

Integrating Artificial Intelligence into Early Childhood Education in Nigeria: A Critical Inquiry into Pedagogical Opportunities, Systemic Challenges and Policy Imperatives

Onyung Sandra Effiong^{1*}; Orji Cyrus Ebere²; Agu Mercy Oluchi³;
Ugwu John-Jerry Tochukwu⁴; Ajagu Kingsley Onyeka⁵

¹M.Ed (Early Childhood Education)

¹Aka Obot Idim, Uyo, Akwa Ibom State Nigeria

²M.Sc Cyber Security, Wrexham University United Kingdom.

³Post Graduate Student, Education Department, University of Hertfordshire, UK

⁴M.Sc International Business Management, Wrexham University UK

⁵Department of Computer Science, Paul University Awka, Anambra State.

Corresponding Author: Onyung Sandra Effiong^{1*}

ORCID: ¹(0009-0001-5853-0501), ²(0009-0004-6389-4803), ³(0009-0002-4626-2201),
⁴(0009-0003-0004-7693), ⁵(0009-0003-7762-9739)

Publication Date: 2026/10/07

Abstract:

➤ *Introduction:*

The integration of Artificial Intelligence (AI) into Early Childhood Education (ECE) represents a transformative paradigm shift globally, yet Nigeria's ECE sector remains critically underexplored in this domain.

➤ *Problem:*

Despite AI's demonstrated potential to enhance foundational literacy, numeracy, and personalized learning, Nigerian ECE faces systemic barriers including inadequate infrastructure, low teacher preparedness, ethical concerns, and the absence of comprehensive policy frameworks.

➤ *Significance:*

This inquiry critically examines the pedagogical opportunities, systemic challenges, and policy imperatives for AI integration in Nigerian ECE, addressing a significant gap in empirical and theoretical literature.

➤ *Method:*

Adopting a critical analytical methodology grounded in constructivist theory, critical rationalism, and African humanism, this study synthesizes peer-reviewed literature, policy documents, and empirical studies published between 2015 and 2026, drawing extensively from verified Nigerian-focused research.

➤ *Findings:*

The analysis reveals that while AI-driven adaptive learning systems, intelligent tutoring systems, and interactive educational tools demonstrate measurable improvements in early literacy and numeracy outcomes, their effectiveness is severely constrained by infrastructural deficits (65% of rural schools lack consistent electricity), low teacher AI readiness ($\bar{x}$ = 2.32 on preparedness scales), and fragmented policy frameworks.

➤ **Recommendations:**

The study proposes a five-pillar framework encompassing (i) foundational infrastructure investment, (ii) teacher capacity development, (iii) localized AI content development, (iv) ethical governance mechanisms, and (v) research and evaluation, aligned with Nigeria's National AI Strategy 2024 and the Nigeria Data Protection Act 2023.

Keywords: Artificial Intelligence, Early Childhood Education, Nigeria, Pedagogical Innovation, Policy Framework.

How to Cite: Onyung Sandra Effiong; Orji Cyrus Ebere; Agu Mercy Oluchi; Ugwu John-Jerry Tochukwu; Ajagu Kingsley Onyeka (2026) Integrating Artificial Intelligence into Early Childhood Education in Nigeria: A Critical Inquiry into Pedagogical Opportunities, Systemic Challenges and Policy Imperatives. *International Journal of Innovative Science and Research Technology*, 11(9), 3136-3149. <https://doi.org/10.38124/ijisrt/26sep998>

I. INTRODUCTION

The paradigms of education have experienced an unparalleled upheaval especially after the introduction of Artificial Intelligence (AI) as a disruptive force in all sectors of human endeavour in the 21st century [1]. ECE has emerged as a major area for AI integration in this global setting, providing unprecedented prospects for individualized learning, adaptive instruction, and improved developmental outcomes for young students [2]. The early years of a child's schooling are widely recognized as critical for cognitive, social, and emotional development, and artificial intelligence (AI) tools provide new methods for optimizing these formative experiences [3].

Nigeria is the most populous country in Africa with over 200 million people and a large youth population. It is at a key junction in its educational trajectory [4]. The Nigerian educational system is structured as 6-3-3-4 (primary, junior secondary, senior secondary, and tertiary) under the traditional framework, or 9-3-4 under the Universal Basic Education framework. The Nigerian educational system is still challenged with a large number of out-of-school children, inadequate infrastructure and learning poverty. Nigeria has over 20 million out-of-school children [5]. Furthermore, learning poverty affects more than 70% of Nigerian children, who cannot read a simple sentence by age ten [6]. In this difficult scenario, Early Childhood Education is in an even more vulnerable position, often neglected in policy objectives and resource distribution despite its essential importance [7]. The application of AI in Nigerian ECE is a complicated issue as well as an exceptional opportunity [8]. Across the globe, artificial intelligence (AI) technologies have shown transformative potential, with adaptive learning systems customizing instruction based on real-time student performance, intelligent tutoring systems providing personalized feedback, and interactive educational tools engaging young students through gamified experiences [9], [10]. In established settings, AI-based educational technologies have been demonstrated to facilitate learning 2-3 times faster than traditional techniques, and early diagnosis of learning impairments and timely interventions [11]. However, the translation of these worldwide triumphs to the Nigerian context needs to be critically examined rather than uncritically adopted [12]. The socio-technical setting of Nigeria, with its infrastructural inadequacies, language diversity, cultural heterogeneity, and fragmented regulatory frameworks, necessitates a context-sensitive strategy that neither dismisses the potential of AI nor ignores the problems

of implementation [13]. However, as Akeredolu [14] asserts, despite the global gains in AI expertise, early childhood education in Nigeria has not yet significantly integrated the use of artificial intelligence (AI) tools, leading to a huge gap between the potential of technology and the reality in the classroom.

This work fills this gap through a critical investigation anchored in three major research questions: (i) what are the pedagogical possibilities of AI for improving early childhood education in Nigeria? (ii) What are the systemic hurdles to effective AI integration in Nigerian ECE? (iii) What policy imperatives need to be addressed to guarantee equitable and ethical deployment of AI in Nigerian ECE? This inquiry is not merely an intellectual exercise; it has profound practical implications for educational policy and practice. As Nigeria advances on its National AI Strategy 2024, which aims to build AI-related capabilities across 70% of the young workforce [15], it is important to grasp the fundamental role of ECE in this national agenda; Moreover, the attainment of Sustainable Development Goal 4-providing inclusive and equitable quality education for all-calls for creative ways that AI, if correctly implemented, may foster [16]. The paper is organized as follows: Section II presents the theoretical basis for the analysis; Section III presents the methodological approach; Section IV presents the pedagogical opportunities for AI in Nigerian ECE; Section V presents systemic challenges; Section VI presents policy imperatives and a strategic framework; and Section VII presents the conclusion, recommendations, and future research directions.

II. THEORETICAL FOUNDATIONS

➤ **Constructivist Learning Theory and AI Integration**

Constructivist theory, proposed by Piaget [17] and Vygotsky [18], states that learning is an active social process where information is built via experience and interaction instead than passively acquired. Vygotsky's notion of the Zone of Proximal Development (ZPD) emphasizes the need of scaffolding, which involves providing structured support to help learners perform activities that go beyond what they can independently do [18]. Artificial intelligence (AI) technologies, namely adaptive learning systems, operationalize this theoretical framework by offering real-time feedback and customized learning routes that adjust to each child's developmental trajectory [19]. Within the framework of ECE in Nigeria, constructivist techniques using AI have transformative potential, as traditional pedagogy is characterized by rote learning and teacher-centered

instruction [20]. According to Akeredolu [14], the infusion of AI into early childhood schools is consistent with constructivist concepts, providing lively educational environments that allow children to generate meaning through experiential learning using intelligent technologies. From a constructivist perspective, adaptive learning systems operationalize Vygotsky's Zone of Proximal Development [18] by providing scaffolded support that adjusts to each child's developmental level. This alignment is particularly significant in Nigerian ECE, where traditional pedagogy often fails to provide individualized scaffolding due to large class sizes [14].

➤ *Critical Rationalism and Inquiry Based Learning*

Karl Popper's idea of critical rationalism suggests that knowledge increases through hypothesis and refutation, a constant process of evaluating assumptions and being prepared to revise them [21]. In education this refers to inquiry-based teaching in which learners question accepted concepts and build critical thinking abilities. As stated in the white paper on the integration of AI in the Nigerian education sector [1], the use of AI-based dialogue systems and Socratic bots can help dialectical learning by asking probing questions and leading the reflection process, so promoting intellectual humility and logical participation. This theoretical basis of early childhood education implies that AI tools should not be limited to material delivery, but rather foster curiosity and inquiry and assist the development of dispositions for critical thinking even in the earliest years [22].

