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The Role of Artificial Intelligence and Emerging Technologies in Enhancing Learning in Kwara State Schools

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Abstract

Background of Study: This study explores the role of Artificial Intelligence (AI) and emerging technologies in enhancing learning outcomes within Nigerian secondary education, with a focus on Kwara State. AI-driven tools, such as adaptive learning systems and intelligent tutoring systems, have the potential to improve instructional delivery, learner engagement, and access to educational resources. However, Nigeria faces challenges in integrating these technologies, including infrastructural limitations, teacher capacity, and policy constraints.

Aims and Scope of Paper: The aim of this paper is to critically review the influence of AI and emerging technologies on learning outcomes in Nigerian secondary schools, specifically in Kwara State. By synthesizing existing literature, the study seeks to identify key themes, gaps in current knowledge, and explore the potential of AI to enhance instructional practices, learner engagement, and data-driven decision-making.

Methods: This research adopts a Systematic Literature Review (SLR) approach, analyzing peer-reviewed studies and credible reports published between 2015 and 2025. The data were synthesized using thematic analysis to identify recurring patterns in instructional practices, learner engagement, resource access, and implementation challenges.

Results: The findings suggest that AI has significant potential to enhance personalized learning, improve instructional efficiency, and motivate learners. However, the evidence is context-specific and often based on self-reported data, with limited empirical validation of long-term outcomes. The effectiveness of these technologies depends on infrastructure, teacher preparedness, and policy support.

Conclusion: AI serves as a complementary tool to teachers, and its success depends on systemic alignment. The study identifies areas for future research and policy development to support AI integration in Nigerian education.

A. Introduction

Education systems across the world are undergoing significant transformation driven by the rapid advancement of Artificial Intelligence (AI) and emerging digital technologies. Innovations such as adaptive learning systems, intelligent tutoring systems, educational data analytics, Virtual Reality (VR), and Augmented Reality (AR) are redefining how knowledge is delivered, accessed, and assessed (Egunjobi & Adeyeye, 2024). These technologies are gradually shifting education from traditionally uniform, teacher-centred approaches toward more personalised, interactive, and data-driven learning environments. Increasingly, AI is viewed not as a replacement for teachers but as a complementary tool that can enhance instructional effectiveness, improve learner engagement, and support evidence-based teaching practices

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(Alam, 2021). In Nigeria, growing interest in AI and educational technologies reflects ongoing efforts to address persistent challenges within the education system (Abubakar et al., 2025). Despite policy attention and reform initiatives, issues such as overcrowded classrooms, limited instructional resources, uneven teacher capacity, and declining student engagement continue to constrain learning outcomes at the basic and secondary education levels (Ekwevugbe, 2025; Abdul-Salaam, 2024). In response, AI-driven technologies are increasingly being explored as potential solutions to these systemic inefficiencies. For example, adaptive learning platforms enable the customisation of instruction to individual learners' needs, while educational data analytics provide real-time insights that can inform instructional and administrative decision-making (Ibrahim et al., 2024).

Emerging evidence from Nigerian studies suggests that AI has the potential to improve learner engagement, instructional delivery, and assessment practices when effectively integrated into existing educational frameworks. AI-supported platforms have been shown to promote sustained student interest, provide immediate feedback, and support personalised learning experiences (Okunade, 2024). Similarly, immersive technologies such as AR and VR can enhance conceptual understanding by transforming abstract ideas into interactive and concrete experiences, particularly in science-related subjects (Abdul-Salaam, 2024). However, the effectiveness of these technologies is not automatic; it is strongly influenced by contextual factors such as teacher preparedness, infrastructure availability, and alignment with curriculum standards. Kwara State presents a particularly relevant context for examining these dynamics. Like many regions in Nigeria, the state reflects both the opportunities and constraints associated with the adoption of digital technologies in education. While awareness of the potential benefits of AI is increasing among educators and policymakers, the pace of implementation remains uneven. Many schools continue to face challenges related to inadequate digital infrastructure, limited access to technological tools, insufficient teacher training, and disparities between urban and rural educational settings (Alabi et al., 2025; Ofosu-Asare, 2024; Olanrewaju et al., 2021). These contextual realities raise important questions about the extent to which AI can be effectively leveraged to improve learning outcomes without reinforcing existing inequalities.

Despite the growing body of literature on AI and educational technologies in Nigeria, significant gaps remain. First, existing studies are often fragmented, focusing on specific tools, isolated interventions, or limited geographic areas, with insufficient synthesis of evidence across contexts. Second, there is a lack of comprehensive analysis that integrates findings on learner outcomes, teacher practices, and systemic challenges within a unified framework. Third, limited attention has been given to state-specific contexts such as Kwara State, where local conditions may significantly influence the implementation and impact of AI-driven innovations. Finally, much of the current research emphasises the potential benefits of AI without adequately examining the constraints, trade-offs, and conditions necessary for sustainable and equitable integration. These gaps highlight the need for a systematic and critical synthesis of existing evidence to provide a clearer understanding of how AI and emerging technologies are shaping educational practices in Nigeria. Without such synthesis, policymakers, educators, and stakeholders may lack the comprehensive insights required to make informed decisions regarding technology adoption, investment, and implementation.

