INTEGRATION AND UTILISATION OF ARTIFICIAL INTELLIGENCE SYSTEMS IN OPEN AND DISTANCE ELEARNING INSTITUTIONS IN NIGERIA: CHALLENGES AND SUSTAINABLE SOLUTIONS

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Abstract
This paper examined the challenges of artificial intelligence (Al) integration and utilisation in Open and Distance eLearning (ODeL) systems in Nigeria and proposed sustainable solutions. Existing scholarly literature had largely focused on the benefits of Al in ODL systems in Nigeria, with limited attention devoted to examining the challenges and the proposition of sustainable solutions for addressing them. This paper was written to fill this knowledge gap. Using conceptual and narrative literature synthesis with appropriate theoretical framework, this paper discussed the conceptual overview of ODeL, conceptual overview of Al systems, major AI tools relevant in ODeL institutions in Nigeria, key challenges in Al integration and utilisation in ODeL systems in Nigeria, and the sustainable solutions to address the identified challenges. It was concluded that the sustainable integration of AI in Nigerian ODeL systems requires multiple interventions and initiatives The paper subsequently made implementable recommendations to mitigate the challenges.

Keywords: *Artificial intelligence systems, Open and distance eLearning, Challenges, Sustainable solutions, Learning management systems*

Introduction

Globally, Open and Distance eLearning (ODeL) has been fundamentally driven by the application of technologies which constituted its operational backbone. In other words, application of technological tools application has been the livewire of ODeL practice and programme delivery right from its

emergence as correspondence education. Prior to 2001, literature didn't sufficiently document systematic technological framework for understanding the evolution of ODL until James C. Taylor proposed a five-generation technological framework that conceptualised the progress development of ODL technologies which were:

i. The first generation ODeL, which was in correspondence, between 1850s – 1960s predominantly made used of print technology such as printed study material, postal services, and self-instructional manuals.
ii. The second generation between 1960s -1980s made use of multimedia technology comprising print combined with radio, television, audio cassettes, and video tapes.

iii. The third generation between 1980s -1990s made used of telelearning technology such as audio conferencing, video conferencing, teleconferencing, telephone tutoring, and interactive television. iv. The fourth generation between mid-1990s -2001 made use of internet-based flexible learning such as Learning Management Systems (LMS), e-learning, email, discussion forums, be-based learning, online libraries, virtual classrooms, and multimedia web content.

v. The fifth generation 2010s till date made use of intelligent flexible learning comprising Open Educational Resources (OER), Massive Open Online Course (MOOC), mobile learning, and personalised learning, among others. Taylor's model clearly shows that without technological infrastructure, ODeL would lack the flexibility, scalability, and accessibility that define its global relevance.

Although Taylor's fifth generation pointed to increasing intelligence and automation in ODL, the emergence of contemporary artificial intelligence (Al), generative Al, adaptive learning systems and learning analytics has introduced technological capabilities that extend substantially beyond the technologies envisaged in his original framework. Therefore, Al is conceptualised as a post-Taylor or sixth-generation development in the continuing technological evolution of ODL. The rapid deployment of Al to all human endeavours necessitated its extension to the education industry in general and ODL in particular.

The cardinal reasons justifying Al integration in ODeL included:
(i) The rapid shift to online and blending learning mode in ODeL practice demonstrated that Al is inevitable to the continuity of ODeL systems all over the world (Ojokheta & Omokhabi, 2023).

(ii) The Beijing agreement, otherwise known as *Beijing Consensus on AI and Education*, submitted that "Artificial Intelligence has the potential of reshaping the core foundations of teaching, learning and research and also has the potential to address some of the biggest challenges in education today, innovate teaching and learning practices, and ultimately accelerate the progress towards Sustainable Development Goal 4 (UNESCO, 2019).

