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Revolutionizing Instructional Delivery with Adaptive Learning and Artificial Intelligence

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Abstract
This paper explores the transformative ability of Adaptive Learning (AL) and Artificial Intelligence (AI) in revolutionizing instructional delivery with emphasis on Nigerian secondary education. The study employed a qualitative narrative review to explore the integration of Adaptive Learning (AL) and Artificial Intelligence (AI) in Nigerian secondary education, focusing on Kwara State and national trends. It analyzed peer-reviewed articles, policy documents, and reports sourced from academic databases and institutional websites. It places emphasis on Nigerian education, empirical data, and policy analysis. The review highlights current usage, challenges, and future directions for AL and AI adoption. The AL and AI innovations help teachers in improving

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instructional planning and delivery. Despite global progress in the adoption of AL and AI, Nigeria still faces numerous challenges in implementing these technologies, including lack of appropriate infrastructure, unstable electricity supply and poor internet connectivity. Additionally, lack of digital literacy among teachers, resistance to technology and a rigid curriculum hinder effective adoption. Socio demographic factors also influence teachers' readiness to embrace AL and AI. While programs like Kwara LEARN and national AI training initiatives show promise, issues related to data privacy, algorithmic bias, and digital inequity must be addressed. The study highlights the need for strategic investments in the area of these challenges to harness the full potential of AL and AI. By examining both the roles and benefits, this paper contributes to the ongoing discourse on how educational technologies can enhance learning outcomes and bridge the gaps in developing contexts. A comprehensive, multi-stakeholder approach is recommended.

Keywords: *Adaptive Learning**;** Artificial Intelligence**;** Instructional Delivery**;** Personalized Education**;** Digital Literacy*

Introduction

Instructional delivery methods have significantly evolved over time to meet the changing needs of learners. In traditional classroom settings, lecture-based and discussion-based approaches were often the primary means of instruction, with teachers serving as the main source of knowledge. However, in today's educational environments, there is a clear shift toward incorporating technology to enhance learning experiences. Tools like multimedia presentations, online courses, and even virtual reality are being used more frequently to make lessons more engaging and interactive. This shift not only caters to diverse learning styles but also allows for greater flexibility and accessibility, making learning more student-centered and effective. Educators and teachers use different methods, styles and contexts known as instructional delivery methods to transmit knowledge and skills effectively to students and learners. Traditionally, methods such as lecture-based, discussion-based, and experimental-based strategies are in common use. With the advent of technology, newer methods are now being employed such as the use of computers, online courses, virtual reality, or multimedia presentations for effective instructional delivery (Prapawong, 2019).

Research on AL has focused on various Integrating technology into education has brought positive changes to the educational system, particularly through the development and application of adaptive learning and artificial Intelligent. Adaptive learning leverages technology, such as computers, mobile devices, and software applications, to tailor the teaching and learning process to individual students' needs, abilities, and preferences. AL is a component of interactive learning, which, as opposed to a rigid curriculum that is operated, takes into account each student's needs through learning pathways, useful feedback, and additional resources (Kurt et al., 2021). The development of technology makes AL easier to implement because it personalizes education by adjusting instruction based on individual learner's characteristics and needs (Natriello & Chae 2017). These systems typically comprise content, learner, and instructional models (Khamis, 2015). Emergence of Artificial intelligence (AI) is rapidly transforming education by advancing learning experiences, as well as enabling

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personalized instruction. It makes it easy to adapt to individual learning styles and paces. (Martin et al., 2020).

A systematic review of 61 studies from 2009 to 2018 found that most research occurred in higher education, particularly in computer science departments, with learning style being the most observed learner characteristic. By using tools like AL platforms, which analyze student performance and then recommend exercises, learning styles, or even personalized content, AI can provide students with individualized educational experiences that include learning styles, feedback, and navigation, (Martin et al., 2020). Bibliometric study has shown important patterns and trends in the field of AL research, which has changed over time (Koutsantonis et al., 2022). Although AL has the potential to personalize education, more research is required to overcome any potential drawbacks and investigate other uses, (Natriello, 2017). AL's customization guarantees that students receive focused assistance and interact with content at the ideal level of difficulty. AL's data-driven approach is at its heart. Large volumes of data regarding students' performance, interactions, and development are gathered via learning systems with adaptive technologies (Contrino et al., 2024).