Therefore, this systematic review seeks to examine the role of Artificial Intelligence and emerging technologies in enhancing learning within the Nigerian educational context, with particular emphasis on Kwara State. Specifically, the study aims to synthesise existing research to identify key themes related to personalised learning, instructional support, learner engagement, access to educational resources, and data-driven decision-making. In addition, the review seeks to critically analyse the challenges associated with implementation and to highlight existing knowledge gaps that require further empirical investigation. By addressing these gaps, this study contributes to the development of a more coherent and evidence-based understanding of AI integration in education. The findings are expected to inform policy development, guide teacher training initiatives, and support the design of contextually relevant and sustainable educational innovations. The review seeks to provide a foundation for future research and practice that can

enhance educational quality, promote equity, and support meaningful learning outcomes in Kwara State and similar contexts.

B. Research Methods

This study adopts a Systematic Literature Review (SLR) approach to examine the role of Artificial Intelligence (AI) and emerging technologies in enhancing learning outcomes in Nigerian secondary education, with particular emphasis on Kwara State. The SLR method was selected because it enables a structured, transparent, and comprehensive synthesis of existing research, allowing for the identification of key themes, patterns, and gaps within the literature. A comprehensive literature search was conducted across major academic databases and digital repositories, including Google Scholar and ERIC (Education Resources Information Centre). The search focused on publications produced between 2015 and 2025, ensuring that the review reflects recent developments in AI and educational technologies. Search terms were developed using combinations of keywords and Boolean operators, including: "Artificial Intelligence" AND "education" "emerging technologies" AND "secondary schools" "adaptive learning" OR "intelligent tutoring systems" and "learner engagement", "digital learning", and "educational technology". These search terms were refined iteratively to improve relevance and coverage. To ensure the quality and relevance of the review, studies were selected based on the following criteria: Peer-reviewed journal articles, conference papers, and credible institutional reports. Studies focusing on AI or emerging technologies in educational contexts. Research conducted in Nigeria or contexts with comparable educational conditions. Studies reporting empirical findings or substantial theoretical analysis and publications written in English. Exclusion criteria include studies published before 2015. Articles not related to education or learning outcomes. Non-scholarly sources (e.g., blogs, opinion pieces), duplicate publications and studies lacking sufficient methodological detail.

The study selection was conducted in multiple stages. First, titles and abstracts of retrieved articles were screened to identify potentially relevant studies. This was followed by a full-text review to confirm eligibility based on the inclusion criteria. Duplicate records were removed during this process to ensure accuracy. Only studies that met all criteria were retained for the final analysis. Relevant data from selected studies were systematically extracted using a structured approach. A thematic analysis technique was employed to synthesise the findings. Extracted data were coded and organised into recurring themes, including: Personalised learning, Teacher support and instructional practices, Learner engagement and motivation, Access to educational resources, Data-driven decision-making, Implementation challenges and policy implications. Patterns, similarities, and differences across studies were then analysed to develop a coherent understanding of how AI and emerging technologies influence educational practices. To enhance the reliability of the review, selected studies were evaluated based on: Clarity of research objectives, Appropriateness of methodology, Credibility and consistency of findings and Relevance to the research focus. Only studies that met acceptable academic standards were included in the synthesis. This study is based exclusively on secondary data obtained from published sources. All materials were properly cited to ensure academic integrity and to avoid plagiarism.

C. Results and Discussion

The literature search and screening process resulted in a body of studies focusing on the application of Artificial Intelligence (AI) and emerging technologies in Nigerian education. The selected studies span secondary and tertiary education contexts, with a stronger concentration on secondary education. Methodologically, the studies include a mix of qualitative analyses, survey-based research, and a limited number of experimental or quasi-experimental designs. Across the reviewed literature, there is general convergence on the potential of AI to enhance educational processes, although the strength of evidence varies depending on study design and context.

AI Technologies Support Instructional Practices

The reviewed literature indicates that Artificial Intelligence (AI) and emerging technologies influence instructional practices through three primary mechanisms: administrative automation, learning analytics, and intelligent tutoring support. However, the strength and nature of evidence across these areas vary significantly, necessitating careful interpretation. A recurring finding across multiple studies (Abubakar et al., 2025; Karim et al., 2026) is that AI-enabled tools can automate routine administrative functions such as grading, attendance tracking, and basic assessment processing. These studies consistently report that teachers perceive a reduction in administrative workload, which potentially allows greater focus on lesson planning and learner interaction. However, a critical examination of this evidence reveals two limitations. First, the majority of these findings are derived from self-reported data, rather than time-use

studies or observational measures. As a result, the extent to which automation translates into measurable pedagogical improvement cannot be conclusively established. Second, there is limited differentiation between partial and full automation, making it unclear whether reported efficiencies are substantial or marginal.

Consequently, while there is moderate evidence supporting the efficiency gains of AI in administrative tasks, there is insufficient empirical verification linking these gains directly to improved instructional quality. A stronger and more consistently supported theme in the literature is the role of AI-driven learning analytics in shaping instructional decision-making. Wakil et al. (2024) indicate that analytics dashboards provide real-time insights into student performance, enabling teachers to identify misconceptions, track progress, and adapt instructional strategies. Analytics have the potential to enhance formative assessment practices by providing immediate feedback on learner performance, identifying recurring error patterns, and allowing for differentiation of instruction based on learner needs. Despite this convergence, the evidence base exhibits important constraints. Studies rely on case-based or institution-specific implementations, with limited replication across diverse school settings. Furthermore, few studies provide quantitative measures of impact, such as effect sizes on student achievement or learning gains.

