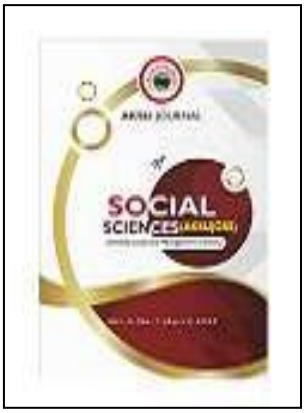


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The Role of Artificial Intelligence in Open and Distance Learning in Nigeria: A Systematic Review

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Abstract
This review paper examines the current state of research on the application of artificial intelligence (AI) in open and distance learning (ODL). A systematic review of existing literature on AI-powered tools and systems in ODL, highlighting their potential benefits, challenges, and strategies, was conducted. Findings reveal that AI can enhance ODL outcomes in areas such as personalized learning, assessment, and student support. However, the study also identified concerns related to data quality, bias, and digital divide. The strategies for the adoption of AI in ODL were also stated. Based on the findings of the study, it was recommended that digital skills literacy and competencies be enhanced to solve the challenges encountered in the adoption of AI in ODL.

Keywords: Artificial intelligence, distance education, digital learning, digital teaching tools, e-learning.

Introduction

The emergence and widespread adoption of information and communication technologies (ICT), especially artificial intelligence, have instigated a significant transformation in education, fundamentally altering teaching and learning processes. In recent years, artificial intelligence has proven itself a powerful tool across diverse fields, including education (Ojokheta & Omokhabi, 2023), healthcare (Omokhabi, Erumi, Omilani & Omokhabi, 2025), and other crucial sectors. As digital technologies continue to advance rapidly, they are reshaping the ways individuals interact with devices such as computers, tablets, and smartphones, thereby influencing daily routines and optimising performance strategies (Omokhabi, 2021). The continual expansion of digital technology's scope, along with evolving tools and patterns of use, is fundamentally changing the nature of work and life (Omokhabi, 2023). Notably, the internet and web-based platforms have

accelerated this revolution, particularly through the rise of e-learning, which has added a new dimension to educational access for open and distance learning (ODL) providers.

While ODL has been widely celebrated for expanding access to education and helping countries address mass education needs, e-learning is pushing these boundaries even further. By removing geographical barriers, e-learning enables individuals to pursue education anytime and anywhere, at a pace that suits their circumstances. This shift has rendered traditional teaching and learning methods increasingly obsolete, potentially affecting students' competitiveness on a global scale. The evidence suggests that students today learn more efficiently using AI-powered educational tools; however, the scarcity of such tools in many Nigerian universities presents a significant challenge. This highlights the urgent need for the integration of AI technologies to enhance the effectiveness of teaching and learning and to prepare students for international competition. Consequently, this paper undertakes a systematic review of the role of artificial intelligence in open and distance learning, examining topics such as AI-powered systems, conceptual perspectives on ODL, the benefits and challenges of AI adoption in Nigeria, and strategies for incorporating AI components into teaching and learning within ODL institutions.

Research Questions

1. What are the potential benefits of AI-powered tools and devices in ODL?
2. What are the challenges of AI adoption in ODL?
3. What are the strategies for adoption of AI components in teaching and learning in ODL institutions?

Literature Review

The Systemic Review of AI-Powered Tools in Literature

Artificial Intelligence (AI) is rapidly transforming higher education by introducing innovative approaches to enhance learning outcomes and personalise educational experiences. Universities are increasingly implementing AI technologies such as intelligent tutoring systems, adaptive learning platforms, and virtual assistants. These tools utilise machine learning algorithms to analyse students' learning behaviours, delivering tailored content and supporting individual progression. AI-powered e-learning platforms facilitate remote and interactive learning, providing immediate feedback and allowing students to advance at their own pace. Additionally, chatbots and AI-driven question-and-answer systems address academic queries and reduce administrative workloads, improving access to information (Olanrewaju & Adegboyega, 2023). AI's benefits include identifying knowledge gaps, recommending targeted resources, and promoting inclusivity through speech-to-text and real-time translation technologies.

