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Artificial Intelligence for Inclusive Education in Nigeria: Systemic Challenges and Bridging the 21st Century Digital Divide

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Abstract

Nigeria's education sector is constrained by entrenched systemic challenges that impede progress toward equity, efficiency, and digital inclusion. These challenges range from inadequate infrastructure, weak digital governance, and teacher shortages to deeply rooted inequities - disproportionately affect marginalized and underserved populations. While Artificial Intelligence (AI) is increasingly leveraged globally to deliver inclusive, adaptive, and personalized education, its adoption in Nigeria remains fragmented and underdeveloped. This study critically explores AI's transformative potential within the Nigerian context, framing inclusivity not merely as access, but as the integration of cultural relevance, learner personalization, and equity-driven pedagogy. Emphasis is placed on rural and underserved areas where the digital divide is most pronounced. The paper examines strategic points for AI deployment during periods of educational reform or recovery, the roles of key stakeholders (students, teachers, administrators, and policymakers) and the ethical imperatives of context-sensitive integration. Core barriers identified include low digital literacy, infrastructural deficits, inconsistent policy frameworks, and gaps in data governance. In response, the study proposes a context-aware roadmap anchored in global best practices and local innovation, highlighting principles of equitable access, systemic transformation, and sustainable governance. It concludes that AI, when strategically implemented, represents not a distant aspiration but an immediate, viable instrument for closing Nigeria's educational divide and driving inclusive transformation in the 21st century.

Keyword: Inclusive Education, Technology, Digital Pedagogy & Localized AI Content

Introduction

Nigeria's educational landscape continues to grapple with entrenched systemic barriers that undermine efforts toward achieving equity, operational efficiency, and inclusive digital learning. Despite significant educational policy reforms, Nigeria still records the highest number of out-of-school children globally, estimated at over 20 million as of 2023 (UNESCO, 2023; Guardian Nigeria, 2024). Even for children who are enrolled and regularly attend school, learning outcomes remain alarmingly low, as reflected in persistent gaps in instructional quality, curriculum relevance, and resource availability. Studies show that more than 70% of Nigerian children cannot read and



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understand a simple sentence by age ten, which is a stark reflection of persistent learning poverty (World Bank, 2022; Guardian Nigeria, 2024). These inequities are compounded by structural inefficiencies across the system, ranging from insufficient funding, digital resource gaps decaying infrastructure and poor teacher training to governance deficits (Phillips Consulting, 2022; Okonkwo & Agbatogun, 2023). Many rural schools still lack basic electricity or internet access, making it nearly impossible to integrate modern learning technologies such as Artificial Intelligence (AI). The national teacher-student ratio remains critically high in many regions reaching as much as 1:70 while educational quality suffers due to a lack of culturally relevant instructional materials and limited continuous teacher professional development (Olayemi & Ogunyemi, 2021). In the face of these challenges, AI has emerged globally as a potentially transformative force in education. The technology promises language translation, personalized learning pathways, real-time feedback, early learner diagnostics and adaptive content delivery (Luckin et al., 2016; Holmes et al., 2019). In developed countries contexts, AI-powered tools have already been used to reduce administrative burdens, improve student engagement and outcomes and support learners with disabilities. Studies show that AI tutoring systems can accelerate learning by 2 - 3 times compared to traditional methods (World Bank, 2023; Zawacki-Richter et al., 2019). However, AI integration in Nigeria is just at the developmental stage and uneven; thereby facilitating some private EdTech companies like Edves and uLesson leveraging AI to deliver interactive content to millions of learners (Guardian Nigeria, 2024). Subsequently, most public education institutions are far behind in infrastructure provision, technical training and digital culture. This drawback reflects broader systemic dysfunctions: unclear ethical governance, low teacher readiness, limited national strategies for AI in education and inadequate indigenous software localization (Adewale & Oduwole, 2024; Olubiya, 2022).