An additional limitation is the assumption that access to data automatically leads to improved teaching. The literature suggests that effective use of analytics depends heavily on teacher data literacy, yet this variable is rarely operationalised or measured. Intelligent tutoring systems (ITS) are identified as a mechanism for extending instructional support beyond the classroom. Adayilo et al. (2025) report that ITS can provide personalised practice, adaptive feedback, and continuous learner engagement, particularly in contexts characterised by large class sizes and limited teacher availability. Intelligent Tutoring Systems (ITS) enhance education by reinforcing classroom instruction, allowing individualised pacing of learning, and increasing learner autonomy. However, critical analysis reveals that evidence supporting these claims is methodologically limited. Small or non-representative samples, a focus on short-term interventions, and the lack of control or comparison groups are significant limitations in the analysis. In addition, Onyam and Chukwu (2022) do not sufficiently account for implementation conditions, such as access to devices, digital literacy, and curriculum alignment. This raises concerns about the scalability and transferability of reported outcomes. Therefore, while ITS demonstrates promising instructional value, the current evidence base remains preliminary and context-bound.

Synthesising insights from three key areas reveals important findings regarding the use of AI in education. Firstly, there's a consensus that AI significantly improves instructional efficiency, responsiveness, and accessibility through automation, analytics, and tutoring systems, fostering a data-informed and learner-centred environment. However, there exists a notable disparity between the perceived benefits of AI, as reported by teachers and students, and objective measures of instructional effectiveness, which results in a gap between expectations and actual outcomes. Moreover, the effectiveness of AI tools is heavily reliant on the capabilities of teachers, particularly in their ability to interpret data and incorporate technology into their teaching methods. This teacher competency factor is often underexplored in existing empirical studies. Lastly, generalizability is limited, as many investigations are conducted in affluent or isolated contexts, thereby restricting the findings' applicability to broader Nigerian secondary schools, particularly those in rural or under-resourced areas. Taken together, the evidence suggests that AI and emerging technologies have the potential to augment rather than replace teacher instructional practices. Their primary contribution lies in enhancing efficiency, providing actionable insights, and extending learning opportunities. However, the current body of literature does not provide sufficiently robust empirical evidence to confirm that these technologies consistently lead to improved teaching effectiveness or learning outcomes across contexts. The findings should therefore be interpreted as indicative rather than conclusive, highlighting both the promise of AI and the need for more rigorous, large-scale, and longitudinal research.

Access to Educational Resources

Access to quality educational resources emerges as a central theme across the reviewed literature, particularly within the Nigerian context, where material shortages and uneven resource distribution persist. The analysis indicates that Artificial Intelligence (AI) and emerging technologies influence access through three key mechanisms: digital content platforms, multimedia-enhanced learning tools, and cloud-based resource distribution systems. While the literature consistently highlights the potential of these technologies, the actual extent of impact remains contingent on contextual and infrastructural conditions. A dominant finding across studies (Ejjami, 2024) is that AI-powered digital platforms expand access to instructional materials by providing curriculum-aligned, adaptive, and personalised content. These systems enable learners to engage with materials tailored to their performance levels, thereby addressing variability

in prior knowledge and learning pace. There is a consensus in the literature regarding the advantages of educational platforms, which include reducing reliance on a limited array of physical textbooks, ensuring continuous access to updated learning materials, and supporting differentiated instruction through the use of adaptive pathways.

However, closer examination reveals important limitations. First, much of the evidence is based on availability and usage metrics, rather than direct measures of improved learning outcomes. Second, few studies specify the extent of alignment between digital content and the Nigerian curriculum, raising questions about relevance and pedagogical coherence. Moreover, access to these platforms is often assumed rather than empirically demonstrated. Studies rarely quantify actual student reach, making it difficult to determine whether these tools significantly reduce resource inequities at scale. Thus, while AI-enabled platforms demonstrate strong theoretical capacity to expand access, the empirical evidence of equitable and effective utilisation remains limited. The literature also identifies multimedia tools—such as simulations, videos, and interactive modules—as critical in enhancing access to qualitatively richer learning materials. Adewumi (2024) suggests that these resources improve conceptual understanding by enabling learners to visualise abstract or complex phenomena, particularly in STEM subjects.

Across the reviewed studies, multimedia resources are shown to consistently enhance comprehension of abstract concepts, promote active and experiential learning, and provide alternatives to resource-intensive physical experiments, thereby improving overall educational effectiveness. Despite the advantages noted, the supporting evidence for the claims is methodologically uneven, as many studies are characterised by small-scale interventions, short-duration exposure, and context-specific implementations. Additionally, there is limited comparative analysis between multimedia-supported instruction and traditional teaching methods, making it difficult to isolate the specific contribution of these tools. A further limitation identified in the literature is the implicit assumption that mere access to multimedia resources is sufficient for effective use in educational settings. There is a notable lack of insights regarding several important areas, including teacher facilitation strategies, the integration of multimedia into lesson designs, and the variations in learner engagement across different contexts. This gap in the literature highlights the need for further exploration and understanding of these aspects to optimise the use of multimedia resources in educational practices.