(iii) The submission of the Commonwealth of Learning [CoL], (2023) that "globally, AI has become the new trend of technology in the education sector and competitively changing learning environment", and

(iv) The multidimensional advantages of the application of AI in education compiled by UNESCO (2019).
Based on the above justifications, many empirical studies had been conducted as well as theoretical papers written justifying the integration and utilisation of Al in ODeL systems, particularly within the Nigerian context. However, these studies and theoretical papers significantly looked at the opportunities and benefits of Al integration and utilisation in ODeL system with limited attention to the challenges of such integration, utilisation and sustainable solutions to the challenges. Arising from this knowledge gap, this paper discussed the major challenges of the integration and utilisation of Al in ODeL system in Nigeria and proposed sustainable solutions for addressing the challenges.

Literature Review of Related Concepts

Conceptual Definitions and Components of Open and Distance Learning (ODL)

Many definitions of ODeL provided by scholars exist in literature. The most common cited definitions are: Open and Distance Learning is the provision of educational opportunities that remove barriers to learning such as age, geographical location, disability, employment, and prior qualifications. "Open" denotes flexibility in access, admission, learning

pace, place, and time, while "distance learning" refers to teaching and learning where teachers and learners are separated by time and/or place but connected through appropriate communication technologies and learner support systems (Commonwealth of Learning (COL) (revised 2020).

In a similar definition, ODeL is perceived as an educational approach that uses digital technologies, multimedia resources, online platforms, and learner support services to provide equitable, inclusive, and lifelong educational opportunities irrespective of learners' physical location (UNESCO 2021). The cardinal synthesis of these definitions is that ODeL, according to Maphosa and Bhebhe (2020), should not merely be understood as geographical separation between learners and teachers but as an educational philosophy built upon openness, flexibility, inclusiveness, lifelong learning, and equitable access. Invariably, the concept of openness includes flexible admission policies, learner-centred curriculum design, flexible assessment, and diversified instructional delivery.Another form of synthesis of these foregoing definitions, and many others, can be summed up thus: ODeL is a flexible, technology-enabled educational system that provides equitable access to quality learning through the integration of digital technologies, online communication, learner-centred pedagogy, comprehensive learner support services, and institutional flexibility, enabling learners to study regardless of geographical, temporal, or social constraints. Some recent literature such as Aderinoye and Ojokheta, (2020), Moore, (2020), and Commonwealth of Learning (2020), have documented the critical components which determine the effectiveness of modern ODeL systems as follows:

i. *Openness and Flexible Access* - The cardinal characteristic of ODeL is openness. Modern ODeL institutions provide flexible admission requirements, multiple entry and exit opportunities, recognition of prior learning, flexible study schedules, among others. This enables many people including working adults, women, persons with disabilities, learners based in rural areas, and other disadvantaged populations to participate in greater dimension in ODeL programmes.

ii. *Technology-Enabled Teaching and Learning* – In the 21st century ODL,teaching and learning are substantially facilitated through Learning Management Systems (LMS), Video Conferencing Platforms, Virtual

Classrooms, Mobile Learning Applications, Cloud-Based Learning Environments, Digital Libraries, Open Educational Resources (OER) and Massive Open Online Courses (MOOCs). These technologies enable synchronous learning (where teacher and learners participate in learning activity at the same time, although they are physically located in different places) and asynchronous learning (where teacher and learners do not need to participate at the same time) while improving accessibility and learner engagement.

iii. *Learner-Centred Pedagogy* - Modern ODeL adopts learner-centred instructional approaches that encourage self-directed learning, collaborative learning, problem-solving, personalised learning, and lifelong learning. Rather than merely transmitting knowledge, instructors function as facilitators, mentors, and learning designers.

iv. *Digital Learning Resources* - High-quality digital learning materials constitute one of the most important components of ODeL. These include self-instructional modules, interactive e-books, recorded lectures, podcasts, educational videos, multimedia simulations, Open Educational Resources (OER), and virtual laboratories. These resources enable independent and flexible learning.

v. *Student Support Services* – These services, which are a cardinal determinant of students retention, are highly important tosuccessful ODeL programmes globally. The 21st century student supports includes academic advising, academic counselling, technical support, digital library services, career guidance, online tutoring, help desk services, mental health support, administrative support, and AI-powered chatbots.

