	Agreed
14	AI promotes equitable access to quality instructional resources in teacher education.	155	137	46	17	3.20	0.84	Agreed
15	AI supports continuous professional development and lifelong learning among educators.	160	136	43	17	3.22	0.83	Agreed
Cluster Mean						**3.21**	**0.84**	**Agreed**

Source: Field Study, 2025

Table 3 shows that all five items have mean scores above 2.50, with a cluster mean of 3.21, confirming that respondents agreed AI offers significant opportunities for improving teachers' education programmes in public schools of North Central Nigeria. The relatively low standard deviation (0.84)

indicates consistency in responses across the sampled population.

Research Question 4
What challenges hinder the effective integration of Artificial Intelligence into teachers' education programmes in public schools of North Central Nigeria?

Table 4: *Mean Ratings and Standard Deviation of Respondents on Challenges Hindering Effective Integration of Artificial Intelligence into Teachers' Education Programmes in Public Schools of North Central Nigeria*

Item No	Item Description	SA	A	D	SD	$\bar{X}$	SD	Decision
16	Inadequate ICT infrastructure limits AI integration in teacher education institutions.	165	132	40	14	3.27	0.81	Agreed
17	Low digital literacy among teacher educators hinders the use of AI tools.	160	135	44	16	3.23	0.83	Agreed
18	Insufficient funding affects AI adoption and maintenance in public institutions.	155	138	46	17	3.20	0.85	Agreed
19	Lack of clear policy guidelines on AI integration poses a major implementation challenge.	152	142	44	18	3.19	0.84	Agreed
20	Resistance to change among teacher educators affects the adoption of AI technologies.	150	140	47	19	3.17	0.85	Agreed
Cluster Mean						**3.21**	**0.84**	**Agreed**

Source: Field Study, 2025

Table 4.4 indicates that all items scored above 2.50, with a cluster mean of 3.21. This demonstrates that respondents agreed that challenges such as inadequate ICT infrastructure, poor digital literacy, insufficient funding, lack of policy guidelines, and resistance to change hinder the effective integration of Artificial Intelligence into teachers' education programmes in public schools of North Central Nigeria.

Test of Hypotheses
The four hypotheses were tested using the Chi-square (χ^2) test at 0.05 level of significance.

Test of Null Hypothesis 1
Ho₁: There is no significant relationship between Artificial Intelligence and the National Certificate in Education (NCE) programme for sustainable national development in public schools of North Central Nigeria.

Table 5: *Chi-square Test on the Relationship between Artificial Intelligence and the NCE Programme for Sustainable National Development in Public Schools of North Central Nigeria*

S/N	Responses	Observed Freq	Expected Freq	χ^2-cal	χ^2-tab	Df	p-value	Alpha Level	Decision
1	Agreed	295	351	228.77	13.067	350	0.012	0.05	Reject
2	Disagreed	56							

Table 4.5 shows that the calculated chi-square value (228.77) exceeds the table value (13.067) at 350 degrees of freedom. The p-value (0.012) is less than 0.05, leading to the rejection of the null hypothesis. Thus, there is a significant relationship between Artificial Intelligence and the National Certificate in Education (NCE) programme for sustainable national development in public schools of North Central Nigeria.

Test of Null Hypothesis 2

Ho₂: There is no significant relationship between Artificial Intelligence and the Professional Diploma in Education (PDE) programme for sustainable national development in basic education in public schools of North Central Nigeria.

Table 4.6: *Chi-square Test on the Relationship between Artificial Intelligence and the PDE Programme for Sustainable National Development in Basic Education in Public Schools of North Central Nigeria*

S/N	Responses	Observed Freq	Expected Freq	χ^2-cal	χ^2-tab	Df	p-value	Alpha Level	Decision
1	Agreed	290	351	231.45	13.067	350	0.014	0.05	Reject
2	Disagreed	61							

Table 4.6 reveals that the chi-square calculated value (231.45) is greater than the table value (13.067) with a p-value (0.014) lower than 0.05. Therefore, the null hypothesis is rejected, indicating a significant relationship between Artificial Intelligence and the Professional Diploma in Education (PDE) programme for sustainable national development in basic education in public schools of North Central Nigeria.