The discourse on AI and education in Nigeria reveals several critical research gaps. Studies conducted revealed that there is a marked inadequate of empirical research on the real-world effectiveness of AI tools in the Nigerian context. The existing pilot studies such as the World Bank sponsored revealed the prevalence of AI-enhanced learning in low-income communities; few numbers of peer-reviewed evaluations explore outcomes at scale, particularly for marginalized learners (Adigun & Folorunso, 2023). Teacher preparedness towards integration and adoption of AI in facilitating pedagogic experiences seemed critically low. Findings from a study conducted by Okonkwo and Agbatogun (2023) shows that the pre-service teachers report low technological self-efficacy and limited exposure to AI-based instruction. The findings further revealed effort expectancy and insufficient institutional support are the major constructs acting as the key barriers to AI adoption in Nigeria. Subsequently, Ojo and Salawu (2022) attests that majority of AI learning tools are developed for foreign educational systems and fail to consider curriculum standards, local linguistic diversity, and pedagogical styles. This lack of contextual adaptation hinders effective uptake in Nigeria, especially in multilingual and under-resourced classrooms (Ojo & Salawu, 2022). The absence of regulatory frameworks and robust policy is another noteworthy void towards integration and adoption of AI in Nigeria. Nigeria currently lacks clear national roadmap for AI deployment in education and issues such as data privacy, algorithmic bias, and equitable access are major gray areas that are underexplored in policy discourse (Adefolu & Ezeani, 2023). Moreover, the digital divide continues to widen educational inequality, especially among rural and conflict-affected regions. Also, gender disparities are particularly pronounced as females in northern region of Nigeria face disproportionately low access to both formal schooling and digital resources, a fact corroborated by empirical reviews on female education and digital equity in Sub-Saharan Africa (UNESCO, 2022; Wikipedia, 2024). Students with disabilities are largely excluded from AI-driven educational

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interventions, thereby highlighting crucial need for inclusive design and universal access standards (Okeowo & Omoniyi, 2022). Based on these contextualized premise, these gaps call for a reimagined approach to AI integration that is not merely technologically driven but been informed by Nigeria’s socio-cultural, economic, and policy realities. There is a pressing need for grounded, context-sensitive research that examines what inclusivity truly means within the Nigerian educational context; identifies where the digital divide is most pronounced; determines when AI deployment can be both strategic and sustainable; clarifies who the key actors are in implementing inclusive AI systems; and explores how such systems can be ethically and effectively embedded within public education (Holmes et al., 2022; World Bank, 2023). This paper addresses these interlocking concerns by offering a systems-level analysis of how AI can be ethically and strategically deployed to overcome long-standing educational inequities in Nigeria. Through a multidimensional framework, it proposes an inclusive AI roadmap will designed not only to bridge the digital divide but also confront the underlying system fragilities that have, for decades, constrained educational advancement across the country. Figure 1 shows the proposed conceptual framework for inclusive AI integration in Nigerian education system.

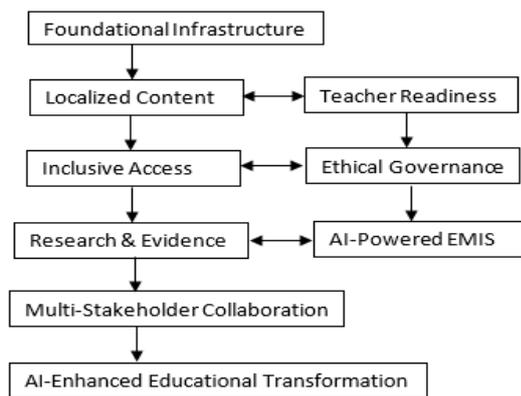


Fig. 1: Proposed Conceptual Framework for Inclusive AI Integration in Nigerian Education