vi. *Interactive Communication Systems* – Efficient modern ODeL system requires continuous interaction, which enhances engagement, collaboration, and learner satisfaction, among learners, tutors, academic advisers, and institutions using the following email, discussion forums, social media, instant messaging through WhatsApp, video conferencing, learning communities, and virtual classrooms.

vii. *Assessment and Feedback Systems* – Twenty-first-century ODeL systems require diverse assessment methods, including continuous

computer-based testing, online examinations, electronic assignments, portfolio assessment, AI-assisted assessment, automated quizzes, and timely and constructive electronic feedback for improved learning outcomes.

viii. *Quality Assurance* – Twenty-first-century ODeL institutions always aspire to improve quality through curriculum review, instructional design standards, faculty development, accreditation, learners satisfaction, continuous monitoring and evaluation, and institutional performance. Thus,quality assurance helps ensure equivalence between ODeL and conventional higher education institutions.

ix. *Institutional Management and Governance* - Twenty-first-century ODeL institutions require strong institutional leadership to facilitate innovation and institutional sustainability through strategic planning, policy implementation, sustainable funding, staff development, digital governance, ICT infrastructure, data management, and cybersecurity.

Conceptual Definitions and Characteristics of Al Systems

Artificial Intelligence (AI), as a domain of academic study, was created at a workshop that took place in the summer of 1956 at Dartmouth College in America, and the participants in that workshop, who later became the pioneers of Al research for decades to come, anticipated that a machine equal in its capabilities to the human would emerge in just one generation (Moor, 2006). Large Language Models (LLMs), which include artificial intelligence (Al) systems, are trained on massive quantities of text data to comprehend, synthesize, analyze, translate, and respond to human language. These Al models are designed based on deep learning techniques and especially the transformer model, allowing them to accomplish various natural language processing (NLP) tasks (Brown, Mann, Ryder, et al. 2020, & Zhao, Zhou, Li, et al. 2023).

Given a set of human-oriented goals, AI can make predictions, recommendations, or decisions that may impact either real or virtual worlds (Vincent-Lancrin & van der Vlies, 2020). They can accomplish tasks that demand human intelligence (Rossi, 2019). In simple words, AI refers to a term used commonly for machines that perform cognitive tasks in a human

way, including learning, comprehending, reasoning, and communicating (Baruffaldi, et al, 2020).

Artificial intelligence (AI), being the leading digital technology in the Fourth and upcoming Fifth Industrial Revolutions, has been described in different ways by many scholars: Al consists of computers that can "think" like humans, and have the ability to recognize patterns, analyze data, deduce conclusions and give advice (Zhang, Zhang, & Li, 2019). Russell and Norvig, (2021) describe AI as the science of studying intelligent agents that have the capability to perceive its environment and undertake actions that increase its possibilities of accomplishing its desired objectives.

According to the Organisation for Economic Co-operation and Development [OECD] (2019), an AI system refers to a machine-based system that can make decisions, recommendations, or predictions with regard to either real or artificial environments. This definition of AI has been embraced extensively in the field of AI governance and business policies. According to Nwadiani, (2025), AI can be referred to as digital technology used in enabling computer systems to mimic human intelligence through problem-solving and decision-making processes in businesses.

From the above definitions, it can be concluded that artificial intelligence involves the capacity of computing systems and software applications to emulate human intelligence through learning from data, pattern recognition, understanding of languages, problem solving, prediction, and assist in decision making processes in order to enhance organizational performance and efficiency. The major characteristics of AI systems include the following:

i. *Learning Capability* - The capabilities of AI systems include acquiring knowledge from experience, data, and user interactions without the need to program them for all tasks. This improvement in performance is made possible through the use of machine learning and deep learning techniques (UNESCO, 2021; OECD, 2022; Wang et al., 2024).

ii. *Reasoning and Problem-Solving* - AI systems analyse information, identify relationships, evaluate alternatives, and generate logical solutions to complex problems. This enables them to support decision-making in

education, healthcare, finance, and business (UNESCO, 2021 & Russell & Norvig, 2021).

iii. *Decision-Making* - According to the OECD, AI systems generate predictions, recommendations, or decisions that influence physical or virtual environments. Decision-making is therefore a defining characteristic of AI systems (OECD, 2022).