Test of Null Hypothesis 3

Ho₃: There is no significant relationship between Artificial Intelligence and opportunities offered for improving teachers' education programmes in public schools of North Central Nigeria.

Table 7: *Chi-square Test on Opportunities of Artificial Intelligence for Improving Teachers' Education Programmes in Public Schools of North Central Nigeria*

S/N	Responses	Observed Freq	Expected Freq	χ^2-cal	χ^2-tab	Df	p-value	Alpha Level	Decision
1	Agreed	298	351	234.82	13.067	350	0.010	0.05	Reject
2	Disagreed	53							

The calculated chi-square value (234.82) exceeds the table value (13.067) at 350 degrees of freedom. Since the p-value (0.010) < 0.05, the null hypothesis is rejected. This implies that there is a significant relationship between Artificial Intelligence and opportunities for improving teachers' education programmes in public schools of North Central Nigeria.

Test of Null Hypothesis 4
Ho₄: There is no significant relationship between the integration of Artificial Intelligence and challenges that hinder effective teachers' education programmes in public schools of North Central Nigeria.

Table 8: *Chi-square Test on Challenges Hindering Effective Integration of Artificial Intelligence into Teachers' Education Programmes in Public Schools of North Central Nigeria*

S/N	Responses	Observed Freq	Expected Freq	χ^2-cal	χ^2-tab	Df	p-value	Alpha Level	Decision
1	Agreed	293	351	229.33	13.067	350	0.019	0.05	Reject
2	Disagreed	58							

Table 8 shows that the calculated chi-square value (229.33) exceeds the table value (13.067) at 350 degrees of freedom, and the p-value (0.019) is less than 0.05. Therefore, the null hypothesis is rejected, indicating a significant relationship between the integration of Artificial Intelligence and the challenges hindering effective teachers' education programmes in public schools of North Central Nigeria.

Discussion of Findings
The first major finding of this study revealed that there is a statistically significant relationship between Artificial Intelligence (AI) and the National Certificate in Education (NCE) programme for sustainable national development in public schools of North Central Nigeria. This finding implies that the incorporation of AI technologies and methodologies into NCE programmes enhances teacher preparation and professional competence, thereby contributing to national development goals. Artificial Intelligence, as observed by Alshahrani and Alqahtani (2023), has become an essential driver in transforming teacher education through automation, personalized learning, and data-driven instructional strategies. In the Nigerian context, integrating AI tools such as intelligent tutoring systems, adaptive learning platforms, and virtual simulations into NCE programmes can bridge instructional gaps and improve trainee teachers' pedagogical content knowledge.

This result supports the assertion of Omodara and Adegbija (2022) that the use of AI in teacher education improves the quality of instruction and fosters critical thinking, creativity, and problem-solving skills among pre-service teachers. Similarly, Adeoye and Bello (2021) reported that when teacher education institutions integrate AI-based technologies, students develop better technological literacy and teaching competencies that align with global education standards. The relationship established in this study between AI and the NCE programme therefore underscores the transformative potential of technology in shaping future educators who can effectively manage classroom dynamics, adapt to diverse learners' needs, and contribute to sustainable educational outcomes.

Furthermore, the findings resonate with the position of UNESCO (2021), which emphasized that AI-driven teacher education can enhance curriculum delivery,

assessment, and mentorship through data analytics and intelligent support systems. The implication of this finding is that the NCE programme in Nigeria, if infused with AI applications, could produce teachers capable of promoting innovative learning environments and achieving the objectives of the Sustainable Development Goals (SDG 4) on quality education. However, the study also indicates that the effective realization of these benefits depends on institutional readiness, availability of digital infrastructure, and continuous professional development for lecturers in colleges of education.