AI is also revolutionising teaching by offering tools that support both instruction and learning. While adoption rates vary across disciplines and institutions, core applications include e-learning platforms like Moodle, intelligent tutoring systems, and administrative chatbots, all of which help track student performance and offer personalised resources (Ezekiel & Akinyemi, 2022). AI-powered virtual assistants manage routine queries, benefitting both students and academic staff. However, in developing countries, AI adoption is limited by traditional pedagogical approaches, inadequate digital infrastructure, and insufficient training. Although science and engineering disciplines increasingly use AI for simulations and predictive modelling, wider uptake is hindered by resource constraints and resistance to change. Nevertheless, AI enables adaptive learning, supports immersive teaching methods like augmented and virtual reality, and streamlines assessment, thereby allowing lecturers to focus on more interactive and impactful teaching (Fahimirad & Kotamjani, 2018).

Influence of AI-Powered Tools on Online Learning in ODL

Online learning refers to the delivery of educational content through information and communication technology, predominantly via the internet (Northedge, 2008). It supports learning activities with digital devices such as tablets, computers, and projectors, fostering interaction between teachers and students (Èze & Bello, 2018). This approach has transformed education by incorporating interactive resources like quizzes and videos. Worldwide, countries such as the United States, United Kingdom, China, and India have adopted comprehensive online learning programmes, with enrolments in the United States now surpassing those in traditional classrooms (Seaman & Seaman, as cited in Palv, 2018). The flexibility of online learning enables learners to study at their own pace, expanding access for those unable to attend in-person classes (Bastrikin,

2020). Nonetheless, adoption and effectiveness vary across regions, particularly in developing countries.

In Nigeria, several barriers impede the widespread adoption of online learning. During the COVID-19 pandemic, inadequate infrastructure prevented most schools from continuing classes, in contrast to developed nations (Idris, 2020). E-learning provision is often limited to basic lectures on CDs rather than fully interactive platforms (Ajadi, Salawu, & Adeoye, 2008). Reliable internet access remains scarce for many students (Mahmoud, 2008; Anan & Anwar, 2020), and most universities lack e-learning libraries and suitable IT facilities, mainly due to high costs and low awareness of online learning's benefits (Anene, Imam, & Odumuh, 2014). Nevertheless, some Nigerian institutions have begun to use online learning to expand access to higher education, which is vital for social and occupational mobility (Jegede, 2003).

The Need for Online Learning Applications

Online learning applications are digital tools designed to enhance education by utilising social software and social media, enabling learning through interpersonal interaction and connected systems (Appana, 2008). The creation of e-learning applications aims to make education more accessible and engaging, supporting remote knowledge acquisition and user interaction. Examples include learning management systems like Moodle, communication platforms such as Zoom, Google Meet, and Google Classroom, and social media apps like Telegram and WhatsApp (Appana, 2008). While social media platforms are recognised for fostering communication within online communities (Obar & Wildman, as cited in Omokhabi, Omokhabi, & Oloyede, 2025), digital technology's use extends far wider, rapidly reshaping daily life (Omokhabi, 2023).

Online learning applications serve as intermediaries in both formal and informal educational settings, facilitating connections among learners, instructors, and educational content. These connections help establish dynamic knowledge networks, which can benefit not only students but also administrators and educators (Hewett & Power, 2007). In schools, e-learning applications offer a new dimension beyond traditional teaching by impacting students and their support networks. Furthermore, these tools allow individuals to share ideas, ranging from academic research to practical skills, within broader communities. By integrating learning into daily life, online learning applications contribute to a more supportive and adaptable educational environment (Hewett, 2007).

Conceptual Views of Open and Distance Education in Literature

In Nigeria's diverse educational landscape, distance education has emerged as a strategic response to persistent access challenges. Defined as a systematic and autonomous learning process, distance education enables learners to access instructional materials and guidance remotely, often via print or digital communication technologies (Dohmen, 1967, as cited in Keegan, 1996; Moore, 1973). Unlike traditional classroom teaching, where face-to-face interaction is central, distance education relies on periodic, technology-mediated exchanges between teachers and learners (Holmberg, 1977; Garrison & Stale, 1987).