iv. *Autonomy* – ModernAI systems operate with varying degrees of autonomy, requiring little or no continuous human intervention after deployment. The level of autonomy varies according to the AI application (Ojokheta, Omokhabi, Fashogbon, & Osu, 2025).

v. *Perception* - AI systems perceive their environments using data collected from text, images, audio, video, sensors, cameras, and other digital inputs. They recognise patterns and interpret information before taking action (UNESCO, 2021).

vi. *Knowledge Representation* - AI systems organise and represent knowledge in ways that support reasoning, inference, planning, and intelligent decision-making. Knowledge representation enables AI to solve complex problems efficiently (UNESCO, 2021).

vii. *Automation* - AI automates repetitive, time-consuming, and routine tasks, thereby improving efficiency, productivity, consistency, and accuracy.Examples include automated grading, chatbots, document processing, scheduling, and learners support (Ojokheta, &Odusanya, 2023).

viii. *Personalisation* - AI analyses users' behaviours, preferences, and performance to provide personalised recommendations, adaptive instruction, and customised services.In ODL, AI can help to personalise learning pathways, feedback, tutoring, assessment, andlearner support (Russell & Norvig, 2021).

ix. *Robustness and Reliability* - AI systems can operate consistently under different conditions while remaining resilient to errors, cyberattacks, bias, and unexpected inputs. Robustness is regarded as a key characteristic of trustworthy AI (Chan, 2023).

Theoretical Framework

This paper was anchored on two theories because they substantially explain the complexity of AI adoption in ODL They are: The *Technology–Organisation–Environment (TOE) Framework* developed by Tornatzky and Fleischer in 1990 and the *Resource-Based View Theory* developed by Barney in 1991. The Technology–Organisation–Environment (TOE) Framework explains why organisations adopt technological innovations by examining three interacting contexts: *Technological context* (Availability, compatibility, complexity, AI infrastructure, cybersecurity, interoperability), *Organisational context* (Leadership support, funding, staff competencies, institutional readiness, organisational culture), and *Environmental context* (Government policies, NUC regulations, competition, national ICT infrastructure, stakeholder expectations). This theory is most relevance to this paper because it provides the strongest and the most excellent theoretical framework for analysing AI integration in ODeL institutions, institutional barriers, policy challenges, and sustainable implementation strategies.

The second theory considered most appropriate for this paper is the Resource-Based View Theory developed by Barney in 1991. The theory argues that organisations achieve sustainable competitive advantage by possessing and effectively deploying valuable, rare, inimitable, and non-substitutable (VRIN) resources. In modern business systems, Al has evolved into a strategic resources to improve efficiency and productivity. If combined with skilled employees, organisational knowledge, data, and supportive leadership, Al will enable organisations to improve efficiency, innovation, decision-making, and productivity. The relevance of this theory to the paper is denoted in terms of the deployment of Al as a strategic organisational assets, Al's contribution to operational efficiency and productivity, Al's role in creating competitive advantage, and the importance of organisational capabilities in successful al adoption.

Major AI Tools Relevant for Integration and Utilisation in ODL Institutions

Scholars, including Chan, (2023), Bali, et al. (2024), Ogunleye, et. al., (2024) and Oparaduru, & Uchendu, (2024), have extensively documented the relevant and applicable Al tools in ODeL programmes to enhance teaching, learning, learner support, assessment, quality assurance, and

institutional management. These tools are widely viewed as supporting ODeL programmes when implemented with appropriate human oversight. These Al tools include:

i. Teaching and Learning – The relevant Al tools for enhancing teaching and learning in ODeL include *ChatGPT, Google Gemini, Microsoft Copilot, Khanmigo, and Intelligent Tutoring Systems (ITS).* These tool can be used for lesson preparation, explanations, personalised learning, content generation, and classroom interaction.

ii. Students Support Services – The relevant Al tools for improving the provision of students support services in ODL include *Al chatbots, Virtual Assistants, IBM Watson Assistant, Google Dialogflow, and Microsoft Copilot Chat.* These tools can be used for all-today enquiries, admission support, registration guidance, academic advising, FAQs, and learners counselling.