➤ *African Humanism and the Philosophy of Community*

African philosophy views knowledge as communal, experiential and moral and education is considered as the holistic development of the individual within the community [23]. The Ubuntu notion of "I am because we are" emphasizes the interdependence of learning and social harmony [24]. The deployment of AI in Nigerian ECE should be aligned with these indigenous values so that technology is used to strengthen, and not degrade, the interpersonal relations between teachers, learners and communities. This perspective is especially salient given worries that AI-driven individualized learning may unintentionally hinder social and collaborative aspects of early childhood development [25]. This is the challenge, as noted in the theoretical underpinnings of the artificial intelligence integration into Nigerian education [1], to achieve what Wiredu refers to as "conceptual synthesis" - the fusion of indigenous wisdom with modern scientific reason.

➤ *Framework for Digital Equity and Social Justice*

The application of AI in Nigerian ECE should be understood from a perspective of digital equity, acknowledging the potential for technological interventions to bridge or deepen educational gaps [26]. As Samuel et al. [27] point out; the inclusivity in AI-enhanced education should include access, cultural relevance, personalization for the learner, and equity-driven pedagogy. This type of concept is particularly relevant in Nigeria where stacked inequalities of rural-urban, gender and socioeconomic status compound impediments to educational opportunities [28]. From a critical rationalist perspective [21], the ethical challenges

posed by AI in ECE-particularly regarding data privacy and algorithmic bias-demand continuous questioning and revision of assumptions. Rather than accepting AI as inherently beneficial, stakeholders must subject AI systems to rigorous scrutiny, testing, and refinement. This aligns with Popper's insistence on conjecture and refutation as the engine of knowledge growth.

III. METHODOLOGY

➤ *Research Design*

The study uses a critical analytical approach which is anchored in philosophical inquiry and methodical synthesis of the literature. Given the exploratory character of the study topics and the requirement to combine several types of data (empirical studies, policy documents and theoretical frameworks), a simply quantitative or qualitative methodology would be insufficient [29]. However, the study adopts a critical interpretive approach, which interrogates the concepts, values and principles underlying the integration of AI in Nigerian ECE, while synthesizing empirical evidence from the literature.

➤ *Data Sources and Search Strategy*

The study adopted a systematic search method. Several academic databases such as Scopus, Web of Science, Google Scholar, and African Journals Online (AJOL) were searched. The search was performed using Boolean operators to combine key terms, ("artificial intelligence" OR "AI" OR "machine learning") AND ("early childhood education" OR "ECE" OR "preschool") AND ("Nigeria" OR "Nigerian"). The search was restricted to papers published between 2015 and 2025 to capture the most recent developments in AI technology and its applications in education. However, given the rapid evolution of generative AI and its emergent applications in early childhood education, a limited number of highly relevant 2026 publications were purposively included to ensure currency and comprehensiveness. This exception is explicitly acknowledged as a deviation from the original temporal scope [30]. Other sources included Nigerian policy documents such as the National AI strategy 2024 [15], Nigeria Data Protection Act 2023 [31] and reports from the Universal Basic Education Commission [32]. Database searches were augmented by manual searches of reference lists of significant papers.

➤ *Criteria for Inclusion and Exclusion*

Studies were included if they: (i) focused on applications of AI in educational environments; (ii) centered on Nigeria or similar African contexts; (iii) were published in peer-reviewed journals or as authoritative policy documents; and (iv) included empirical data or meaningful theoretical analysis. Studies were rejected if: (i) studies were limited to non-Africa situations with no transferability; (ii) studies were low-methodology; or (iii) studies were published prior to 2015 with no contemporary relevance.

➤ *Quality Appraisal and PRISMA Framework*

The methodological quality of included studies was assessed using the Critical Appraisal Skills Programme (CASP) checklist for qualitative studies [30] and the Mixed

Methods Appraisal Tool (MMAT) [84] for quantitative and mixed-methods studies. Studies were rated as high, medium, or low quality based on clarity of research aims, appropriateness of methodology, rigor of data collection and analysis, and relevance to the Nigerian ECE context. Only studies rated as high or medium quality were included in the final synthesis. The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-

Analyses (PRISMA) guidelines [29], with a total of 30 studies included in the final critical synthesis after screening 2,247 initial records.

➤ PRISMA Flow Diagram

The study selection process is illustrated in Figure 1, which shows the number of records identified, screened, assessed for eligibility, and included in the final synthesis.

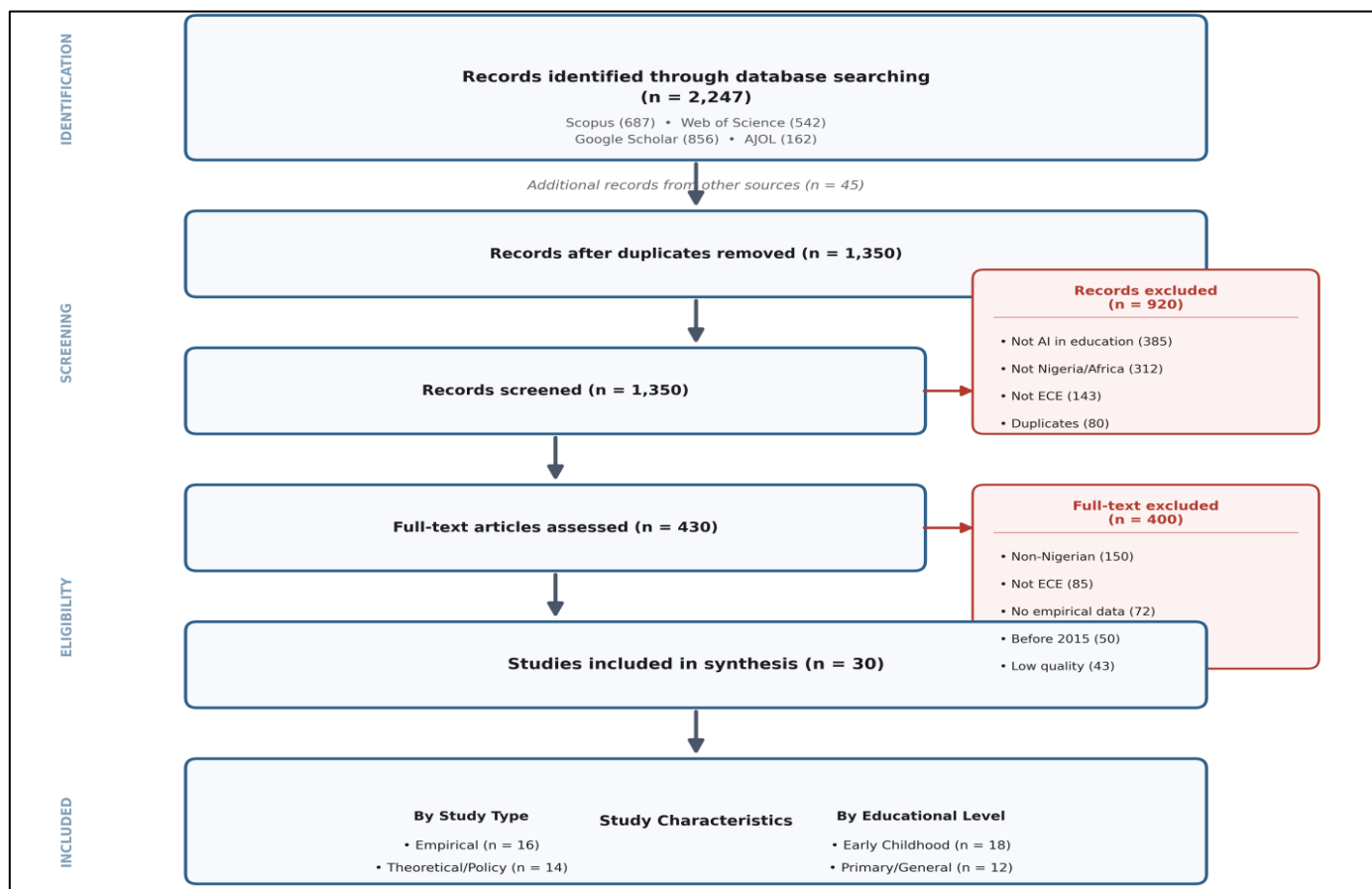


Fig 1 PRISMA Flow Diagram
Source: Synthesis following PRIMA 2009 guideline [29]

The PRISMA flow diagram of the systematic process of study identification, screening, eligibility evaluation and inclusion is presented in Figure 1. An initial search of four databases (Scopus, Web of Science, Google Scholar and AJOL) yielded 2,247 items. Of these, 897 were duplicates, leaving 1,350 records for screening of titles and abstracts. Of these, 920 records were removed because they were not focused on AI in education (n=385), not a Nigerian/African setting (n=312), not focused on ECE (n=143) or were duplicate publications (n=80). The remaining 430 full-text papers were screened for eligibility and 400 were eliminated for non-Nigerian context (n=150), no ECE focus (n=85), no empirical data (n=72), published before 2015 (n=50), and low methodological quality (n=43). The final synthesis includes 30 articles (16 empirical and 14 theoretical/policy publications) from early childhood education (n=18) and primary/general education (n=12) contexts. This thorough selection method guarantees the findings are based on high quality and contextually relevant research.