Lane and Portway (1994, as cited in Keegan, 1996) highlight the importance of electronic and print media in overcoming geographical barriers, while Perraton, Creed, and Robinson (2002) emphasise the learner-centred nature of distance programmes, which use diverse tools to support independent and flexible study.

Keegan (1993) identifies key features of distance education, including the physical separation of teacher and learner, educational authority, and two-way technology-enabled communication. Open learning shares these characteristics, offering minimal entry barriers and recognising prior learning, thus supporting a broader range of participants (Glen, 2005). This model accommodates various learning styles and reaches remote or under-served populations (Jain, 2001; Jegede, 2003). Delivery methods are diverse, from videocassettes and online platforms to face-to-face tutorials, and learning materials typically include texts, guides, and multimedia resources. Assignments are completed independently, with support provided through local study centres or online tutors. As such, distance education is a powerful mechanism for promoting equitable access and educational opportunity in Nigeria.

Methods and Materials

This study employed a systematic literature review (SLR) to investigate the benefits, challenges, and strategies for adopting artificial intelligence (AI) in open and distance learning (ODL), utilising a transparent and replicable process. The review encompassed major databases, peer-reviewed journals, conference papers, and manual searches using key terms such as e-learning, online learning, AI in education, ICT, and digital teaching tools in Nigeria (Moher et al., 2009). Empirical studies, theoretical papers, policy reports, and book chapters published in English and focusing on e-learning, distance education, or AI in educational contexts were included. The inclusion criteria encompassed both Nigerian and international studies relevant to AI in ODL, while unpublished and non-English articles, duplicates, and studies unrelated to education were excluded. The search was conducted in databases like Scopus, Web of Science, Google Scholar, and ResearchGate. Titles and abstracts were screened for relevance, followed by full-text reviews against the criteria. Articles were assessed for clarity, methodological rigour, and relevance to AI integration. Thematic synthesis extracted key details and findings on learning outcomes, benefits, challenges, and strategies for AI adoption in ODL, ensuring local perspectives were represented (Thomas & Harden, 2008).

Result and discussion

Benefits of AI-Powered Tools for the Delivery of Open and Distance Education in Nigeria

There are many benefits associated with the opportunity for e-learning spaces to deliver education Open and distance education in Nigeria in the post-digital world. Some advantages are given below:

More Active Learning

Online learning environments encourage active participation using virtual images, animations, and interactive resources, which help to keep students engaged and reduce frustration (Alghamdi, 2013). The format fosters enhanced interaction between students, teachers, and content, placing learners at the centre of the educational process. Online platforms enable diverse teaching strategies, such as using animations for complex topics, which facilitate discussion and deeper understanding (Okafor, 2022). This model allows students to learn at their own pace, offering flexibility to tailor study schedules according to individual needs and interests (Muibi, 2017). Collectively, these features lead to increased student involvement and concrete attention to learning.

Cost Reduction

Online learning significantly reduces educational costs by minimising expenses linked to transportation, accommodation, and printed materials, as digital resources are easily distributed (Muibi, 2020). It enables both students and teachers to participate from any location, reducing the need for physical infrastructure and allowing multiple learning activities simultaneously. Tuition fees can also be lower, and learners can enrol in courses across different institutions without additional financial strain. As universities can accommodate larger enrolments without space constraints, they are able to generate more revenue. Overall, online learning supports cost-effective access to education while helping learners manage resources efficiently.

Effective Resource Management

Online learning applications enable teachers to efficiently organise and store teaching materials, attendance, and academic records in digital formats, reducing reliance on paper documents and enhancing resource management (Okafor, 2022). This digital approach helps teachers streamline their work, allowing more effective lesson planning and delivery. The use of visual simulations and interactive resources can make online learning as impactful as face-to-face teaching (Joshi & Babacan, 2012). Visual simulations model real-life environments, helping students grasp complex concepts more easily. Consequently, online platforms provide teachers with tools to stimulate intellectual curiosity and manage classroom activities with greater effectiveness (Muibi, 2024).

Personalised Learning Experience

Online learning is inherently student-centred, enabling learners to access a variety of materials and resources beyond those provided by the teacher (Iloanusi, 2007). Technology facilitates access to academic databases, video resources, and virtual conferences, which can be tailored to individual learning needs. This personalisation enhances course delivery, makes assessment management more efficient, and supports group projects. Instructors can update electronic course materials easily, ensuring content remains current and relevant (Quadri & Muibi, 2024). Through virtual learning environments, assessments and collaborative projects are managed more smoothly, allowing for a more tailored and consistent learning experience.