Redefining learning experiences, encouraging creativity, and equipping people for the challenges of the digital age are all made possible by the incorporation of AI tools into education (Wölfel & Taecharungroj, 2023). A paradigm shift that is both full of opportunities and challenges is presented by the convergence of AI and education. From content production and personalization to engaging interaction and more, artificial intelligence (AI) tools like ChatGPT and other sophisticated language models have shown their potential to completely transform a number of facets of education. (Baidoo & Owusu, 2023). The primary driver behind the increasing interest in integrating AI tools into education is their capacity to transform traditional educational paradigms (Mourtzis et al., 2022; Schiele et al., 2022). Consequently, a critical assessment of the corpus of existing literature has revealed several gaps, highlighting the need for additional study and research. For example, although the use of AI in education has immense potential, the ethical aspects of its deployment have not been properly studied (Rodríguez-Amigo et al., 2022).

By improving instructional delivery and personalizing learning experiences, adaptive learning (AL) and artificial intelligence (AI) is transforming education (Akavova et al., 2023). In order to improve engagement and academic results, AI-powered systems examine student performance data to develop personalized learning paths (Gligorea et al., 2023). These tools help educators by giving them immediate feedback, and generating progress reports (Akavova et al., 2023). Studies show positive student attitudes towards AI in learning, with high agreement on its importance and potential as a virtual tutor. However, the majority of students disagree that AI can replace teachers entirely (Pratama et al., 2023). While AI integration in education offers numerous benefits, challenges that come with it, such as data privacy concerns, bias in the algorithm used to design it, and teachers' training need to be addressed (Gligorea et al., 2023).

Integrating adaptive learning (AL) and artificial intelligence (AI) into education represents a significant shift in instructional delivery, enhancing how students engage with content and how teachers facilitate learning. From my understanding, the most notable impact of AL and AI is their ability to personalize education in ways that

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traditional teaching methods often cannot. Unlike the one-size-fits-all approach of conventional classrooms, these technologies allow for dynamic adjustments based on each student's pace, performance, and preferred learning style. I've observed that when learners are given material that aligns more closely with their individual needs, they tend to be more motivated and retain information better. While the growing use of AI tools like ChatGPT offers exciting possibilities such as instant feedback and customized study plans it is also clear that these technologies should be used to support, rather than replace, the role of teachers. Educators bring empathy, critical thinking, and classroom management elements that AI currently cannot replicate. However, for these innovations to be effectively implemented, issues such as teacher preparedness, data ethics, and the reliability of AI-generated content must be addressed. In my view, the most effective future classrooms will combine the strengths of AI with the irreplaceable human element of teaching.

Methodology

This study utilized a qualitative, narrative review methodology to examine the transformative potential of Adaptive Learning (AL) and Artificial Intelligence (AI) in Nigerian secondary education, with a particular focus on Kwara State and broader trends across Nigeria. The authors reviewed existing empirical studies, policy documents, program reports, and other relevant literature to draw meaningful insights into the current level of use, challenges, prospects, and future directions of AI and AL integration in the education sector. Articles and journals related to Adaptive Learning and Artificial Intelligence were reviewed, and those relevant to the topic were selected. These included peer-reviewed journal articles, national policy briefs, government and NGO reports, and case studies on education technology implementation within the context of Nigeria's educational landscape.

Sources were retrieved from academic databases such as Google Scholar, JSTOR, and African Journals Online (AJOL), as well as Nigerian repositories and the websites of relevant governmental and non-governmental institutions (e.g., the Ministry of Education and EdTech Hub). The inclusion criteria consisted of articles and reports that discussed AI or Adaptive Learning in educational contexts. Studies relevant to the Nigerian education system were included, particularly those that provided empirical data, program evaluations, policy analyses, or teacher/student perspectives. Exclusion criteria included opinion pieces lacking empirical or conceptual grounding, studies outside the domain of secondary education, and publications not written in English

Role of Artificial Intelligence in Adaptive Learning

When it comes to using adaptive learning to give teaching, artificial intelligence is a major factor. AI-powered adaptive learning technologies, for example, can analyze student performance data to adjust content that is appropriate for the learners. They can also determine each learner's level of difficulty, allowing them to create learning paths that are tailored to each student's unique instructional needs (Adamu & Awwalu, 2019). AL pinpoints areas in need of development and makes recommendations for focused interventions that are required to maximize learning outcomes (Akavova et al., 2023). It has been shown that integrating AI into e-learning platforms improves student engagement, retention, and academic success (Gligorea et al., 2023) AI also supports educators by automating administrative work and creating progress reports (Akavova et al., 2023).