Cloud-based platforms are increasingly identified as mechanisms for overcoming geographic and institutional barriers to resource access. Ojika et al. (2022) indicate that cloud repositories enable the storage and dissemination of up-to-date educational materials, accessible across different locations and devices. The literature identifies multiple benefits, including: the reduction of geographic disparities between urban and rural schools, the capability for real-time updating of instructional materials, and the scalability of resource distribution across large populations. When combined with mobile technologies, cloud systems are argued to extend access through widely available devices such as smartphones. This is particularly relevant in contexts where traditional ICT infrastructure is limited. The effectiveness of these systems is highly conditional, with multiple studies highlighting that access is limited by factors such as internet connectivity, data affordability, and device availability. Importantly, the literature lacks quantitative evidence on usage patterns, such as frequency of access, depth of engagement, or differences across socio-economic groups. Without such data, claims regarding expanded access remain largely inferential. Thus, while cloud-based systems offer significant potential for scalability, their actual impact is uneven and dependent on external enabling conditions.

A synthesis of the reviewed evidence highlights four key patterns regarding the impact of AI and digital technologies on educational access. First, while these technologies expand potential availability, there is a lack of empirical evidence supporting equitable and sustained access across diverse school contexts. Second, the transition from a model of resource scarcity to conditional abundance is evident; however, socio-economic constraints affect universal availability. Third, the quality of content may improve through multimedia and adaptive systems, yet the absence of standardised measures makes it difficult to evaluate educational effectiveness beyond engagement. Lastly, the underrepresentation of rural and low-resource contexts in research limits the generalizability of findings, as studies predominantly focus on better-resourced environments. The evidence suggests that AI and emerging technologies have a substantial capacity to transform access to educational resources by increasing availability, enhancing content quality, and enabling flexible distribution. However, this transformation is not automatic. It is shaped by structural factors such as infrastructure, affordability, and digital literacy.

Learner Engagement and Motivation

Learner engagement and motivation are consistently identified in the reviewed literature as key areas where Artificial Intelligence (AI) and emerging technologies exert influence. The synthesis indicates

that this influence operates primarily through three interrelated mechanisms: gamification, immersive learning technologies, and AI-enabled personalised and collaborative learning systems. While there is strong convergence in reported positive effects on engagement, the robustness and nature of the supporting evidence vary considerably. Gamification is one of the most frequently cited strategies for enhancing learner engagement. Atoyebi et al. (2025) and Ikpat (2025) the integration of game elements—such as points, leaderboards, challenges, and rewards—is associated with increased student participation, attention, and persistence in learning tasks. The literature consistently indicates that gamified environments foster active participation in classroom activities, enhance time-on-task and sustained attention, and promote competitive and goal-oriented learning behaviours. However, critical evaluation reveals that these findings are predominantly based on short-term interventions and self-reported measures of engagement, such as student interest or enjoyment. Few studies employ objective indicators (e.g., performance analytics, behavioural tracking over time) or assess the long-term sustainability of engagement gains. Furthermore, the literature rarely distinguishes between surface-level engagement (e.g., participation driven by rewards) and deep cognitive engagement (e.g., critical thinking and conceptual understanding). This limits the ability to determine whether gamification leads to meaningful learning improvements or primarily enhances motivational intensity without corresponding cognitive gains.

Immersive technologies, particularly Virtual Reality (VR) and Augmented Reality (AR), are identified as tools for enhancing engagement through experiential and interactive learning environments. Usman (2021) suggests that these technologies increase learner curiosity, attention, and emotional involvement by simulating real-world contexts and abstract phenomena. The reviewed literature highlights the benefits of immersive technologies in education, noting that they facilitate experiential learning by providing simulations of otherwise inaccessible environments. These technologies also enhance conceptual understanding through visualisation and interaction, while increasing emotional and sensory engagement with the learning content. Despite reported benefits, the evidence base is limited due to many studies being conducted in controlled settings, involving small participant samples, and focusing mainly on specific subject areas like STEM. In addition, there is minimal comparative analysis between immersive and non-immersive instructional approaches, making it difficult to isolate the unique contribution of VR/AR technologies. The high cost and infrastructural demands associated with these tools are also insufficiently addressed in relation to their scalability in typical Nigerian school contexts.

AI-driven systems, including adaptive learning platforms and collaborative digital environments, are presented in the literature as mechanisms for enhancing both individualised engagement and social interaction in learning. Oni and Ngongpah (2025) suggest that these tools allow learners to progress at their own pace while participating in collaborative tasks and problem-solving activities. Key contributions identified in the literature include the personalisation of learning pathways based on individual performance, continuous feedback to support self-regulated learning, and facilitation of peer collaboration through digital platforms. Studies indicate that tailored instructional systems can enhance learner motivation by matching content to individual needs and abilities. However, evidence is limited due to reliance on subjective data, lack of long-term studies on engagement, and insufficient differentiation between learner types. Additionally, the effectiveness of personalised systems is closely tied to algorithm quality, data accuracy, and teacher facilitation, variables that are rarely examined in detail within the reviewed studies. A synthesis of the findings on AI and emerging technologies reveals key insights: while strong evidence indicates these tools increase learner engagement—boosting participation, attention, and motivation—there is limited evidence correlating these improvements with long-term academic success or deep learning. Most studies focus on short-term interventions and self-reported engagement measures, lacking assessments of long-term effects or causal relationships. Additionally, the literature frequently conflates types of engagement (behavioural, emotional, cognitive), risking superficial interpretations of engagement improvements. Finally, the effectiveness of these technologies is heavily influenced by contextual factors like teacher facilitation and learner attributes, which are often neglected in research, limiting the generalizability of the findings. The reviewed evidence suggests that AI and emerging technologies play a significant role in reconfiguring learner engagement and motivation by making learning more interactive, personalised, and participatory. However, the current body of research provides stronger support for enhanced engagement experiences than for demonstrable improvements in learning outcomes.