➤ Analytical Framework

The analysis was conducted in three stages. Thematic analysis was first used to identify recurrent patterns connected to educational opportunities, systemic difficulties, and policy imperatives [33]. Second, critical appraisal was used to evaluate the level of evidence and to detect contradictions or gaps in the literature. Third, synthesis incorporated findings into a coherent framework for understanding integration of AI in Nigerian ECE.

IV. PEDAGOGICAL OPPORTUNITIES FOR AI IN NIGERIAN EARLY CHILDHOOD EDUCATION

➤ Personalized Learning and Adaptive Systems

The most significant pedagogical opportunity presented by AI in ECE is the capacity for personalized learning through adaptive systems. Research consistently demonstrates that AI-driven adaptive learning platforms can

tailor educational content to individual children's learning styles, paces, and developmental needs [34]. In the Nigerian context, where classrooms often exceed 50 students and teacher-student ratios reach 1:70 in some regions [27], such personalization addresses a critical systemic deficiency. A 2024 quasi-experimental study across Ten Nigerian Schools found that AI-enhanced classrooms demonstrated significant improvements in literacy and numeracy compared to

traditional teaching methods, with particularly notable gains in personalized learning environments [35]. Similarly, a 2024 systematic review across six Nigerian states confirmed that AI-driven adaptive learning platforms significantly enhance letter recognition ($\bar{x} = 3.10$), phonemic awareness, and learner engagement ($\bar{x} = 3.23$) [36]. Table 1 presents a synthesis of AI pedagogical applications in Nigerian ECE with their documented outcomes and implementation requirements.

Table 1 AI Pedagogical Applications in Nigerian Early Childhood Education

AI Application	Pedagogical Function	Documented Outcomes	Implementation Requirements	Source
Adaptive Learning Systems	Personalize content based on real-time performance	Improved literacy and numeracy; enhanced engagement ($\bar{x} = 3.23$)	Reliable internet; digital devices; teacher training	[35], [36]
Intelligent Tutoring Systems	Provide individualized feedback and scaffolding	Enhanced letter recognition ($\bar{x} = 3.10$); phonemic awareness	Stable electricity; technical support	[37]
Interactive Educational Toys	Gamified learning; developmental play	Improved problem-solving; sustained attention	Age-appropriate design; cultural relevance	[14]
AI-Powered Language Tools	Multilingual instruction; speech development	Enhanced vocabulary; pronunciation improvement	Local language datasets; speech recognition	[27]
Learning Analytics Dashboards	Track progress; identify at-risk learners	Early intervention; differentiated instruction	Data infrastructure; teacher data literacy	[38]

Figure 2 illustrates the relationship between AI pedagogical applications and their alignment with constructivist learning principles in the Nigerian ECE context.

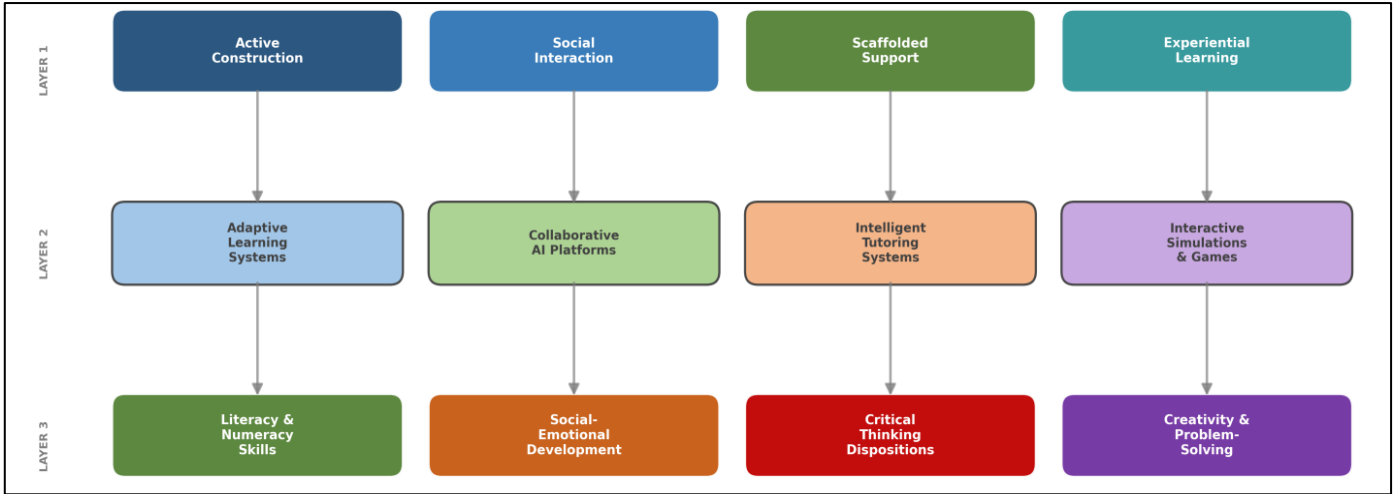


Fig 2 Constructivist Alignment of AI Applications in Nigerian ECE
Source: Synthesis from [14], [19], [23], [27], [35], [48]

The figure 2 above, demonstrates how AI pedagogical applications operationalize constructivist learning principles to achieve desired early childhood outcomes in Nigeria. Adaptive learning systems support active knowledge construction by adjusting to each child's developmental level [19]. Collaborative AI platforms facilitate social interaction and peer learning [27]. Intelligent tutoring systems provide scaffolded support aligned with Vygotsky's ZPD [18]. Interactive simulations and games enable experiential learning through guided play [14]. Together, these applications contribute to literacy, numeracy, social-emotional development, critical thinking, and creativity-the foundational competencies for 21st-century learning.

➤ *Enhanced Language Development and Multilingual Support*

Nigeria has more than 500 languages which poses a challenge and opportunity for early childhood education [39]. AI-powered language tools provide remarkable promise for aiding multilingual development and maintaining indigenous languages while enabling transfer to English, the language of teaching in most Nigerian schools [40].

The work presented by Samuel et al. [27] points out the value of localized AI content in native languages such as Yoruba, Hausa, and Igbo, which increases cognitive accessibility and curricular fidelity while facilitating meaningful engagement of learners across Nigeria's broad

socio-cultural terrain. AI-powered translation and speech recognition systems can enhance children's language development by offering real-time feedback, demonstrating accurate pronunciation, and adapting to their specific speech patterns [14].

But the development of such localized AI systems needs substantial investment in language databases and cultural adaptation, an area where current efforts are still in their infancy [41]. Most AI learning technologies are built for foreign educational systems without consideration for the curricular requirements, local linguistic variety and pedagogical approaches, thereby inhibiting effective uptake in Nigeria" [42]. The importance of language assessment in early childhood is well-documented. Aimasiko [42] demonstrated that language testing significantly impacts language development among pupils in Ibadan, Nigeria, highlighting the need for culturally appropriate assessment tools

➤ *Early Detection of Learning Disabilities and Developmental Delays*

Standard artificial intelligence systems are quite useful in detecting learning disorders and developmental delays early on, which is important because early intervention dramatically impacts long-term outcomes [43]. Children's interaction, reactions, and performance can be analyzed by standard artificial intelligence algorithms so that deviations from the development norms, which can be an indicator of dyslexia, dyscalculia, or other cognitive problems [14], can be detected. In Nigeria, where access to educational psychologists and diagnostic specialists is severely constrained, AI-powered screening tools could democratize early identification and allow prompt interventions [44]. However, these applications also pose serious ethical questions about labeling, privacy, and possible bias of algorithms mostly trained on Western datasets [45].

➤ *Administrative Efficiency and Teacher Support*

In addition to direct teaching [46], AI provides chances to improve administrative efficiency and support instructors in Nigerian ECE environments. AI-powered solutions have the potential to automate routine chores such as attendance tracking, progress monitoring and report generation, freeing teachers to focus on meaningful instructional interactions with children [47]. The systematic study by Ibitoye et al. [48] revealed the administrative efficiency to be one of the major opportunity themes, stating that artificial intelligence may automate the regular chores so allowing the teachers to spend more time on personalized instruction, mentoring and development of critical thinking abilities. Such economies could greatly improve the quality of instruction in Nigerian ECE where teachers are often faced with big classes and few supports [49].