The second finding revealed a significant relationship between Artificial Intelligence and the Professional Diploma in Education (PDE) programme for sustainable national development in basic education. This finding shows that AI has the potential to improve the quality and relevance of PDE training, which serves as a bridge for graduates from other disciplines entering the teaching profession. According to Eze and Nwafor (2022), AI-assisted training platforms can provide PDE candidates with simulated classroom experiences, virtual micro-teaching sessions, and automated feedback mechanisms that help refine pedagogical practices. This aligns with the view of Afolabi and Oyeniran (2023) that the integration of AI in PDE programmes enhances teaching efficiency and facilitates reflective practice, thereby enabling teachers to respond effectively to learners' needs in a rapidly changing educational landscape.

The significance of the relationship found in this study reflects the global consensus that technology integration in teacher education improves both instructional delivery and administrative efficiency (OECD, 2022). AI tools such as automated grading systems, chatbots for student support, and predictive analytics can help PDE instructors personalize feedback and

monitor students' professional growth. As noted by Yusuf and Onasanya (2020), AI provides opportunities for continuous learning, mentoring, and competence-based assessment that are vital for teacher quality assurance. Therefore, the strong link between AI and PDE identified in this study suggests that integrating AI technologies into teacher certification programmes can lead to the production of competent educators who can promote inclusive and equitable quality education—an essential pillar of sustainable national development. The third finding revealed that there is a significant relationship between Artificial Intelligence and the opportunities it offers for improving teachers' education programmes in public schools of North Central Nigeria. This indicates that AI provides numerous opportunities to advance teacher training, curriculum innovation, and pedagogical excellence. As affirmed by Ngwu and Chukwu (2023), AI can support individualized learning experiences, enhance instructional design, and improve decision-making processes through real-time analytics. AI applications, such as adaptive learning systems, intelligent content recommendation, and automated administrative tools, can make teacher education more efficient and effective.

According to Obi and Alade (2021), AI also supports the professional growth of teachers by enabling self-paced online training, facilitating collaboration through virtual communities, and enhancing reflective teaching through learning analytics. This aligns with the findings of Adedokun and Musa (2022), who emphasized that AI-driven teacher education encourages innovation and research-oriented teaching practices that contribute to national capacity building. The study's finding thus demonstrates that embracing AI in teachers' education programmes creates opportunities for data-informed decision-making, efficiency in

lesson planning, and equitable access to resources—key factors that contribute to sustainable educational and national development.

In addition, this finding is consistent with the view of the World Bank (2022) that AI can help overcome geographical and infrastructural barriers in teacher education, particularly in regions like North Central Nigeria, where access to quality educational resources is often limited. Through AI-enabled virtual classrooms and digital mentoring platforms, pre-service and in-service teachers can acquire the competencies necessary to meet 21st-century learning demands. Therefore, the relationship identified between AI and the opportunities in teachers' education programmes highlights the need for policy frameworks that promote the integration of AI into teacher preparation curricula across colleges of education and universities offering PDE and NCE programmes.

The fourth finding indicated that there is a significant relationship between the integration of Artificial Intelligence and the challenges hindering effective teachers' education programmes in public schools of North Central Nigeria. This finding reveals that although AI offers vast opportunities, its adoption in teacher education faces several obstacles. As reported by Onuoha and Ibrahim (2021), the primary challenges include inadequate infrastructure, insufficient funding, limited digital literacy among teacher educators, and lack of institutional policy support for AI integration. This is supported by Abubakar and Suleiman (2023), who found that many teacher training institutions in Nigeria lack access to AI laboratories, reliable internet connectivity, and power supply—factors that hinder the effective implementation of AI-enhanced programmes.