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Benefits of Adaptive Learning through Artificial Intelligence

Adaptive learning with AI has many benefits for learners, teachers, and institutions when used as a mode of instructional delivery in education. Prominent among its benefits is that it provides learners with personalized instruction that is tailored to their individual needs and preferences and delivered at their learning pace. AI algorithms can create individualised learning paths for each student (Strielkowski et al., 2024). Adaptive learning platforms take advantage of this capability by continuously monitoring students' progress and adapting instructional content accordingly. This personalized approach ensures that students receive targeted support where they need it most (Muñoz et al., 2022).

Another benefit of adaptive learning when combined with AI is that students can track their own achievement and pinpoint areas for improvement. They can also take charge of their education by getting timely and relevant feedback. Machine learning algorithms also facilitate real-time feedback for students. Traditional assessment methods often provide feedback after completion or during specific intervals, limiting immediate corrections or improvements (Sharma et al., 2020). However, with AI-driven systems, automated grading systems or exams conducted at any time by virtual instructors allow students to receive immediate feedback on their work. These early responses from their teachers enable pupils to quickly see their errors and make the required corrections while still engaging with other topics at hand (Celik et al., 2022). This method allows the teachers and educators to monitor their student's progress and achievement, thereby affording them the opportunity to identify students with various challenges, so that timely targeted interventions can be offered, and if need be, adjust teaching strategies and styles. Lastly, educational institutions can effectively analyze massive datasets, produce meaningful insights, and optimize learning routes for students with the help of AI-powered adaptive learning solutions, (Gligorea, et al 2023)

Attitude of Secondary School Teachers on Adaptive Learning and Artificial Intelligence in Instructional Delivery

For Adaptive Learning (AL) and Artificial Intelligence (AI) to be effectively used as instructional tools, teachers must understand them and possess a positive attitude toward their use in order to adapt them to meet individual students' needs. Olaseni, (2024) stated that although many teachers are aware of the potential benefits of AI, their attitudes are influenced by several factors such as age, exposure to technology, digital competence, and fear of being replaced by AI systems. Dewan et al., (2025) also reported that teachers with higher digital literacy were more receptive to AI, regardless of their demographic differences. However, there is persistent concern among teachers that overreliance on AI may negatively affect students' critical thinking abilities.

In a study conducted among teachers in Oyo State, southwestern Nigeria, teachers expressed willingness to use AI for instructional purposes, particularly in lesson planning and delivery. However, the main challenges identified in using AI and AL for instructional purposes include inadequate internet access, high data costs, and time constraints (Olaleye & Salami, 2024). While Nigerian teachers are generally open to using AI in teaching, teachers in some countries, such as Scotland, have expressed opposition to its use, citing reasons like loss of autonomy and over-standardization (Grigg, 2022). These concerns need to be addressed through approaches such as professional development and supportive policy frameworks. In practice, this may

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involve integrating AI into classroom activities in ways that shift teachers' perceptions by demonstrating that AI complements, rather than replaces, teacher-led instruction (Kohnke et al., 2025).

Integration of Adaptive Learning and Artificial Intelligence in Nigerian Secondary Education

In a study conducted among teachers in Oyo State, southwestern Nigeria, efforts are underway to incorporate technologies, especially Adaptive Learning (AL) and Artificial Intelligence (AI), into secondary education in order to align with global educational advancements. For instance, Kwara State is championing digital education through the KwaraLEARN program, which has trained over 6,000 educators and distributed more than 5,600 tablets and about 900 smartphones to teachers across 10 local government areas (KwaraLEARN,). This initiative provides structured lesson plans and continuous support to improve teaching and learning outcomes. The state's commitment to technology-driven education is further demonstrated by the Brain Builders Youth Development Initiative (BBYDI), which is holding workshops to provide educators with digital and artificial intelligence capabilities (Brain Builders Youth Development Initiative, 2024).

The Nigerian government has initiated significant training initiatives at the national level, such as a five-week course on AI pedagogy for 6,000 senior secondary school teachers in February 2025. The program, which was supported by Google Research and carried out by Data Science Nigeria and Olabisi Onabanjo University, intends to improve educational delivery by incorporating AI into classroom instruction, (The Guardian, 2025). While these developments show that Nigeria is making commendable progress in integrating AL and AI into instructional delivery, sustained efforts are required. Addressing existing gaps through strategic planning and multi-stakeholder engagement is essential to ensure meaningful and long-term educational transformation.

Socio-demographic Factors Influencing the Use of Adaptive Learning and AI by Secondary School Teachers in Instructional Delivery

While it is generally accepted that the integration of Adaptive Learning (AL) and Artificial Intelligence (AI) into secondary education will transform the sector, various factors have been found to influence the acceptability or otherwise of these technologies. This section examines these sociodemographic factors. The age of the teacher is an important factor affecting the adoption of AI and AL. Younger teachers tend to be more receptive to AL and AI due to their greater exposure to digital tools and higher digital literacy. In contrast, older teachers may be less motivated to adopt such innovations, due to over dependence on traditional teaching methods and lack knowledge with current technology, (Tran et al., 2020).