Data-Driven Decision-Making

The reviewed literature identifies data-driven decision-making (DDDM) as a critical pathway through which Artificial Intelligence (AI) enhances educational planning, instructional responsiveness, and institutional effectiveness. The synthesis indicates that DDDM operates through three principal mechanisms: education management information systems (EMIS), learning analytics, and predictive

modelling. While there is strong conceptual agreement on the value of data-driven approaches, the empirical evidence supporting their effectiveness remains uneven and context-dependent. A consistent theme across studies (Adenubi et al., 2025) is the role of EMIS in improving the collection, organisation, and utilisation of educational data at institutional and policy levels. These systems enhance data accuracy and timeliness, monitor student attendance and performance, and support evidence-based policy formulation. The literature suggests that EMIS enables administrators to identify trends and allocate resources more strategically. However, closer analysis reveals that most studies focus on system functionality and perceived usefulness, rather than demonstrable improvements in institutional outcomes. There is limited evidence regarding the integration of EMIS into decision-making and the translation of data insights into effective policy or administrative action. This highlights a gap between data availability and utilisation, indicating that merely having EMIS does not guarantee enhanced decision-making.

At the classroom level, learning analytics is presented as a tool for enabling real-time instructional adaptation. Abanyam and Laetitia (2024) report that analytics platforms provide feedback on learner behaviour, performance patterns, and engagement levels, allowing teachers to tailor instruction accordingly. The literature identifies key contributions, including the identification of individual learning gaps, personalisation of feedback and instructional content, and support for formative assessment practices. Methodological limitations affect the strength of the evidence, including a reliance on case studies and pilot implementations, limited use of controlled experimental designs, and the lack of standardised metrics for evaluating impact. Furthermore, the assumption that teachers can effectively interpret and act on data is rarely interrogated. Few studies assess teacher data literacy, which is a critical mediating factor in the successful application of learning analytics. Thus, while learning analytics demonstrates high theoretical value, its practical effectiveness is inconsistently evidenced.

Predictive modelling represents a more advanced application of AI in education, focusing on forecasting student outcomes based on historical data. Ngulube (2025) suggest that predictive analytics can identify at-risk students and enable early interventions to improve retention and performance. Reported benefits of the discussed approach include early detection of academic risk factors, targeted support for vulnerable learners, and improved planning of intervention strategies. However, the evidence base is limited, with most studies focusing on tertiary education, lacking transparency on model accuracy and validation, and not addressing bias, data quality, or ethical implications. In addition, there is insufficient longitudinal evidence demonstrating that predictive interventions lead to sustained improvements in student outcomes. Therefore, while predictive analytics offers significant potential, its application in Nigerian secondary education remains emerging and insufficiently validated. A synthesis of the evidence reveals several patterns: There is a gap between the generation of educational data by AI systems and their effectiveness in improving decision-making and outcomes. The literature often relies on conceptual evidence rather than empirical validation for data-driven approaches. Most evidence is based on tertiary education, raising concerns about its relevance to secondary education. Important factors such as data literacy, institutional capacity, and organisational culture are underexplored, despite their role in effective data-driven decision-making. The evidence suggests that AI-enabled data-driven decision-making has the capacity to transform educational systems by improving responsiveness, efficiency, and strategic planning. However, the current literature provides stronger support for the availability of data systems than for their effective use and measurable impact. As such, DDDM in Nigerian education should be understood as a developing capability rather than an established practice, requiring further empirical validation, capacity development, and contextual adaptation.

Implementation Challenges

The reviewed literature demonstrates strong and consistent convergence on the existence of systemic barriers that constrain the effective integration of Artificial Intelligence (AI) and emerging technologies in Nigerian education. These challenges are best understood across four interrelated domains: infrastructural limitations, teacher capacity constraints, policy and funding gaps, and equity-related barriers. Unlike other thematic areas, the evidence in this domain is relatively robust, with high agreement across studies. Infrastructure emerges as the most consistently cited constraint across the literature (Ibrahim & Jibia, 2024). Key issues identified are the unreliable electricity supply, limited internet connectivity, and insufficient access to digital devices. These factors directly affect the usability and sustainability of AI-powered tools, which depend on stable technological environments. A critical insight from the literature is that infrastructural challenges do not merely limit access but also disrupt continuity of use, reducing the effectiveness of digital interventions even where initial adoption occurs. However, few studies provide quantitative assessments of infrastructure deficits, making it difficult to evaluate the scale and distribution of these challenges.

Teacher capacity and preparedness are key challenges in implementing effective education strategies. Sunday et al. (2025) and Isiaka et al. (2025) highlight that many teachers face constraints such as inadequate digital literacy skills, insufficient pedagogical knowledge for integrating AI tools, and a lack of confidence in using technology for instruction. Although professional development is often suggested, there is a notable absence of standardised training frameworks and evidence regarding the effectiveness of current training programs. Importantly, the relationship between teacher capacity and technology outcomes is often assumed rather than empirically tested, representing a key gap in the literature. Policy and institutional factors significantly influence implementation outcomes, with current policies often being fragmented, inconsistently applied, lacking clear implementation guidelines, and insufficiently supported by long-term funding. Studies highlight that many technology initiatives remain confined to pilot projects, with limited scalability due to funding and governance constraints. There is a lack of empirical analysis regarding policy effectiveness, budget allocation patterns, and the long-term sustainability of interventions. This suggests that while policy gaps are widely acknowledged, they are under-analysed in terms of measurable impact. Equity challenges in AI adoption relate to socio-economic disparities, rural-urban divides, gender inequalities, and accessibility for learners with disabilities. Literature indicates that without interventions, AI may amplify existing inequalities by favouring advantaged groups. However, empirical studies seldom quantify access disparities or assess impacts across demographic groups, making equity claims often normative rather than evidence-based.