Greater Interaction and Collaboration

Online learning enhances both institutional reputation and opportunities for collaboration among academics and students. It connects faculty and students across universities, encouraging knowledge sharing and exposure to best practices globally (Muibi, 2022). This connectivity fosters organisational awareness and allows for collaboration between institutions, whether locally or internationally. Students benefit from a diverse range of perspectives, and professors can deliver guest lectures to audiences beyond their own institutions. Self-paced learning is encouraged, leading to higher information retention and enabling students to control their own learning process, ultimately reducing stress and enhancing overall satisfaction with their studies.

Broad Geographical Reach

Online learning eliminates geographical barriers, allowing students to access education from anywhere and at any time (Iloanusi, 2007). Individuals can earn qualifications from distant institutions without needing to relocate, supporting learning alongside other commitments. This broad reach means students can download materials and study at their convenience, reducing the pressures of classroom attendance and note-taking. The integration of multimedia elements such as images, videos, and audio in learning content enhances motivation and retention (Muibi, 2022). As a result, online learning provides flexible access to education, making it possible for a wider population to participate in advanced study.

Challenges Faced in Integrating AI-Powered Tools in ODL Institutions

First, students face significant challenges in understanding machine learning (ML) concepts, particularly advanced techniques like neural networks. Limited access to real-world datasets and high computational requirements hinder practical application, while inadequate infrastructure and difficulty interpreting ML results further slow progress (Ajiye & Omokhabi, 2025). Second, natural language processing (NLP) introduces hurdles due to the complexity of frameworks such as NLTK and SpaCy. Language diversity, biases in pre-trained models, and limited practical projects complicate student learning. Customising NLP solutions for specific needs remains a persistent difficulty (Ajiye & Omokhabi, 2025). Third, integrating computer vision requires advanced hardware, such as GPUs, which are often unavailable. Large datasets cause storage issues, and understanding convolutional neural networks is challenging. Lack of domain-specific support further impedes project development (Ajiye & Omokhabi, 2025).

Fourth, robotics presents cost barriers, as purchasing kits and components is expensive. Limited access to laboratory facilities and mentorship restricts hands-on experimentation, making it difficult for students to integrate robotics, AI, and IoT effectively (Ajiye & Omokhabi, 2025). Fifth, expert systems are often neglected due to perceptions of being outdated. Students struggle to design rule-based systems for dynamic environments and lack user-friendly tools, resulting in difficulty finding real-world applications for their studies (Ajiye & Omokhabi, 2025). Sixth, reinforcement learning (RL) is challenging due to its abstract concepts and high computational demands. Simulating real-world scenarios is difficult without advanced software, and beginners often lack accessible resources to develop RL projects (Ajiye & Omokhabi, 2025).

Seventh, ethical considerations in AI are frequently overlooked in curricula. Students struggle to identify and mitigate biases, ensure fairness, and align projects with ethical standards due to limited exposure and guidance on responsible AI development (Ajiye & Omokhabi, 2025). Eighth, the rapid evolution of AI development tools and frameworks like TensorFlow and PyTorch creates a steep learning curve. Compatibility and integration issues arise, and inadequate institutional support forces students to rely on self-learning (Ajiye & Omokhabi, 2025). Ninth, broader institutional barriers include insufficient hardware, software, and internet access, as well as a shortage of skilled faculty. Financial and psychological constraints, alongside outdated curricula, limit students' ability to fully engage with AI in ODL contexts (Ajiye & Omokhabi, 2025).

Strategies for Adoption of AI Components in Teaching and Learning in ODL Institutions

The adoption of Artificial Intelligence (AI) in education offers tremendous potential to enhance teaching and learning processes. However, implementing AI effectively requires a well-thought-out strategy that addresses technological, pedagogical, and organizational challenges. This document outlines comprehensive strategies for adopting key AI components, including adaptive learning systems, intelligent tutoring systems, automated grading systems, chatbots and virtual assistants, and learning analytics tools.