Figure 1 depicts a proposed conceptual framework for inclusive AI integration in Nigerian education, which outlines a systemic and context-sensitive pathway for embedding artificial intelligence into the national education system. It recognizes the interconnectedness of infrastructure, governance, content, and collaboration in ensuring equitable and sustainable AI adoption. At the foundation of the framework is Foundational Infrastructure, which supports the localization of educational content and the development of teacher readiness. These foundational elements enable Inclusive Access and demand Ethical Governance, which together feed into the establishment of AI-Powered EMIS (Education Management Information Systems). Simultaneously, the framework highlights the centrality of Research and Evidence and the necessity of Multi-Stakeholder Collaboration including educators, policymakers, technologists, and communities. These components collectively contribute to AI-Enhanced Educational Transformation, the ultimate goal of the framework. This model emphasizes that AI integration must be inclusive, ethically guided, research-informed, and built on a foundation of robust infrastructure and local relevance.

Key Components and Their Synergistic Relationships

Foundational Infrastructure: This component comprises key subcomponents such as device access, internet connectivity, electricity and platform availability. Together, they form the bedrock upon which AI tools and systems can operate effectively in education. Without this foundational



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layer, the deployment and functionality of AI particularly in rural and marginalized areas remain impractical or severely limited. The significance of foundational infrastructure is underscored by national efforts like Nigeria's National Broadband Plan and the Rural Electrification Agency (REA) initiatives, which aim to expand digital and energy access to underserved communities (NCC, 2022).

Localized and Culturally Relevant AI Content: This component includes critical subcomponents such as curriculum alignment, language diversity (including indigenous languages like Yoruba, Hausa, and Igbo), and cultural relevance. The inclusion of localized contents will ensure that AI tools are contextually responsive, thereby engaging learners meaningfully across Nigeria's diverse socio-cultural landscapes. By enhancing cognitive accessibility and maintaining curriculum fidelity, localized AI-powered educational tools will improve learning outcomes. This synergy is evident in partnerships between EdTech startups like uLesson and Gradely and public education stakeholders, which have successfully tailored digital content to meet the needs of Nigerian learners (Ojo & Salawu, 2022).

Teacher Digital Capacity and Pedagogical Readiness: This dimension comprises pre-service and in-service AI training, digital pedagogy development, and building teacher confidence in technology integration. As frontline enablers of AI adoption, teachers play a pivotal role in determining how effectively AI tools are leveraged for instruction, learner engagement, and assessment. Teachers' digital competence directly affects classroom innovation and the scalability of AI solutions in education. This component is being operationalized through institutions such as the Teachers Registration Council of Nigeria (TRCN), National Teachers' Institute (NTI), Colleges of Education and Universities of Education, which are central to teacher professional development (Olayemi & Ogunyemi, 2021; Adigun & Folorunso, 2023).

Inclusive and Equitable Access: this component will address gender equity, disability inclusion, support for conflict-affected zones and rural outreach; thereby ensuring that no learner is left behind in AI-driven educational reforms. Inclusive and equitable access will promote social justice by leveraging assistive AI technologies such as text-to-speech tools, implementing gender-sensitive designs and deploying zero-rated educational platforms to reduce digital marginalization. By bridging access gaps, this pillar will enhance both equity and learning outcomes for vulnerable populations. It will strategically align with UNESCO's digital inclusion principles and national equity policies (Okeowo & Omoniyi, 2022; UNESCO, 2022).

Ethical Governance and Data Protection: this component will encompass algorithmic fairness, child data privacy, informed consent protocols, and anti-surveillance safeguards forming the ethical backbone of AI deployment in education. It will ensure that the rights, dignity, and agency of learners are protected in a data-driven ecosystem. By fostering trust, transparency, and accountability, it will mitigate risks of misuse and bias inherent in AI systems. Its implementation will be drawn from national frameworks such as the Nigeria Data Protection Regulation (NDPR) and emerging sector-specific AI-in-education policies (Holmes et al., 2022; UNESCO, 2021).