Synthesising insights reveals that implementation barriers are systemic and interconnected, involving infrastructure, capacity, policy, and equity factors. While there is strong agreement on the challenges, quantitative evidence regarding their impact is limited. Although barriers are recognised, effective and scalable solutions are scarce. Moreover, without intentional intervention, technological adoption risks worsening existing inequalities. The literature provides strong and consistent evidence that implementation challenges represent a primary constraint on the effectiveness of AI in education. These challenges are structural rather than incidental, requiring coordinated and sustained interventions across multiple levels of the education system. Importantly, the findings suggest that the success of AI integration is less dependent on the technology itself and more on the conditions under which it is implemented. Addressing these systemic barriers is therefore a prerequisite for realising the potential benefits identified in other areas of the literature.

Policy and Practice Implications

The synthesis of the reviewed literature indicates that the successful integration of Artificial Intelligence (AI) and emerging technologies in Nigerian education is contingent not only on technological availability but on the alignment of policy frameworks, institutional practices, and implementation conditions. The implications derived from the evidence can be organised into four interdependent domains: infrastructure development, teacher capacity building, institutional collaboration, and evidence-informed policy design. While there is broad consensus on these priorities, the strength of supporting evidence varies, and important gaps remain in their operationalisation. Across the reviewed studies, there is strong convergence that infrastructure constitutes the primary enabling condition for effective AI integration. Reliable electricity, stable internet connectivity, and access to digital devices are consistently identified as prerequisites for the deployment and sustained use of AI-driven educational tools. The literature indicates that policy frameworks should focus on long-term investment in digital infrastructure, expand broadband access in underserved areas, and provide suitable technological devices in schools. However, key limitations include insufficient analysis of cost implications, funding models, the feasibility of large-scale deployment, and the sustainability of such investments. Consequently, while the importance of infrastructure is acknowledged, recommendations are more strategic than operationally specific. The literature consistently identifies teacher capacity as a central determinant of successful technology integration. Effective use of AI tools requires not only basic digital literacy but also the ability to integrate technology into pedagogical practice and interpret data generated by AI systems. Furthermore, professional development is often discussed in general terms, without addressing variations in teacher readiness across different regions and school types. Thus, while teacher capacity building is clearly a priority, the literature offers limited guidance on how it can be effectively designed, implemented, and scaled.

Another key implication emerging from the literature is the importance of collaborative partnerships between education systems, higher education institutions, and the private technology sector. Collaborations serve to bridge the gap between technological innovation and classroom application, co-develop contextually relevant digital tools, and support capacity building and knowledge transfer. The literature suggests that partnerships with universities and technology hubs can facilitate the development of localised, cost-effective, and culturally relevant solutions. Private sector involvement is also associated with

innovation and scalability. Empirical evidence regarding the effectiveness of partnerships is limited and mainly anecdotal, with few studies evaluating outcomes, analysing governance structures or accountability mechanisms, and assessing the long-term sustainability of partnership models. Consequently, while collaboration is widely advocated, its practical implementation remains under-theorised and insufficiently evidenced.

The reviewed studies emphasise the need for policies that are evidence-based, context-sensitive, and adaptable over time. Given the evolving nature of AI technologies, static or fragmented policy approaches are unlikely to be effective. Key recommendations emphasise the need for continuous monitoring and evaluation, support for ongoing research, and utilising data for iterative policy refinement. However, a disconnect exists between policy intent and empirical evidence, with many policy suggestions arising from conceptual arguments, limited case studies, and extrapolations from non-comparable contexts. Moreover, there is little evidence of systematic evaluation of existing policies, making it difficult to determine which approaches are most effective. Thus, while the need for evidence-informed policy is clearly articulated, the current knowledge base does not yet provide robust empirical foundations for policy design at scale.

Equity is a significant concern in AI literature, with studies indicating that without intentional intervention, AI could worsen existing inequalities linked to socio-economic status, geographic location, gender, and disability. Recommendations include allocating resources to underserved communities, designing inclusive digital tools, and providing support for disadvantaged learners. However, the evidence for these suggestions is primarily normative, with a lack of quantitative research on access to AI technologies, learning outcome variations among demographics, and the effectiveness of equity-focused interventions. As a result, while equity is widely recognised as essential, strategies for achieving it remain insufficiently specified and empirically underdeveloped. A synthesis of the policy and practice implications reveals several overarching patterns: there is a strong conceptual consensus on priorities such as infrastructure, teacher training, and policy reform, but operational clarity on implementation is limited. Additionally, there is a gap between recommendations and evidence, as many implications arise from theoretical reasoning rather than large-scale empirical validation. The domains of implementation—infrastructure, capacity, policy, and equity—are interconnected, meaning weakness in any one area diminishes the others. Lastly, the diverse educational contexts in Nigeria call for context-specific approaches rather than uniform policies. The evidence suggests that realising the potential of AI in education requires a system-level approach that integrates infrastructure development, human capacity building, institutional collaboration, and adaptive policy design. However, the current literature provides stronger support for identifying what needs to be done than for demonstrating how it can be done effectively at scale.