iii. *Course Material Development* - The relevant Al tools for course material development in ODeL include *ChatGPT, Gemini, Copilot, Canva Magic Write, Gamma AI, and MagicSchool Al.* These tools can be used for writing course modules, lecture notes, presentations, quizzes, and multimedia learning resources.

iv. *Tutors' Guidance on Course Delivery* - The relevant Al tools for enhancing tutors' guidance on course delivery in ODeL include *ChatGPT, Gemini, Copilot, MagicSchool AI,* and *Teachally.* These tools can be used for lesson planning, teaching strategies, discussion questions, learning activities, and instructional design.

v. *Assignment Writing Support* - The relevant Al tools for supporting assignment writing in ODeL include *ChatGPT, Gemini, Copilot, Grammarly, QuillBot, andElicit.* These tools can be used for brainstorming, literature searches, outlining, proofreading, paraphrasing, and referencing (with academic integrity policies).

vi. *Marking Students' Scripts* - The relevant Al tools for marking students' scripts in ODeL include *Gradescope, Turnitin Feedback Studio, and AI-assisted LMS grading tools*. These tools can be used for automated

marking, rubric-based grading, plagiarism detection, and feedback generation.

vii. Assessment of Students' Examination Performance - The relevant Al tools for assessment of students' examination performance in ODeL include *Learning Analytics Dashboards, Predictive Analytics Systems, and Intelligent Assessment Systems.* These tools can be used for performance analysis, identification of at-risk learners, competency analysis, and trend reporting.

viii. *Feedback to Learners* - The relevant Al tools for disseminating feedback to leaners on their academic performance in ODeL include *ChatGPT, AI chatbots, Intelligent Tutoring Systems, and LMS AI assistants.* These tools can be used for instant formative feedback, explanations, revision guidance, personalised recommendations.

ix. *Monitoring and Evaluation of Learning* - The relevant Al tools for monitoring and evaluation of learning in ODeL include *Learning Analytics, Moodle Analytics, Blackboard Analytics, Canvas Analytics, and Power BI with AI*. These tools can be used for learner engagement tracking, progress monitoring, retention analysis, and intervention alerts.

x. *Institutional Performance Management* - The relevant Al tools for ensuring institutional performance management include AI Business Intelligence tools, Power BI AI, Tableau AI, Predictive Analytics, and ERP with AI. These tools can be used for Institutional planning, enrolment forecasting, quality assurance, resource allocation, and decision support.

Key Challenges in the Integration and Utilisation of Al in ODL Systems in Nigeria

From the above literature review on Al and its applicable tools in ODeL, it can be deduced that Al and technological tools support personalised learning, early identification of at-risk students, intelligent tutoring systems, automated grading, student performance prediction, adaptive learning pathways, and institutional decision-making. In overall, AI significantly enhances learner engagement, student support, and institutional effectiveness.

Nevertheless, several institutional, technological, pedagogical, ethical, and socio-economic challenges continue to hinder its effective adoption. Furthermore, the effective integration and utilisation of Al in ODeL systems in Nigeria is confronted with multiple challenges. For instance, in supporting this claim, Bali, et. al (2024), Oparaduru & Uchendu, (2024), Abubakar, Onasanya, & Ibrahim, (2024), and Luwoye, et. al (2024) documented the cardinal challenges as including:

i. *Inadequate Digital Infrastructure* - Many Nigerian ODeL institutions experience unreliable electricity supply, poor internet connectivity, inadequate bandwidth, limited cloud computing facilities, and insufficient AI-enabled hardware. These infrastructural deficiencies reduce the effectiveness of AI-powered learning platforms, virtual classrooms, intelligent tutoring systems, and automated assessment tools.

ii. *High Cost of AI Technologies* - The acquisition, deployment, maintenance, and upgrading of AI software, learning management systems, cloud services, and computing infrastructure require substantial financial investment. Many Nigerian ODeL institutions operate under limited budgets, making large-scale AI adoption difficult.