Evidence-Based Research and Evaluation: this component will integrate empirical studies, AI impact assessments, and the use of open data repositories to inform adaptive and context-aware decision-making. It will create robust feedback loops that will guide policy refinement, support localized AI tool development, and facilitate knowledge sharing across all educational tiers. Evidence-based research and evaluation will be anchored by institutions such as universities, the Nigerian Educational Research and Development Council (NERDC), teacher education colleges and Universities of Education, this evidence-driven ecosystem will ensure that AI integration remains responsive, relevant, and scalable (Adigun & Folorunso, 2023).



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Multi-Stakeholder Collaboration: this dimension will encompass active partnerships among the Ministry of Education (MoE), NITDA, NCC, EdTech companies, NGOs, and development partners. Through coordinated engagement, stakeholders will collectively promote sustainable AI integration, minimize resource duplication, and foster harmonized implementation across educational levels. A task-force-based national coordination model, as proposed by Adewale & Oduwole (2024) will exemplify how collaborative frameworks can streamline policy execution and ensure context-relevant innovation in Nigeria's education system.

AI-Powered Educational Management Systems: this component focuses on embedding AI-driven capabilities such as predictive analytics, dropout tracking, and real-time data utilization into existing Educational Management Information Systems (EMIS). These tools enable evidence-informed decision-making, facilitate targeted interventions, and support adaptive planning, especially in fragile, marginalized, and underserved regions. The integration of AI into EMIS, as emphasized by Zawacki-Richter et al. (2019) and the World Bank (2023), underscores its potential to transform educational governance and resource allocation.

The proposed conceptual framework is underpinned by three foundational assumptions that collectively shape the pathway for effective integration of Artificial Intelligence (AI) in the Nigerian education system. These assumptions recognize the multifaceted and dynamic nature of educational transformation in a resource-constrained yet culturally diverse context like Nigeria. First, the framework assumes that contextual relevance and equity are indispensable to AI's success. The application of AI technologies must be tailored to reflect local socio-cultural, linguistic, infrastructural, and educational realities. Without this localization, AI risks reinforcing existing inequalities rather than bridging them. Equity must therefore be a guiding principle to ensure inclusive access for all learners regardless of gender, disability, location, or socioeconomic status. Second, the framework is built on the belief that systemic transformation is necessary for sustainable impact. AI should not be treated as a plug-in solution; rather, it should be integrated within a holistic ecosystem that includes robust infrastructure, teacher capacity development, curriculum enhancement, inclusive digital content, and ethical governance. Transformation must be comprehensive, cutting across all layers of the education system. No single element—whether technological or human can drive change in isolation.

Lastly, the framework acknowledges the importance of a synergistic relationship between policy, practice, and research. These three domains must operate in continuous dialogue. Policymakers must be informed by empirical evidence and grounded classroom realities; practitioners must be supported by enabling policies; and researchers must study real-world implementation to inform adaptive strategies. This dynamic feedback loop ensures that AI integration remains contextually relevant, pedagogically sound, ethically responsible, and responsive to emerging needs and challenges. Together, these three assumptions form the philosophical and operational bedrock of the framework, guiding its structure and informing its components toward achieving inclusive, equitable, and sustainable AI-enhanced educational transformation in Nigeria.

Suggestions for a Contextualized Inclusive AI Integration in Nigerian Educational System

A contextualized roadmap for inclusive AI integration in Nigerian education is proposed as one that will address systemic inefficiencies while remaining sensitive to local sociocultural and infrastructural realities. Drawing on current research, international benchmarks, and national data, the "Way Forward" provides practical, evidence-based strategies for inclusive deployment of AI in ensuring that no learner is left behind in the digital transformation of education in Nigeria. The



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followings are suggestions to aid in contextualizing inclusive AI integration into Nigerian education system:

Reinvest in Foundational Education Infrastructure: to tackle poor learning outcomes and pervasive learning poverty, Nigeria needs to prioritize foundational investments in electricity, classrooms, connectivity and instructional materials, as these form the bedrock for effective AI deployment. Evidence from UNESCO (2023) and the World Bank (2022) shows that nations combining literacy improvements with infrastructure investment achieve greater EdTech impact. In Nigeria, strategic public-private partnerships such as with Airtel Education Projects and MTN Foundation can play a crucial role in funding ICT labs, particularly in underserved regions (Phillips Consulting, 2022).