D. Conclusion

This study synthesizes existing literature on the role of Artificial Intelligence (AI) and emerging technologies in enhancing learning within Nigeria, particularly in Kwara State. The findings show that AI technologies—such as adaptive learning systems, intelligent tutoring systems, and immersive tools—have strong potential to improve instructional efficiency, expand access to resources, and enhance learner engagement. However, much of the evidence is perception-based, context-specific, and lacks robust empirical validation. The study highlights that the effectiveness of AI is highly dependent on factors such as infrastructure, teacher capacity, and policy support. Challenges, including inadequate digital infrastructure, limited teacher preparedness, and socio-economic disparities, play a critical role in implementation success. Without coordinated interventions, AI adoption may exacerbate existing educational inequalities. The study contributes by offering a balanced, evidence-based evaluation of AI integration in Nigerian education, addressing gaps in geographically specific analyses, and emphasizing the need for systemic alignment of technology, pedagogy, infrastructure, and policy to achieve equitable and sustainable educational innovation.

E. Recommendations

Based on the findings, it is recommended that the integration of AI and emerging technologies in Nigerian education, particularly in Kwara State, should be accompanied by comprehensive infrastructural improvements, teacher training programs, and policy reforms. To ensure equitable access, efforts should focus on bridging the digital divide between urban and rural schools, with targeted investments in digital infrastructure and affordable technology. Teachers must receive continuous professional development to enhance their capacity in effectively utilizing AI tools, and policies should be aligned to support the sustainable adoption of these technologies. Additionally, future research should prioritize large-scale,

longitudinal studies to assess the long-term impact of AI on learning outcomes, with a focus on empirical evidence rather than self-reported data. It is crucial that AI technologies be integrated as complementary tools that support, rather than replace, teachers, ensuring that the system as a whole is aligned with educational goals and the socio-economic context of Nigeria. This holistic approach will maximize the potential of AI while mitigating risks of reinforcing educational inequalities.

F. Author Contribution Statement

This research is the result of a collaborative effort between the authors, each contributing to distinct aspects of the study. Rafat DAUDA was responsible for formulating the research background and identifying the key challenges and opportunities associated with AI in Kwara State schools, as well as coordinating the literature review process. Abdulkarim Salimon GIDADO contributed to the design of the research methodology, overseeing the systematic literature review approach and the thematic analysis of the findings. Dauda Nafisah GIDADO played a key role in analyzing the contextual factors specific to Kwara State, particularly the impact of socio-economic conditions on the integration of AI in education. All authors contributed to the writing, editing, and finalization of the manuscript, ensuring a comprehensive and balanced approach to the study. Each author played a vital role in this research, with their combined expertise resulting in the insightful and practical findings presented in this paper.

References

Abanyam, V. A., & Laetitia, A. A. (2024). Strategies Employed by Nigerian Educators to Enhance Students' Engagement in Virtual Classrooms: A Meta-Analysis. Prestige Journal of Counselling Psychology, 7(2), 160-172.

Abdul-Salaam, A. O. (2024). Pre-service Teachers' Readiness to Adopt Augmented Reality for Teaching and Learning in Nigeria. International Journal of Research and Innovation in Applied Science, 9(10), 422-430.

Abubakar, A. K., Gillam, L., & Sastry, N. (2025). The Role of the Internet of Things (IoT) in Achieving the United Nations (UN) Sustainable Development Goals (SDGs)-A Systematic Review. ACM Computing Surveys, 58(3), 1-46.

Abubakar, U., Onasanya, S. A., Aliyu, H. I., & Abdulrahman, M. R. (2025). Reimagining Edupreneurship with AI Technologies: Pathways to Modern Educational Excellence in Nigerian Tertiary Institutions. Ilorin Journal of Education, 45(2), 222-236.

Adayilo, D. M., Oyefolahan, I. O., Ndunagu, J. N., Otuya, C., Malcalm, E., & Twabu, K. (2025). AI-Powered Tutoring Systems for Personalised Learning Feedback in Developing Secondary Education Contexts. Journal of Future Artificial Intelligence and Technologies, 2(4), 549-564.

Adenubi, A. O., & Oyenuga, A. O. (2025). A Framework For Real-Time Data-Driven Decision Making in Nigerian Public Basic School System. FUDMA Journal of Sciences, 9(7), 45-48.

Adenubi, O. A., Samuel, N., & Oyenuga, A. O. (2025). A framework for education technology integration in Nigerian basic school system: Digital framework for technology integration in education (DIFTE) for basic school system. University of Ibadan Journal of Science and Logics in ICT Research, 13(1), 188-199.

Adeoye, M. A., Akinnubi, O. P., & Yahaya, A. K. (2023). Unlocking the potential of education in Nigeria's Industry 4.0 era: overcoming challenges of digital transformation. Indonesian Journal of Educational Research and Review, 6(3), 608-617.

Adewumi, O. E. (2024). Immersive Technologies: Exploring the Effectiveness of Immersive Mobile Learning in Enhancing STEM Subjects (Doctoral dissertation, Oklahoma State University).

Alabi, O. A., Adeoye, M. A., Abiola, A. A., & Raji, M. O. (2025). Science education in the digital era: Socioeconomic barriers, ICT integration and emerging gaps in teaching and learning. Eduvis: Jurnal Manajemen Pendidikan Islam, 10(2), 71-88.

Alam, A. (2021, December). Should robots replace teachers? Mobilisation of AI and learning analytics in education. In 2021 International Conference on Advances in Computing, Communication, and Control (ICAC3) (pp. 1-12). IEEE.