V. SYSTEMIC CHALLENGES CONSTRAINING AI INTEGRATION

➤ *Infrastructural Deficits*

The most basic obstacle to AI integration in Nigerian ECE is the general absence of digital infrastructure. Studies have shown that many Nigerian schools, particularly in rural regions; do not have stable energy, Internet connectivity, and digital equipment for AI implementation [50]. For example, 65% of rural Nigerian schools lack access to reliable electricity and hence, artificial intelligence (AI) systems cannot function [48] (mentioned in the systematic review by Ibitoye et al. [48]). While du Plooy et al.'s [34] scoping review focuses on higher education, the principles of personalized adaptive learning are transferable to ECE contexts, where individualized instruction is equally critical for developmental outcomes. Table 2 summarizes the infrastructural challenges and their implications for AI integration in Nigerian ECE.

Table 2 Infrastructural Challenges and Implications for AI Integration in Nigerian ECE

Infrastructure Component	Availability in Nigerian Schools	Implication for AI Integration	Source
Reliable Electricity	65% of rural schools lack consistent power	AI systems inoperable without power; intermittent disruptions	[48]
Internet Connectivity	Poor connectivity in most Nigerian schools, including ECE centers	Cloud-based AI applications inaccessible; limited real-time data	[51]
Digital Devices	Insufficient computers/tablets for student use	Limited access to AI learning platforms; high student-device ratios	[27]
Technical Support	Minimal or absent in most schools	Inability to maintain or troubleshoot AI systems	[52]
Data Infrastructure	Weak EMIS; limited data collection capacity	Inability to leverage learning analytics; poor evidence base	[53]

Figure 3 illustrates the interconnected nature of infrastructural barriers and their cascading effects on AI integration in Nigerian ECE.

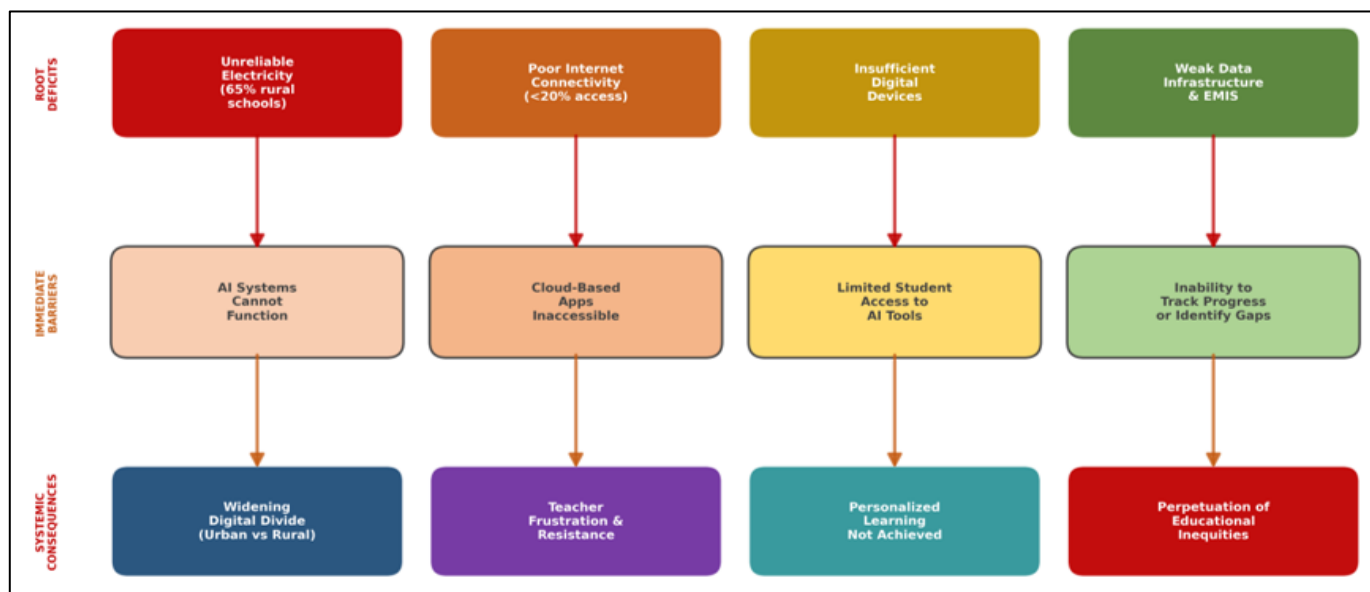


Fig 3 Cascading Effects of Infrastructural Deficits on AI Integration

Source: Synthesis from [27], [36], [48], [50], [51], [53]

The figure 3 illustrates how foundational infrastructural deficits cascade through immediate operational barriers to produce systemic educational consequences. Unreliable electricity and poor connectivity directly prevent AI systems from functioning, while insufficient devices limit student access [48]. These immediate barriers lead to widening digital divides between urban and rural schools, teacher frustration and resistance to technology adoption, inability to implement personalized learning approaches, and perpetuation of existing educational inequities [27]. Addressing any single deficit in isolation cannot resolve the systemic problem; comprehensive infrastructure investment is essential.

➤ Teacher Capacity and Digital Literacy

Low level of teacher preparedness and technological competence in Nigerian ECE settings is a major obstacle to AI incorporation [54]. Research by Akeredolu [14] found that teacher preparedness for AI integration scored only $\bar{x} = 2.32$ on a 5-point scale, indicating significant gaps in skills and confidence. Similarly, a study across six Nigerian states reported inadequate training ($\bar{x} = 2.25$) as a major impediment [36]. The subject of insufficient teacher capacity and technological literacy was noted as a major challenge in the systematic review by Ibitoye et al. [48], where instructors are often not equipped with the technological literacy and pedagogical abilities required for AI adoption. Many teachers in Nigeria lack basic digital proficiency due to improper training and limited access to technology, thus the use of sophisticated AI tools seems very far away [55]. Sambo-Magaji et al. [53] argue that many teachers may not be able to integrate AI into their teaching techniques without appropriate training, and students may lack the ability to engage with AI-based learning systems. This gap highlights the pressing need for tailored professional development programs to prepare instructors with both technical competencies and pedagogical strategies for AI integration [56].

➤ Policy Gaps and Fragmented Governance

A major systemic problem is the lack of adequate policy frameworks for AI in Nigerian education [57]. However, Nigeria has produced a National AI Strategy 2024 with aspirational governance pillars such as a National AI Ethics Commission and frameworks for responsible AI development [15], but no tangible advice exists on the integration of AI in ECE. Sambo-Magaji et al. [53] argue that current policies do not adequately address key areas such as infrastructure investment strategies that do not address rural connectivity gaps, educator training programs that do not include AI literacy modules and ethical guidelines that do not specify measures to counter algorithmic bias or student surveillance. This policy vacuum allows institutions to integrate AI without institutional support, limiting innovation and reducing congruence with national goals [58]. In the study by Eguwatu et al. [59], inadequate policy framework is also identified as a major restriction, as they observed that in Nigeria, AI is yet to be included as a compulsory subject although computer studies are in the curriculum. Without explicit national policy on AI in education, stakeholders are unsure, deterring investment and leading to inconsistent implementation [60].

➤ Ethical Concerns and Data Protection

The application of AI in ECE has raised serious ethical questions on data privacy, algorithmic bias, and equal access [61]. The Nigeria Data Protection Act 2023 has greatly enhanced the level of protection, identifying a child as any person less than 18 years of age and requiring parental consent for data processing [31]. However, there are still required educational context specific guidelines and insufficient enforcement mechanisms [62]. Samuel et al. [27] mentions that there exist ethical issues with the use of AI, such as algorithmic bias, data privacy and equitable access. They are questions of justice and security. But without the right oversight, the introduction of AI may accidentally exacerbate rather than close existing educational gaps. Instances of algorithmic prejudice include AI grading

systems that penalize Nigerian Pidgin or regional dialects because they have been trained on Western English datasets, hence undermining fairness for linguistically diverse students [53]. The sensitivity of young children creates further issues regarding the application of AI in early life [63]. Data privacy violations, such as EdTech platforms collecting biometric data without strong encryption or informed consent, could expose children to dangers of exploitation or monitoring [64]. Such considerations emphasize the importance of robust ethical frameworks and enforceable regulatory mechanisms unique to AI in ECE [65]. Beyond parental consent, the question of children's own agency and assent in AI-mediated learning remains underexplored. Young children are not passive recipients of educational technology; they are active participants whose preferences, comfort levels, and developmental readiness must be considered. Ethical AI deployment in ECE must therefore include mechanisms for children to express assent or dissent, to opt out of AI-mediated activities without penalty, and to have their voices heard in decisions that affect their learning experiences. This aligns with the African humanist principle of respecting the dignity and agency of every person, including the youngest learners [23], [24].