Adopt a National AI-in-Education Strategy Anchored in Inclusivity: Nigeria currently lacks a unified roadmap for AI adoption in education. Therefore, there is an urgent need for a National AI Policy for Education that addresses equitable access, teacher capacity building, localized content, and ethical governance. Adefolu and Ezeani (2023) emphasize the importance of frameworks that ensure child data protection, algorithmic fairness, and inclusion. Lessons from India's "Responsible AI for Youth" program is a good example that offers a model for integrating AI into curricula and scaling training in secondary schools (NITI Aayog, 2021).

Design Indigenous AI Tools Tailored to Local Curriculum and Languages: Most current AI tools are misaligned with Nigeria's curriculum and linguistic diversity, limiting their effectiveness. Collaborations between local EdTech startups such as uLesson, Gradely, and Tuteria and public institutions can support the creation of localized content in major Nigerian languages, aligned with national learning goals (Ojo & Salawu, 2022). Promoting AI-powered multilingual and culturally relevant learning applications can enhance student engagement, particularly in rural and diverse classrooms.

Bridge the Digital Divide through Rural Connectivity and EdTech Subsidies: Many rural schools in Nigeria remain disconnected from the digital ecosystem due to lack of internet electricity, and deepening educational exclusion. Leveraging national initiatives like the Rural Electrification Agency (REA) and National Broadband Plan can help in no small in establishing powered learning hubs in underserved areas (NCC, 2022). Additionally, providing zero-rated access to educational platforms and distributing AI-enabled offline learning devices particularly in conflict zones and low-income communities can significantly bridge the digital divide (Okonkwo & Agbatogun, 2023).

Strengthen Teacher Capacity through Continuous AI-Focused Professional Development: Teacher readiness remains a major barrier to effective AI integration in Nigeria's education system. Introducing mandatory in-service training on digital pedagogy and AI tools through institutions like the National Teachers' Institute (NTI) and the Teaching Regulation Council of Nigeria (TRCN) is essential (Olayemi & Ogunyemi, 2021). In addition, embedding AI-focused modules into pre-service teacher education curricula will foster long-term digital fluency and preparedness (Adigun & Folorunso, 2023).

Develop Inclusive AI Systems for Females, Learners with Disabilities, and Disadvantaged Groups: Systemic exclusion of females in Northern Nigeria and learners with disabilities from AI-enhanced education persists. To bridge this gap, policies must mandate gender-sensitive EdTech practices, establish girls-only ICT centers, and deploy AI-powered assistive technologies like text-to-speech and adaptive interfaces (Okeowo & Omoniyi, 2022; UNESCO, 2022). Inclusive program design should actively engage NGOs, traditional leaders, and disability rights groups to ensure relevance and accountability.



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Institutionalize Data Governance and Ethical Standards for AI in Education: As AI-driven education increasingly relies on learner data, Nigeria requires a strong, education-specific data protection framework. Building on the Nigeria Data Protection Regulation (NDPR), policies must ensure transparency, algorithmic accountability, and safeguards against misuse or surveillance (Holmes et al., 2022). Ethical AI deployment must also protect children's rights, with strict guidelines on consent, data profiling, and privacy (UNESCO, 2021).

Promote Empirical Research and Local Evidence on AI Effectiveness: There is a significant lack of large-scale empirical research on AI's real-world impact in Nigeria's 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 (Adigun & Folorunso, 2023). 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.