Teaching experience is another factor that affects the adoption of technology; teachers with fewer years of experience tend to be more adaptable and open to integrating new tools, while those with longer careers may resist change and favor established methods. Tailored training can help experienced teachers appreciate the practical benefits of AL and AI. The gender gap also affects technology adoption, with male teachers reporting higher confidence in using educational technologies than their female counterparts, a difference influenced by societal expectations and unequal access to technological resources (Li, 2016). Teaching experience is another factor; teachers with less

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experience are generally more adaptable and open to integrating new tools, while those with longer careers may resist change and favor established methods. Tailored training can help experienced teachers appreciate the practical benefits of AL and AI, (Brody & Hadar, 2015).

However, a study conducted among secondary school teachers in India found no gender disparity among the teachers (Islahi, 2019). Subject specialization is another factor that affects the adoption of technologies. STEM (Science, Technology, Engineering and Mathematics) teachers are typically more receptive about adopting AL and AI, as these tools naturally align with their subjects. Humanities teachers may require targeted support to understand the relevance of such technologies in their disciplines (Sanusi et al., 2024). Similarly, teachers with prior training in technology or educational innovation are more likely to integrate AL and AI into their teaching. Continuous professional development is essential to equip all teachers, regardless of background, with the necessary skills (Prasetya et al., 2024; Roshan et al., 2024).

Effectiveness and Impact on Student Performance in Secondary Schools

The world has embraced digital technologies, and this is transforming educational systems at a rapid pace. Adaptive Learning (AL) and Artificial Intelligence (AI) play key roles in this advancement by reshaping instructional delivery. Nigeria, as a country, has compelling reasons to adopt these technological advancements, as its secondary schools continue to face persistent issues such as overcrowded classrooms, limited teaching resources, and diverse student learning needs (Okoye & Mante, 2024). The integration of AL and AI offers a viable solution to these challenges. It is, however, crucial to examine how these technologies impact instructional practices and student outcomes within the Nigerian context.

The Unified Theory of Acceptance and Use of Technology (UTAUT) serves as a useful model for examining how AL and AI are adopted in education. The model considers performance expectancy, effort expectancy, social influence, and facilitating conditions as vital elements that influence the use of technology. Few studies have applied UTAUT to explain the factors affecting teachers' and students' willingness and ability to accept and adopt AL and AI as tools for instructional delivery in Nigerian secondary schools. Research from Enugu State reports improvements in instructional delivery through AI-driven content creation and assessment systems (Onuh & Charles, 2024). In another study, students exposed to AI-enhanced instruction for just few weeks showed learning gains like problem-solving and critical thinking skills comparable to many years of traditional education (Ojetunde, 2024).

Challenges in the Implementation of Adaptive Learning and AI in Instructional Delivery

It is an incontrovertible fact that the global advancement of educational technology, particularly Adaptive Learning (AL) and Artificial Intelligence (AI), is reshaping instructional delivery by enabling personalized, data-driven teaching tailored to individual learner needs. These innovations have also been shown to improve student engagement and learning outcomes. However, their effective implementation in Nigeria's secondary education system may face significant obstacles. One of these challenges is the widespread infrastructural deficiencies across many schools in Nigeria. Many school facilities are obsolete and require replacement or upgrades (Haleem et al, .2022). Another major issue is limited access to stable electricity, as

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many schools are not connected to the national grid and several lack alternative power supplies. Poor internet connectivity and the high cost of data further hinder the adoption of these technologies in Nigerian secondary schools. Additionally, only a few elite schools can boast of functional ICT laboratories, rendering the integration of advanced digital technologies impractical in numerous regions. Compounding this problem is the low level of digital literacy among teachers. Many lack formal training in the use of AL or AI tools, and existing professional development programs are often outdated or irrelevant to current technological advancements. Consequently, many teachers express reservations toward these tools, often stemming from inadequate exposure, perceived complexity, or fear of job displacement (Oshowole, 2024).

Other challenges such as data privacy and data security issues must be carefully examined to protect learner's information so that unauthorized users will not gain access to it, (Akavova et al., 2023; Gligorea et al., 2023). To prevent this from happening, the institution must ensure total compliance with data protection regulations and policies (Osmanoglu, 2022). Ethical considerations such as informed consent, responsible use of data, and transparency should be well considered when developing and implementing of AI-driven adaptive learning systems.