Anafa, D. M., & Friday, A. C. (2025). Design and Evaluation of an Adaptive AI-Powered Learning Companion for Enhancing Digital Literacy in Nigerian Secondary Schools. Journal of Science Innovation and Technology Research, 10(9), 21-35.

Atoyebi, T. O., Olayiwola, J. O., Eru, A. N., Kolapo, R., & Kirubakaran, P. (2025). Gamification: An Educational Strategy To Increase Students'motivation And Academic Performance. FUDMA Journal of Sciences, 9(12), 36-41.

Daramola, F. O., & Aladesusi, G. A. (2022). Information communication technology as a tool for improving Nigerian education at all levels: a theoretical perspective. Indonesian Journal of Educational Research and Review, 5(1), 131-138.

Egunjobi, D., & Adeyeye, O. J. (2024). Revolutionising learning: The impact of augmented reality (AR) and artificial intelligence (AI on education). International journal of research publication and reviews, 5(10), 1157-1170.

Ejjami, R. (2024). The future of learning: AI-based curriculum development. International Journal for Multidisciplinary Research, 6(4), 1-31.

Ekwevugbe, A. O. (2025). Use Of Artificial Intelligence Technology For Revolutionizing Teaching And Learning Practices In Teacher Education Programmes In Nigeria. International Journal of Innovative Information Systems & Technology Research, 13(4), 33-39.

Ibrahim, A. W., Taura, A. A., Iliyasu, A., Shogbesan, Y. O., & Lukman, S. A. (2024). Artificial intelligence (AI): Perception and utilisation of AI technologies in educational assessment in Nigerian universities. Edukasiana: Jurnal Inovasi Pendidikan, 3(3), 367-380.

Ibrahim, T. A., & Jibia, S. A. (2024). Utilising technology for education: Exploring innovative ways in education to bridge the digital divide in underserved communities. International Journal of Library Science and Educational Research 4(8), 106-117.

Ikpat, N. A. (2025). Teacher Perceptions of Gamification's Influence on Student Engagement and Learning in Nigerian Primary Schools. European Journal of Education, 60(3), e70179.

Isiaka, A. O., Olarongbe, S. A., Yaya, J. A., Mahammuod, S. O., & Saliu, A. (2025). Research Collaboration and Use of Artificial Intelligence Tools for Research Output among Polytechnic Lecturers in Kwara State, Nigeria. MiddleBelt Journal of Library and Information Science, 23(1), 127-145.

Karim, S. A. A., Vaithilingam, C. A., & Happonen, A. (Eds.). (2026). Artificial Intelligence Towards Sustainable Impact Accelerator through Education, Research and Advocacy. CRC Press.

Ngulube, P. (2025). Predicting Academic Success and Identifying At-Risk Students: A Systematic Review of Data Analytics and Machine Learning Approaches in Higher Education Institutions. Educational Administration: Theory and Practice, 31(1), 117-134.

Ofosu-Asare, Y. (2024). Developing classroom ICT teaching techniques, principles and practice for teachers in rural Ghana without access to computers or internet: a framework based on literature review. The International Journal of Information and Learning Technology, 41(3), 262-279.

Ojika, F. U., Owobu, W. O., Abieba, O. A., Esan, O. J., Ubamadu, B. C., & Daraojimba, A. I. (2022). Integrating TensorFlow with cloud-based solutions: A scalable model for real-time decision-making in AI-powered retail systems. International Journal of Multidisciplinary Research and Growth Evaluation, 3(1), 876-886.

Okeke, T. E. (2024). Status of ICT in Teaching and Learning of Basic Science in Upper Basic School in Anambra East Local Government Area of Anambra State, Nigeria. Indonesian Journal of Innovative Teaching and Learning, 1(2), 67-76.

Okunade, A. I. (2024). The role of artificial intelligence in teaching science education in secondary schools in Nigeria. European Journal of Computer Science and Information Technology, 12(1), 57-67.

Olanrewaju, G. S., Adebayo, S. B., Omotosho, A. Y., & Olajide, C. F. (2021). Left behind? The effects of digital gaps on e-learning in rural secondary schools and remote communities across Nigeria during the COVID19 pandemic. International Journal of Educational Research Open, 2, 100092.

Oni, O. Y., & Ngongpah, G. (2025). The Role of Collaborative Learning Tools in Nigerian Education System. Asian Journal of Education and Social Studies, 51(5), 325-335.

Onyam, I. D., & Chukwu, E. G. (2022). Optimising digital literacy for sustainable development in Nigeria: issues and challenges. ESCET Journal of Educational Research and Policy Studies, 3(1).

Sunday, G. I., Bassey, E. J., Essien, A. E., Udoh, U. S., & Paul, U. (2025). Teachers' perceptions of the integration of artificial intelligence tools in classroom instruction and academic performance in secondary schools in Akwa Ibom State, Nigeria. ISIR Journal of Arts, Humanities and Social Sciences (ISIRJAHSS), 2(2), 57-70.

Usman, H. (2021). Effects of physical and virtual laboratories on learning outcomes in geography among senior secondary school students in North Central Nigeria (Doctoral dissertation).

Wakil, Z. A., Yashi, K. M., Ahmed, A. A., & Musa, Y. (2024). Teaching and learning process transformation using new and emerging IT trends in the Nigerian educational system. Scientific Journal of Engineering and Technology, 1(1), 28-34.