Build Multi-Stakeholder Ecosystems for AI Innovation: The transformation of AI in education cannot rest solely on the Ministry of Education. A multi-sectoral task force—bringing together the Ministry, NITDA, NCC, UNICEF, EdTech companies, and civil society—must collaboratively design and implement action plans (Adewale & Oduwole, 2024). Moreover, support from international donors and global tech partners such as Google for Education, Microsoft, and the UNICEF Innovation Fund is essential to pilot AI initiatives in low-resource contexts.

Use AI for Early Warning and Education System Optimization: AI's predictive analytics can play a pivotal role in identifying potential dropouts, learning gaps, and inefficiencies in resource allocation. By integrating AI into Nigeria's Education Management Information Systems (EMIS), real-time data tracking and targeted interventions become feasible particularly benefiting fragile regions and marginalized learners (Zawacki-Richter et al., 2019; World Bank, 2023).

Conclusion

This study proposes a context-aware and an equity-driven framework for the integration of Artificial Intelligence (AI) in the Nigerian education system. It emphasizes three core assumptions: the need for contextual relevance and equitable access; the importance of systemic, holistic transformation across infrastructure, pedagogy, and governance; and the critical synergy between policy, practice, and research. The framework highlights that sustainable AI adoption requires localized implementation, inclusive design, and continuous feedback among stakeholders. AI holds transformative potential for education in Nigeria, but its success depends on thoughtful integration rooted in local realities. By aligning technological innovation with inclusive policies, systemic reforms, and collaborative research-practice-policy cycles, Nigeria can harness AI to improve learning outcomes, reduce inequality, and modernize its education system for the future.

In summary, AI holds the potential to transform Nigeria's education sector, but its success depends on how well foundational gaps are addressed, content is localized, teachers are empowered, and governance is ethically aligned. Rescinding Nigeria's entrenched educational challenges requires a paradigmatic shift, where Artificial Intelligence is not just a technological novelty but a strategic, inclusive, and ethical tool for system-wide transformation. Therefore, addressing enabling teacher readiness, infrastructure deficits, promoting inclusive design, and embedding strong ethical and data governance frameworks will in no small measure unlocks AI's full potential of technological engagement in Nigeria. Subsequently, progress will be birth via sustained investment, political will and evidence-based policy implementation that respects Nigeria's unique socio-cultural fabric and educational disparities. With coordinated multi-stakeholder engagement, context-aware



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infrastructure, inclusive policies, and sustained research, Nigeria can move beyond fragmented interventions toward a resilient, AI-enhanced educational future.

Recommendations

The following recommendations are suggested:

1. Government, non-governmental organizations and educational stakeholders should encourage prioritizing the provision of foundational infrastructural facilities (internet connectivity, rural electrification, and access to emerging technological devices) as prerequisites for sustainable AI integration.
2. Educational stakeholders should encourage establishment of unified roadmap that emphasizes teacher capacity development, ethical governance, use of localized content, and inclusivity irrespective of individual special need.
3. Educational stakeholders (curriculum planners, developers and implementers) should encourage the development of indigenous AI-powered educational applications that are aligned with Nigeria's curriculum, diverse languages, and multi-cultural contexts.
4. Educational stakeholders, Government and non-governmental organizations should institutionalize continuous AI-focused professional development and that would support embedding digital pedagogy into pre-service teacher training for professional development.
5. Government and non-governmental organizations should encourage the deployment and engagement of AI systems that will address disability inclusion, gender equity and support indigent students in rural and conflict-affected areas.
6. Government, non-governmental organizations and educational stakeholders should encourage building an ecosystem that would unite EdTech firms, government, global partners, NGOs, and local communities in co-designing of AI innovations.
7. Educational stakeholders, Government, and non-governmental organizations should encourage the mobilization of political will and public-private partnerships in ensuring long-term financing and scalable implementation of inclusive AI solutions.

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