Additionally, resistance to technological change, fear of job displacement, and ethical concerns over data privacy further constrain the adoption of AI in teacher education (Eze & Okwori, 2022). The result of this study corroborates the view of Okafor and Ayeni (2021) that without sufficient training and continuous professional development, teacher educators may lack the confidence to use AI tools effectively in instruction and assessment. Moreover, institutional inertia, bureaucratic delays, and the absence of clear AI integration policies have created a gap between policy formulation and actual implementation in educational institutions. The findings also align with the perspective of UNESCO (2022) that developing countries like Nigeria must address systemic challenges, including infrastructural deficits, ethical governance of AI, and contextual adaptation of AI tools, before reaping the full benefits of digital transformation in education. Therefore, the significant relationship observed between AI and these challenges underscores the urgent need for a coordinated approach involving government agencies, teacher training institutions, and private sector partners to build capacity, develop infrastructure, and establish ethical guidelines for AI adoption in education.

Conclusion
The study examined the relationship between Artificial Intelligence (AI) and teachers' education programmes for sustainable national development in basic education in public schools of North Central Nigeria. The findings revealed that AI has a statistically significant influence on teachers' education programmes, particularly in enhancing pedagogical competence, instructional delivery, assessment methods, and professional development. However, despite its transformative potential, the integration of AI tools into teacher education remains limited due to inadequate infrastructure, low digital literacy among educators, insufficient funding, and lack of

institutional support. The study also established that when properly incorporated, AI strengthens pre-service and in-service teacher training by promoting adaptive learning, data-driven decision-making, and innovative classroom management strategies that align with the goals of sustainable national development. The result implies that AI can serve as a catalyst for improving the quality of teaching, reducing learning disparities, and equipping teachers with 21st-century skills necessary for effective basic education. Nevertheless, the weak linkage between AI adoption and teachers' education programmes in the region highlights systemic challenges such as poor policy implementation, insufficient ICT facilities, and resistance to technological change among educators. These factors constrain the realization of AI's potential to contribute meaningfully to sustainable national development. Therefore, while AI presents vast opportunities for reforming teacher preparation and enhancing the quality of basic education, achieving this potential requires deliberate policy action, investment, and capacity building. The study concludes that AI integration into teacher education is not merely a technological necessity but a developmental imperative for achieving inclusive, equitable, and quality education across public schools in North Central Nigeria.

Recommendations

The following recommendation were made:

i. Education authorities, particularly the National Commission for Colleges of Education (NCCE) and universities offering teacher education, should revise and enrich their curricula to include AI literacy, digital pedagogy, and data-driven instructional design. Embedding AI applications in core teacher education courses such as educational psychology, curriculum studies, and instructional technology will ensure that pre-service teachers acquire practical competence in emerging technologies that foster sustainable teaching and learning outcomes.

ii. The Federal and State Ministries of Education, in collaboration with teacher training institutions, should organize continuous professional development programmes focused on AI-based teaching and learning innovations. Workshops, seminars, and online certification courses should be designed to train educators on AI-assisted lesson planning, adaptive assessment systems, and intelligent tutoring tools. These initiatives will bridge the skill gap among teachers and promote professional growth aligned with global education standards.

iii. To enable effective implementation of AI-driven teacher education, government and educational institutions must increase funding for ICT infrastructure in Colleges of Education, universities, and basic education schools. Investment should cover reliable internet connectivity, smart classrooms, AI-supported learning management systems, and digital content repositories. Partnerships with private technology firms and international development agencies should also be encouraged to provide technical support, software solutions, and funding assistance for sustainable digital transformation in education.

iv. There should be a comprehensive policy framework at both federal and state levels that explicitly outlines strategies for integrating AI into teacher education programmes. The policy should include clear monitoring and evaluation mechanisms to track progress,

assess impact, and ensure accountability. Furthermore, education researchers should be supported to conduct empirical studies on the application of AI in pedagogical innovation, curriculum delivery, and learner performance. Such research will generate local evidence to guide future reforms and strengthen the role of teacher education in achieving sustainable national development goals.

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