The first is adaptive learning systems, which customize learning content to meet individual students' needs. To implement such systems effectively: *Pilot Testing***,** which begins with a pilot program involving a small group of students or a specific department. This allows institutions to identify potential challenges and adjust before full-scale implementation. The second is **c**urriculum integration**,** which ensures the system aligns with the institution's curriculum and learning objectives. Collaborate with content developers to create or adapt resources for use within the platform. Third is professional development, which trains educators on how to use adaptive platforms, interpret student data, and adjust teaching methods accordingly. Fourth is planning for scalability by assessing technical infrastructure and student capacity to ensure smoothexpansion.

Second, Intelligent Tutoring Systems (ITS) simulate one-on-one tutoring experiences, providing personalized feedback and guidance. This has helped in developing high-quality, curriculum-aligned content for the system. This ensures that tutouring aligns with institutional goals and enhances learning outcomes; encourages students and teachers to provide feedback on system performance to refine its effectiveness; maintains teacher involvement to supervise the tutoring process and address complex issues that require human judgment; and regularly updates the ITS to incorporate new learning methodologies and address any gaps identified through user feedback.

Third, automated grading systems save time and improve grading consistency. Effective adoption involves: Start by automating grading for objective assessments such as multiple-choice and fill-in-the-blank questions. Gradually incorporate subjective assessments, such as essays, as the system's capabilities improve; establish a process where teachers review automated grades to ensure fairness and accuracy, particularly in subjective evaluations; regularly audit the grading algorithms to detect and address any biases that may affect student outcomes; and ensure that all student data processed by the system is encrypted and complies with relevant data protection regulations.

Fourth, AI-powered chatbots can provide instant assistance to students and staff, streamlining communication and support services. Clearly define the chatbot's role. It could handle administrative queries (e.g., course registration, schedules) or academic support (e.g., answer course-related questions); tailor the chatbot to the institution’s specific needs and integrate it with existing platforms like learning management systems; ensure the chatbot operates round-the-clock to assist students in different time zones or during off-hours; and continuously improve chatbot performance based on user feedback and emerging requirements.

Fifth, learning analytics tools provide insights into student performance and help educators make data-driven decisions: Establish clear policies on data privacy and usage to ensure compliance with legal and ethical standards; train teachers and administrators to interpret analytics dashboards and apply insights to enhance teaching strategies; use predictive analytics to identify at-risk students early and implement targeted interventions to support them; and foster collaboration between educators and administrators to use analytics effectively for curriculum planning and institutional improvements.

Sixth, engaging all stakeholders is critical for successful AI adoption: Involve teachers in selecting and testing AI tools to ensure they meet pedagogical needs. Highlight the benefits of AI, such as reduced workload and improved teaching outcomes, to gain buy-in; organize workshops and tutorials to familiarize students with AI tools and demonstrate their value in enhancing learning experiences; and collaborate with AI solution providers to customize tools for the institution’s specific requirements and ensure long-term support.

Seventh, providing adequate training is crucial for both faculty and students: conduct regular training sessions on using AI tools and understanding their capabilities; create and share user-friendly guides, video tutorials, and FAQs to support ongoing learning; and establish a helpdesk or dedicated support team to address technical issues and provide assistance during the adoption phase.

Eight, institutions should implement robust mechanisms to evaluate the effectiveness of AI adoption. Key Performance Indicators (KPIs) define metrics such as student engagement, academic performance, and teacher satisfaction to measure success; collect regular feedback from users to identify challenges and areas for improvement; and stay updated on advancements in AI technology and refine strategies to maximize benefits.

Conclusion and Policy Prescriptions

With the above analysis and discussion, integrating AI-powered tools into open and distance education has been identified as a viable and cost-effective way to promote education for all people in Nigeria in the digital age. It is clear, therefore, that progress in open and distance learning requires digital skills, literacy and competence on the part of teachers and learners to negotiate teaching and learning experiences as well as prepare for full social participation in the post-digital world. Basically, it is about promoting education for all and providing people with opportunities to develop their capacities, enrich their knowledge and improve their professional or technical qualifications through updated knowledge on AI-driven education and enhanced study programs in open and remote practice.

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