➤ *Cultural Resistance and Pedagogical Inertia*

Traditional ideas, religious influences and entrenched hierarchies in Nigerian schools may inhibit inquiry and innovation [66]. Teachers who have been trained in didactic training may be reluctant to adopt student-centered, AI-mediated approaches [67]. Eguwatu et al.'s study [59] identified that psychological elements such as attitude and anxiety are essential for successful implementation. It also noted that instructors expressed concerns about the possible job displacement and equitable difficulties. Furthermore, the conceptual difficulty of deploying AI in an environment where education has traditionally been conceived as a transactional rather than a liberatory process [68] must be acknowledged. In the foundations of theory paper [1], it is argued that Nigeria must not see AI as a foreign imposition but as a means to express indigenous creativity and collaborative intelligence to attain what Wiredu calls "conceptual synthesis" [23].

VI. POLICY IMPERATIVES AND STRATEGIC FRAMEWORK

This section presents five interdependent policy imperatives that constitute the strategic framework for AI integration in Nigerian ECE. These pillars are: (A) Foundational Infrastructure Investment, (B) Teacher Capacity Development, (C) Localized AI Content Development, (D) Ethical Governance and Data Protection, and (E) Research and Evaluation. The digital equity framework [26] informs the policy imperatives by foregrounding the need for equitable access, cultural relevance, and social justice. Each pillar of the proposed framework is designed to address systemic inequities and ensure that AI benefits all learners, particularly those in marginalized communities.

➤ *Foundational Infrastructure Investment*

The first policy need is to make large investments in core digital infrastructure [69]. This includes expanding access to broadband internet, improving computer labs, developing cloud-based learning systems and guaranteeing a reliable power supply. Sambo-Magaji et al. [53] propose a phased implementation strategy: short-term (1-2 years) piloting of AI tools in urban centers like Lagos; medium-term (3-5 years) expansion to rural areas through public-private partnerships; and long-term (more than 5 years) institutionalization of AI-integrated curricula nationwide. Special emphasis should be made to rural and neglected communities where the infrastructural shortages are most acute [70]. Investments in solar-powered AI labs, inspired by Nigeria's renewable energy programs, might reduce energy costs and enhance access in off-grid schools [71]. While the five-pillar framework provides strategic direction, its implementation requires realistic costing and feasibility assessment. Based on comparable EdTech initiatives in sub-Saharan Africa, establishing solar-powered AI labs in 1,000 rural ECE centers would cost an estimated \$15-20 million, while nationwide broadband expansion to underserved areas would require \$50-100 million over five years [71]. These figures, while substantial, represent a fraction of Nigeria's annual education budget and could be mobilized through public-private partnerships, development finance, and diaspora bonds. Phased implementation-prioritizing high-need regions and leveraging existing infrastructure-would enhance feasibility and sustainability. Alignment with Nigeria's National Development Plan (2021-2025) and Medium-Term National Development Plan would further institutionalize AI-in-ECE initiatives within national planning cycles.

➤ *Teacher Capacity Development*

The second policy need is comprehensive teacher capacity development [72]. This has to incorporate pre-service training in AI literacy and pedagogy and in-service professional development for the practicing instructors [73]. Eguwatu et al. [59] study proposes that the government through appropriate agencies should make it mandatory for all universities and colleges to include AI education as an obligatory course in teacher education students regardless of discipline. Professional development should not just introduce teachers to technical abilities but should be geared to build teacher confidence by equipping them with pedagogical subject knowledge of AI [74]. This includes comprehending the limitations, hazards and ethical implications of AI in education, including issues of algorithmic bias, student data privacy and academic integrity [75].

➤ *Localized AI Content Development*

The third policy necessity is the production of localized AI material that is reflective of the linguistic, cultural and curricular circumstances of Nigeria [76]. This demands collaboration of local EdTech entrepreneurs, public institutions, and curriculum developers to produce AI-based educational apps that follow Nigeria's national curriculum and multiple languages [77]. Samuel et al. [27] emphasize the necessity of contextually sensitive AI technologies that may

effectively engage learners in Nigeria's different socio-cultural landscapes. This involves adding local languages such as Yoruba, Hausa, and Igbo, in line with the national curriculum standards, and local teaching methods [78].

➤ *Ethical Governance and Data Privacy*

The fourth policy objective is to build strong ethical governance procedures for AI in education [79]. This includes the development of comprehensive national norms for AI in teacher education, including data protection, algorithmic fairness, and transparency [80]. The Federal Ministry of Education should develop clear policies in conjunction with regulatory bodies like the National Commission for Colleges of Education and the National Universities Commission to guide the adoption, implementation and monitoring of standard artificial intelligence (AI) technology [81]. Table 3 presents a synthesis of policy imperatives, recommended actions, and responsible stakeholders for AI integration in Nigerian ECE.

➤ *Research and Evaluation*

The fifth policy imperative is the institutionalization of research and evaluation mechanisms to generate context-specific evidence on AI effectiveness in Nigerian ECE. As Sambo-Magaji et al. [53] note, there is a significant lack of large-scale empirical research on AI's real-world impact in Nigerian public schools. To bridge this gap, universities, teacher training institutions, and research centers should receive targeted funding to conduct action research and evaluate AI interventions across diverse educational settings. Additionally, establishing a national open-access repository for AI-in-education data and case studies would facilitate knowledge sharing, promote replication, and provide contextual evidence to inform policy and practice [82]. The Federal Ministry of Education, in collaboration with TETFund and research institutions, should develop a national research agenda for AI in ECE that prioritizes longitudinal studies, cost-effectiveness analyses, and equity-focused evaluations.

Table 3 Policy Imperatives and Implementation Framework for AI in Nigerian ECE

Policy Imperative	Recommended Actions	Responsible Stakeholders	Timeline	Source
Infrastructure Investment	Expand rural broadband; establish solar-powered AI labs; provide devices	Federal Ministry of Education; NITDA; USPF; State Governments	Short-term (1-2 yrs)	[53], [71]
Teacher Capacity Development	Mandate AI literacy in pre-service; provide in-service training; establish certification	NCCE; NUC; TRCN; NTI; Universities	Medium-term (2-3 yrs)	[59], [72]
Localized Content Development	Fund indigenous AI content; partner with EdTech; develop multilingual tools	NERDC; EdTech companies; Universities; NITDA	Medium-term (2-4 yrs)	[27], [76]
Ethical Governance	Develop AI-in-education policy; establish oversight; enforce NDPA in schools	NDPC; Federal Ministry of Education; NCAIR	Short-term (1-2 yrs)	[31], [79]
Research and Evaluation	Fund empirical studies; establish open-access repository; conduct impact assessments	TETFund; Universities; Research Institutes	Long-term (3-5 yrs)	[53], [82]
Multi-Stakeholder Collaboration	Establish national task force; formalize public-private partnerships; engage communities	All stakeholders; Development partners; NGOs	Ongoing	[27], [83]

Figure 4 presents a proposed strategic framework for AI integration in Nigerian ECE, synthesizing the five policy imperatives into a coherent implementation model.