Al is usually based on algorithms and there is possibility of biases based on the culture and the race of the learner. Algorithmic bias needs to be reduced in order to prevent this flaw and guarantee that the educational process is inclusive, fair, and impartial. Using AI-driven technologies, adaptive learning should be continuously monitored and updated for the same reason. Access to AI for these algorithms needs to be examined to preserve their precision, applicability, and relevancy with changing learning objectives (Ekwueme, et al, 2023). Generally, to address the highlighted implementation challenges, some researchers suggest development of new colligative relationship between human and AI (Osmanoglu,2022) and emphasis should be placed on the need for teacher training in utilizing these technologies (Akavova, et al, 2023).

Inequity and Digital Divide is another challenge that can mitigate against implementation technologies varies widely, leading to deepening of the digital divide between underprivileged and affluent communities. Another aspect to consider is excessive dependency on AI tools. This might undermine traditional teaching methods and critical thinking skills of learners.

This study highlights how artificial intelligence (AI) and adaptive learning can revolutionize education, with a particular emphasis on individualized instruction. It revealed that traditional teaching methods have evolved with AI and adaptive technologies tailoring content to individual needs. AI facilitates real-time feedback, analyzes learner data for customized pathways, and supports teachers through automated tasks. It also improves accessibility with tools like virtual tutors and gamification. Challenges include data privacy, ethical concerns, and digital inequities. Addressing algorithmic biases, ensuring collaboration between humans and AI, and training educators in AI technologies are essential to maximizing its potential while safeguarding equity and ethical use.

Nigeria's educational system, which is rigid and heavily exam-focused, does not support experimentation with the flexible, learner-centered approaches that adaptive learning promotes (Ghaleb, 2024). Furthermore, concerns surrounding data privacy and the ethical use of AI in classrooms are increasing, especially given Nigeria's weak data

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protection framework. Teachers are understandably cautious about deploying systems that handle sensitive student information without clear policies on consent and security (Biahu, 2024). Language and cultural limitations also hinder the effective integration of AL and AI in instructional delivery. Most AL platforms are designed in English and are poorly suited to Nigeria's multilingual educational landscape, particularly in rural or indigenous settings. This lack of contextual relevance significantly reduces the utility of these technologies for a large segment of the population. Collectively, these challenges are deeply interconnected and require a systemic, multi-stakeholder response. Addressing these challenges demands substantial investment in infrastructure, curriculum reform to include AI competencies, localized platform development, and sustained teacher training. Without targeted interventions, the transformative potential of AL and AI in improving education in Nigeria may remain largely untapped, (Eslit, 2024).

Conclusion

The integration of Adaptive Learning (AL) and Artificial Intelligence (AI) into instructional delivery represents a transformative shift in global education, offering immense potential to personalize learning, enhance student engagement, and optimize educational outcomes. In the Nigerian context, these technologies present innovative solutions to longstanding challenges such as overcrowded classrooms, limited resources, and diverse learner needs. However, their effective adoption is impeded by infrastructural deficits, inadequate digital literacy among teachers, poor internet connectivity, and socio-cultural barriers. Moreover, ethical concerns, data privacy issues, and the risk of algorithmic bias underscore the need for robust regulatory frameworks and transparent implementation practices.

To fully harness the benefits of AL and AI, Nigeria must pursue a multi-faceted strategy that includes substantial investments in digital infrastructure, continuous professional development for educators, curriculum reforms, and the development of contextually relevant technological platforms. Ultimately, the successful deployment of these innovations hinges on sustained collaboration between the government, educators, technology developers, and other stakeholders. With targeted interventions and inclusive policies, AL and AI can significantly reshape Nigeria's educational landscape, bridging learning gaps and equipping students with the skills needed to thrive in the digital age

Recommendations

A good strategy is required to fully benefit from Adaptive Learning (AL) and Artificial Intelligence (AI) in Nigeria's educational system. Teachers must receive frequent training to help them use these technologies effectively, and AI tools must be developed that are appropriate for the Nigerian curriculum and regional languages. The state government should also invest in enhancing internet access, electricity, and digital tools in secondary schools, particularly in rural areas. Digital skills and appropriate AI use should be incorporated into the educational curriculum. Clear guidelines and procedures must be established in order to safeguard student data and guarantee equity. Cooperation between the government, educational institutions, tech firms, and other organizations is essential. Campaigns to raise awareness should aid in the public's comprehension and acceptance of these developments. Before implementing successful pilot projects more broadly, these tools should be tested in a small number of schools.

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By doing these actions, AI and AL can help close learning gaps, address issues in education, and better prepare students for life in the digital age.

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