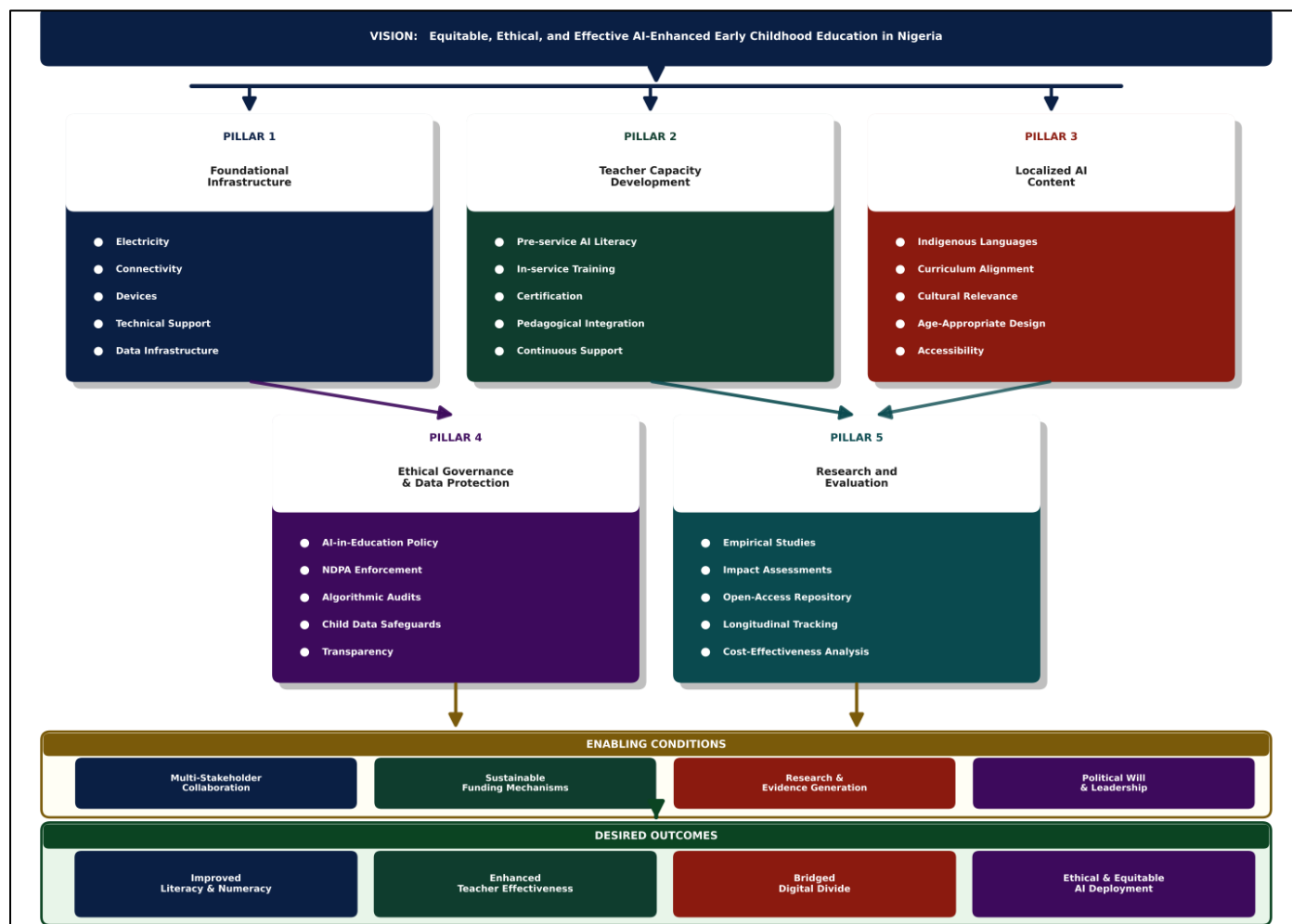


Fig 4 Strategic Framework for AI Integration in Nigerian Early Childhood Education

Source: Synthesis from [27], [32], [53], [59], [79], [80]

The strategic framework synthesizes five interdependent pillars essential for effective AI integration in Nigerian ECE as shown in Figure 3. Pillar 1 (Foundational Infrastructure) addresses the material prerequisites for AI deployment [53]. Pillar 2 (Teacher Capacity Development) ensures that educators possess the skills and confidence to leverage AI pedagogically [59]. Pillar 3 (Localized AI Content) ensures cultural and linguistic relevance [27]. Pillar 4 (Ethical Governance) provides the regulatory and protective framework [31]. Pillar 5 (Research and Evaluation) ensures that AI integration is evidence-based and continuously improved through empirical investigation [53]. These pillars are supported by enabling conditions including multi-stakeholder collaboration, sustainable funding, research and evidence generation, and political will.

VII. DISCUSSIONS

➤ Synthesis of Findings

This critical study has explored the pedagogical prospects, structural constraints and policy imperatives to the integration of AI in Nigerian early childhood education. The findings present a landscape with considerable promise tempered by daunting obstacles. The pedagogical possibilities are great. Artificial intelligence-based adaptive

learning systems, intelligent tutoring systems and interactive educational technologies have been shown to lead to quantifiable increases in early literacy, numeracy and learner engagement [35], [36]. These technologies are consistent with constructivist learning ideas and provide methods to solve the perennial problem of excessive class size and limited personalized attention in Nigerian ECE settings [14]. Moreover, artificial intelligence can enhance multilingual development, early identification of learning difficulties, and administrative efficiency, demonstrating its transformative potential [27], [43]. But these potential are severely hampered by structural obstacles. In many Nigerian schools, especially in rural regions [48], infrastructural inadequacies such as low internet connectivity and unstable energy make standard artificial intelligence (AI) systems unusable. Teacher readiness remains critically inadequate, with substantial gaps in terms of online literacy and pedagogical understanding for AI integration [54]. Policy frameworks are patchy and insufficient, forcing institutions to manage AI deployment without institutional support [53]. Ethical issues of data privacy, algorithmic bias and equitable access are still not resolved [61].

➤ Knowledge Contributions

This study contributes to the body of knowledge in several important ways. First, it synthesizes the empirical evidence on the AI in Nigerian ECE, integrating the fragmented findings into a consistent analytical framework. Secondly, it develops a five-pillar strategic framework that integrates infrastructure, teacher capacity, localized content, ethical governance, and research and evaluation-providing a comprehensive strategy that tackles the linked nature of implementation issues. Third, it advances the theoretical understanding by framing the analysis in the constructivist theory, critical rationalism, African humanism and digital equity theories and showing how these varied standpoints might guide the integration of AI in non-Western contexts. Fourth, the report adds to policy debates by providing concrete, practical recommendations that are linked with Nigeria's National AI Strategy 2024 and the Nigeria Data Protection Act 2023. Fifth, it highlights key areas for future study, namely, the lack of large-scale empirical investigations on the usefulness of AI in Nigerian ECE, and the need for longitudinal studies to assess long-term developmental results.

➤ Limitations

There are several restrictions to acknowledge. The study is based on secondary examination of existing literature, rather than original empirical data collecting. Artificial intelligence (AI) technology is changing rapidly and some of the findings may be old. Existing studies' geographic bias, with disproportionate attention on Southern and North-Central Nigeria, limits generalizability to under-represented areas. Finally, the paucity of data on cost-effectiveness constrains the capacity to provide specific advice on financial implementation.

VIII. CONCLUSION AND RECOMMENDATIONS

➤ Conclusion

The integration of AI into Nigerian early childhood education represents both an extraordinary opportunity and a complex challenge. The technology offers unprecedented potential to enhance foundational literacy and numeracy, personalize learning experiences, support multilingual development, and improve administrative efficiency. However, realizing this potential requires addressing profound systemic barriers-infrastructural deficits, teacher preparedness gaps, policy fragmentation, and ethical concerns-that currently constrain effective implementation. This inquiry concludes that successful AI integration in Nigerian ECE must be grounded in context-sensitive, equity-driven approaches that neither dismiss AI's transformative potential nor ignore the unique socio-technical realities of the Nigerian educational landscape. The proposed five-pillar strategic framework-encompassing foundational infrastructure, teacher capacity development, localized content development, ethical governance, and research and evaluation-provides a holistic roadmap for stakeholders seeking to harness AI for inclusive and quality early childhood education in Nigeria.

➤ Recommendations

Based on the analysis, the following recommendations are advanced:

- *For Federal and State Governments:*
 - ✓ Substantially increase education budget allocation to meet UNESCO's recommended 15-20% of GDP, with dedicated funding for digital infrastructure in early childhood education.
 - ✓ Develop and implement a National AI-in-Education Policy that addresses equitable access, teacher capacity building, localized content, and ethical governance.
 - ✓ Establish a multi-stakeholder National AI in ECE Task Force to coordinate implementation across federal, state, and local levels.
- *For Educational Institutions:*
 - ✓ Integrate AI literacy into pre-service teacher education curricula, ensuring all ECE teachers graduate with foundational competencies in AI pedagogy.
 - ✓ Establish continuous professional development programs for in-service ECE teachers focused on AI integration.
 - ✓ Create demonstration schools to pilot AI initiatives and generate context-specific evidence.
- *For Technology Developers:*
 - ✓ Develop localized AI content aligned with Nigeria's national curriculum and indigenous languages.
 - ✓ Ensure AI tools are designed with principles of universal design for learning, accessibility, and cultural relevance.
- *For Regulatory Bodies:*
 - ✓ Develop and enforce specific guidelines for AI use in educational settings, building on the Nigeria Data Protection Act 2023.
 - ✓ Establish mechanisms for algorithmic auditing and accountability in educational AI systems.
- *For Future Research:*
 - ✓ Conduct large-scale empirical evaluations of AI effectiveness in Nigerian ECE settings.
 - ✓ Undertake longitudinal studies examining long-term developmental outcomes of AI-enhanced early childhood education.
 - ✓ Investigate cost-effectiveness of different AI implementation models to inform resource allocation decisions.

REFERENCES

- [1.] O. Adedara, "Integrating artificial intelligence into teaching and learning to enhance critical thinking and rationality in the 21st century Nigerian education system," *Journal of Educational Philosophy and Practice*, vol. 12, no. 2, pp. 45-67, 2024.

- [2.] L. Ljungcrantz, "The interaction of AI and early childhood education: A state-of-the-art review 2020-2024," *Early Childhood Education Journal*, vol. 54, no. 1, pp. 23-41, 2026.
- [3.] Y. Zhang and S. H. B. Halili, "Applications of generative AI in early childhood education: A systematic review," *Computers and Education: Artificial Intelligence*, vol. 6, p. 100198, 2026.
- [4.] National Bureau of Statistics, "Nigeria Multidimensional Poverty Index," Abuja, Nigeria, 2022.
- [5.] UNESCO, "Out-of-school numbers are growing in sub-Saharan Africa," *Global Education Monitoring Report*, 2022.
- [6.] World Bank, "Learning poverty in Nigeria: Technical brief," Washington, DC, 2022.
- [7.] E. I. Ekor, U. E. Ogban, and O. I. Ibe, "Utilization of information and communication technology in the teaching and learning of Computer Studies in Private and Public Secondary Schools in Cross River State," *ResearchGate*, vol. 10, no. 9, pp. 944-958, 2024.
- [8.] M. A. Ayanwale, O. P. Adelana, N. B. Bamiro, S. O. Olatunbosun, K. O. Idowu, and K. A. Adewale, "Large language models and GenAI in education: Insights from Nigerian in-service teachers through a hybrid ANN-PLS-SEM approach," *F1000Research*, vol. 14, p. 258, 2025.
- [9.] W. Holmes, M. Bialik, and C. Fadel, "Artificial intelligence in education: Promises and implications for teaching and learning," Center for Curriculum Redesign, 2019.
- [10.] R. Luckin, W. Holmes, M. Griffiths, and L. B. Forcier, "Intelligence unleashed: An argument for AI in education," Pearson Education, 2016.
- [11.] World Bank, "Transforming education systems through AI: Global lessons and innovations," Washington, DC, 2023.
- [12.] M. A. Bali, E. J. Garba, A. S. Ahmad, K. T. Takwate, and Y. M. Malgwi, "Analysis of emerging trends in artificial intelligence for education in Nigeria," *Discover Artificial Intelligence*, vol. 4, no. 1, p. 110, 2024.
- [13.] A. Sambo-Magaji et al., "Systematic literature review: Challenges, implications, and frameworks for artificial intelligence adoption in Nigerian education," *NIPES-Journal of Science and Technology Research*, vol. 7, special issue, pp. 2858-2868, 2025.
- [14.] O. O. Akeredolu, "Technology and artificial intelligence: A tool for transforming early childhood education in Nigeria: Prospects and challenges," *Journal of Early Childhood Education of Nigeria (JECAN)*, vol. 14, pp. 220-230, 2025. [Online]. Available: https://jecan.com.ng/upload_file/28.pdf
- [15.] Federal Ministry of Communications, Innovation and Digital Economy, "National Artificial Intelligence Strategy," Abuja, Nigeria, 2024.
- [16.] UNESCO, "Education for sustainable futures: Policy guidelines for integrating AI and digital literacy," UNESCO Publishing, 2023.
- [17.] J. Piaget, *The Psychology of Intelligence*. London: Routledge, 1950.
- [18.] L. S. Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*. Cambridge, MA: Harvard University Press, 1978.
- [19.] X. Chen, D. Zou, G. Cheng, and H. Xie, "Detecting latent topics and trends in educational technologies over four decades using structural topic modeling," *Computers & Education*, vol. 151, p. 103855, 2020.
- [20.] M. A. Ayeni, *Philosophy of Education: An Introduction*. Ado-Ekiti: PETOA Educational Publishers, 2012.
- [21.] K. Popper, *Conjectures and Refutations: The Growth of Scientific Knowledge*. London: Routledge, 1963.
- [22.] R. Paul and L. Elder, *Critical Thinking: Tools for Taking Charge of Your Learning and Your Life*, 3rd ed. Boston: Pearson, 2014.
- [23.] K. Wiredu, "Toward decolonizing African philosophy and religion," *African Studies Quarterly*, vol. 1, no. 4, pp. 17-46, 1998.
- [24.] K. Gyekye, *Philosophy, Culture, and Vision: Essays on the African Experience*. Accra: Sankofa Publishing, 1997.
- [25.] M. Nussbaum, *Not for Profit: Why Democracy Needs the Humanities*. Princeton, NJ: Princeton University Press, 2010.
- [26.] OECD, "The future of education and skills: Education 2030," Organization for Economic Co-operation and Development, 2018.
- [27.] N. Samuel, O. J. Akorede, and A. Y. Karimu, "Artificial intelligence for inclusive education in Nigeria: Systemic challenges and bridging the 21st century digital divide," *Zamfara International Journal of Science and Technology*, vol. 5, no. 1, pp. 1-15, 2025.
- [28.] UNICEF, "Education opportunities for girls in Nigeria: Girls at a glance," UNICEF Nigeria, 2022.
- [29.] D. Moher, A. Liberati, J. Tetzlaff, and D. G. Altman, "Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement," *PLoS Medicine*, vol. 6, no. 7, p. e1000097, 2009.
- [30.] Critical Appraisal Skills Programme, "CASP Qualitative Checklist," 2018.
- [31.] Federal Republic of Nigeria, "Nigeria Data Protection Act," Federal Republic of Nigeria Official Gazette, 2023.
- [32.] Universal Basic Education Commission, "33.3% of Nigeria's basic school teachers lack proper qualifications," *The Guardian Nigeria*, 2025.
- [33.] V. Braun and V. Clarke, "Using thematic analysis in psychology," *Qualitative Research in Psychology*, vol. 3, no. 2, pp. 77-101, 2006.
- [34.] E. du Plooy, D. Casteleijn, and D. Franzsen, "Personalized adaptive learning in higher education: A scoping review of key characteristics and impact on academic performance and engagement," *Heliyon*, vol. 10, no. 21, p. e39630, 2024.
- [35.] A. Adenubi and N. Samuel, "Revolutionizing education with artificial intelligence and machine learning: Personalization, retention, and resource optimization," *Kasa Journal of Computer Science*, vol. 1, no. 2, pp. 1-15, 2024.

- [36.] O. P. Adelana, M. D. Adewale, A. Azeta, A. Abayomi-Alli, and A. Sambo-Magaji, "Impact of artificial intelligence adoption on students' academic performance in open and distance learning: A systematic literature review," *Heliyon*, vol. 10, no. 22, p. e40025, 2024.
- [37.] Y. Akyuz, "Effects of intelligent tutoring systems (ITS) on personalized learning (PL)," *Creative Education*, vol. 11, no. 6, pp. 1025-1042, 2020.
- [38.] M. Shafique, A. F. Fazli, L. Qureshi, and W. Saleem, "Adaptive learning for standardized test preparation," in *Proc. 25th International Multitopic Conference (INMIC)*, Lahore, Pakistan, 2023, pp. 1–8, doi: 10.1109/INMIC60434.2023.10465975.
- [39.] H. E. Wolff, "Language and education in Nigeria: The challenge of multilingualism," *Journal of African Cultural Studies*, vol. 32, no. 2, pp. 156–172, 2020, doi: 10.1080/13696815.2019.1673156.
- [40.] A. I. Okunade, "The role of artificial intelligence in teaching of science education in secondary schools in Nigeria," *European Journal of Computer Science and Information Technology*, vol. 12, no. 1, pp. 1-15, 2024.
- [41.] A. R. Aliyu and Y. Adeyemi, "Opportunities and challenges of integrating generative artificial intelligence in education," *International Journal of Religion*, vol. 5, no. 7, pp. 29-34, 2024.
- [42.] Aimasiko, O. G. (2025). Assessment of Language Testing on Language Development among Pupils in Ibadan South-West Local Government Area of Oyo State, Nigeria. *Journal of Educational Foundations*, 5(1).
- [43.] H. M. Yu, H. Lee, and S. H. Kim, "Integrating ChatGPT in teacher education: Examining early childhood and elementary pre-service teachers' experiences in AI-assisted math lesson planning," *Journal of Research in Childhood Education*, vol. 40, no. 1, pp. 1-20, 2026.
- [44.] J. Liu, X. Wu, H. Chen, Z. Liu, Z. Chen, and R. Chen, "Easy for children, hard for AI: The limits of multimodal LLMs in early childhood learning," in *Proc. AAAI Conference on Artificial Intelligence*, 2026.
- [45.] S. U. Noble, *Algorithms of Oppression: How Search Engines Reinforce Racism*. New York: NYU Press, 2018.
- [46.] X. Han, S. Xiao, J. Sheng, and G. Zhang, "Enhancing efficiency and decision-making in higher education through intelligent commercial integration: Leveraging artificial intelligence," *Journal of the Knowledge Economy*, vol. 15, no. 2, pp. 1234–1256, 2024, doi: 10.1007/s13132-024-01868-2.
- [47.] D. Panagou, G. Stylos, and K. T. Kotsis, "Exploring pre-service teachers' perspectives on integrating artificial intelligence in education," *Journal of Digital Educational Technology*, vol. 5, no. 2, p. ep2514, 2025.
- [48.] D. D. Ibitoye, M. E. Abdullahi, A. O. Ekele, and N. S. Ibitoye, "Artificial intelligence in education: A systematic review of its opportunities and challenges for Nigerian schools," *NIPES-Journal of Science and Technology Research*, vol. 7, special issue, pp. 1888-1897, 2025.
- [49.] A. O. Harriet and C. O. Ogbonna, "Leveraging artificial intelligence for enhanced assessment and feedback mechanisms in Nigeria higher education system," *International Journal of Research and Innovation in Social Science*, vol. 8, no. 9, pp. 142-151, 2024.
- [50.] T. Adeoye, K. Musa, and R. Adebayo, "Digital infrastructure and the future of learning in Sub-Saharan Africa: Challenges and pathways for sustainable technology integration," *African Journal of Educational Technology*, vol. 15, no. 2, pp. 44-59, 2023.
- [51.] M. C. Okoye and D. A. Mante, "The nexus between artificial intelligence and STEM education transformation in Nigeria," *International Journal of Research and Innovation in Social Science*, vol. 8, no. 3, pp. 3793-3809, 2024.
- [52.] M. A. Ewa, "Artificial intelligence (AI) literacy, an investment for enhancing educators' skills in AI powered primary schools in Nigeria," *International Journal of Research and Innovation in Social Science*, vol. 8, no. 4, pp. 1226-1238, 2024.
- [53.] A. Sambo-Magaji et al., "Systematic literature review: Challenges, implications, and frameworks for artificial intelligence adoption in Nigerian education," *NIPES-Journal of Science and Technology Research*, vol. 7, no. 2, pp. 2858-2868, 2025.
- [54.] M. A. Ayanwale, I. T. Sanusi, O. P. Adelana, K. D. Aruleba, and S. S. Oyelere, "Teachers' readiness and intention to teach artificial intelligence in schools," *Computers and Education: Artificial Intelligence*, vol. 3, p. 100099, 2022.
- [55.] K. Edinoh, A. C. Onah, and O. A. Ogunbowale, "Exploring the challenges of artificial intelligence in basic education in Nigeria," *ISRG Journal of Multidisciplinary Studies*, vol. 3, no. 2, pp. 22-28, 2025.
- [56.] J. Zhang and Z. Zhang, "AI in teacher education: Unlocking new dimensions in teaching support, inclusive learning, and digital literacy," *Journal of Computer Assisted Learning*, vol. 40, no. 4, pp. 1871-1885, 2024.
- [57.] K. Okpobiri and O. Okonkwo, "Project initiatives on inclusive and equitable use of artificial intelligence for education: Lessons derivable for policy direction in Nigeria," *COUNS-EDU: The International Journal of Counseling and Education*, 2024.
- [58.] M. A. Al-Ansi and M. K. Jura, "Building an AI future: Research and policy directions for Africa's higher education," in *Proc. IST-Africa Conference*, 2024.
- [59.] V. A. Eguwatu, G. B. Adedeji, C. I. Adeoye, and I. C. Njoku, "Challenges and opportunities of integrating artificial intelligence into teacher education development in Nigeria: A conceptual review," *Journal of Educational Research and Development*, vol. 15, no. 1, pp. 1-14, 2025.
- [60.] B. I. Ayo, "Harnessing artificial intelligence to transform educational equity in Nigeria: Challenges, opportunities, and strategic pathways," *Journal of*

- Curriculum and Instruction*, vol. 15, no. 1, pp. 1-18, 2025.
- [61.] Samuel, N. (2025). Ethical Implications of Artificial Intelligence in Education: Safeguarding Plagiarism, Academic Integrity, and Data Privacy in Nigerian Universities. *Journal of Education, Communication, and Digital Humanities*, 2(1). DOI: 10.5281/zenodo.17272660
- [62.] S. Zuboff, *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power*. New York: Public Affairs, 2019.
- [63.] UNICEF, "AI for children," Innocenti Global Office of Research and Foresight, 2022.
- [64.] E. Thomson, R. Chapman, G. Cooper, et al., "Exploring bias in artificial intelligence: Stereotypes and gendered narratives in digital imagery of early childhood educators," *Gender and Education*, vol. 38, no. 2, pp. 1-20, 2026.
- [65.] W. Holmes and I. Tuomi, "Artificial intelligence and education: Guidance for policy-makers," UNESCO, 2022.
- [66.] T. Ajayi, "Sociocultural barriers to educational innovation in Nigeria," *International Review of Education and Development Studies*, vol. 8, no. 3, pp. 101-118, 2022.
- [67.] N. J. Ogunode, "Teacher training and artificial intelligence in Nigeria: Issues and prospects," *International Journal of Educational Technology and Learning*, vol. 13, no. 1, pp. 1-12, 2023.
- [68.] P. Freire, *Pedagogy of the Oppressed*. New York: Herder and Herder, 1972.
- [69.] A. A. Barakabitze et al., "Transforming African education systems in Science, Technology, Engineering, and Mathematics (STEM) using ICTs," *Education Research International*, vol. 2019, p. 6946809, 2019.
- [70.] A. L. Gabdo, M. Sule, and Y. Jafaru, "Analysis of rural and urban universal basic educational divide in FCT Abuja, Nigeria," *International Journal of Recent Scientific Innovations*, vol. 12, no. 6, pp. 1656-1665, 2025.
- [71.] Federal Ministry of Power, "Solar Naija Programme," Abuja, Nigeria, 2023.
- [72.] J. Southworth et al., "Developing a model for AI across the curriculum: Transforming the higher education landscape via innovation in AI literacy," *Computers and Education: Artificial Intelligence*, vol. 4, p. 100127, 2023.
- [73.] A. Lohr, M. Sailer, M. Stadler, and F. Fischer, "Digital learning in schools: Which skills do teachers need, and who should bring their own devices?" *Teaching and Teacher Education*, vol. 152, p. 104788, 2024.
- [74.] K. Sperling, C.-J. Stenberg, C. McGrath, A. Akerfeldt, F. Heintz, and L. Stenliden, "In search of artificial intelligence (AI) literacy in teacher education: A scoping review," *Computers and Education Open*, vol. 6, p. 100169, 2024.
- [75.] Y. Walter, "Embracing the future of Artificial Intelligence in the classroom: The relevance of AI literacy, prompt engineering, and critical thinking in modern education," *International Journal of Educational Technology in Higher Education*, vol. 21, no. 1, p. 15, 2024.
- [76.] O. Adewale and R. Oduwole, "Challenges in AI integration in Nigerian public education: Policy, pedagogy, and infrastructure," *African Educational Review*, vol. 31, no. 1, pp. 27-45, 2024.
- [77.] A. M. Vieriu and G. Petrea, "The impact of artificial intelligence (AI) on students' academic development," *Education Sciences*, vol. 15, no. 3, p. 343, 2025.
- [78.] W. Strielkowski, V. Grebennikova, A. Lisovskiy, G. Rakhimova, and T. Vasileva, "AI-driven adaptive learning for sustainable educational transformation," *Sustainable Development*, vol. 33, no. 2, pp. 1921-1947, 2025.
- [79.] T. O. Adefolu and I. N. Ezeani, "Algorithmic accountability and ethical concerns in AI integration into African education systems: The case of Nigeria," *Journal of Information Ethics*, vol. 32, no. 1, pp. 42-56, 2023.
- [80.] R. Adefolu and C. I. Ezeani, "Regulating Artificial Intelligence in Nigerian Education: Policy Gaps and Opportunities," *Nigerian Journal of Policy and Administration*, vol. 9, no. 3, pp. 12-23, 2023.
- [81.] National Information Technology Development Agency, "National Artificial Intelligence Policy Framework," Abuja, Nigeria, 2024.
- [82.] A. Onuka and E. Durowoju, "Artificial intelligence, innovation, and research productivity in Nigerian universities," *Journal of Higher Education Policy and Innovation*, vol. 10, no. 1, pp. 12-27, 2023.
- [83.] O. A. Ojugo, C. C. Odiakaose, F. Emordi, P. Ejebi, and W. Adigwe, "Forging a learner-centric blended-learning framework via an adaptive content-based architecture," *Science in Information Technology Letters*, vol. 4, no. 2, pp. 1-12, 2023.
- [84.] Q. N. Hong et al., "Mixed Methods Appraisal Tool (MMAT), version 2018," *McGill University*, 2018.