iii. *Inadequate AI Knowledge and Digital Competencies among Academic* ***Staff*** - Many lecturers lack adequate AI literacy, digital pedagogical skills, and technical competence to integrate AI effectively into online teaching, learner support, assessment, and course design. This skills gap limits successful implementation.

iv. *Insufficient Professional Development and Training* - Continuous professional development programmes on AI remain inadequate in many institutions. Without regular training, educators cannot effectively utilise intelligent tutoring systems, adaptive learning platforms, predictive analytics, or generative AI applications.

v. *Weak Institutional Policies and Governance Frameworks* - Many Nigerian higher education institutions, including ODeL institutions, lack comprehensive AI policies governing ethical use, academic integrity, privacy, intellectual property, accountability, and responsible AI implementation.

vi. *Ethical, Privacy and Data Security Concerns* - AI systems collect and analyse large volumes of learner data. Concerns relating to data privacy, cybersecurity, algorithmic bias, informed consent, surveillance, and confidentiality discourage widespread adoption.

vii. *Academic Integrity Challenges* - The widespread availability of generative AI tools raises concerns regarding plagiarism, contract cheating, AI-generated assignments, examination malpractice, and reduced originality in students' work. ODeL institutions face increasing challenges in maintaining assessment credibility.

viii. *Digital Divide among ODeL Students* - Many ODeL students, particularly those in rural and underserved communities, lack reliable internet access, digital devices, and affordable data subscriptions. This inequality limits equitable access to AI-enhanced learning opportunities.

ix. *Resistance to Technological Change* - Some academic staff and administrators remain reluctant to adopt AI because of fears of job displacement, lack of confidence, perceived complexity, and uncertainty about AI's educational value. Such resistance slows institutional transformation. Moreover,successful AI implementation requires continuous technical support, software updates, cybersecurity management, and system maintenance. Many ODeL institutions in Nigeria face shortages of qualified ICT and AI specialists.

x. *Limited Government Funding and Policy Suppor**t*** - Although Nigeria has introduced initiatives to encourage digital transformation, sustained funding, national AI implementation frameworks for higher education, and institutional support remain inadequate for large-scale AI integration in ODeL.

Key Sustainable Solutions to Overcome the Challenges

The most sustainable solutions that will help overcome the above-mentioned challenges of integrating and utilising AI-based systems in ODeL practice are:

i. *Development of Long-Term AI Strategic Plans by ODeL Institutions* - Each ODeL institution should prepare a five- to ten-year AI strategic plan

with clear objectives, implementation phases, funding mechanisms, performance indicators, and sustainability measures aligned with *institutional goals.*

ii. Strengthening Institutional AI Governance - Every ODeL institution in Nigeria should develop ethical guidelines covering fairness, transparency, accountability, human oversight, bias mitigation, explainability, andresponsible use of generative AI.

iii. *Building AI Competencies of Academic Staff* - Continuous professional development should be provided to lecturers, tutors, instructional designers, librarians, ICT personnel, and administrators on generative AI, prompt engineering, AI-assisted teaching, AI-supported assessment, learning analytics, and AI ethics.

iv *Improving Students' AI and Digital Literacy* - ODeL institutions should integrate AI literacy into orientation programmes and curricula to enable students to use AI responsibly for learning, research, problem-solving, and innovation while avoiding plagiarism and academic misconduct.

v. *Expanding AI-Powered Student Support Services* – ODeL institutions should deploy AI to provide virtual academic advising, career guidance, mental health support, and multilingual learner support to ODL students.This will improve learner engagement, satisfaction, and retention.

v*i. Development of Al-powered Monitoring Mechanism* – ODeL institutions should developed Al powered mechanism forregular monitoring which should concentrate on assess AI adoption rates, learning outcomes, student satisfaction, institutional efficiency, return on investment, andpolicy implementation. Findings from the monitoring exercise should inform continuous improvement of ODeL institutions in Nigeria.

Implications of AI Integration and Utilisation for Key ODeL Stakeholders

The integration and utilisation of Artificial Intelligence (AI) in ODeL have significant implications for the diverse key stakeholders such as:

i. *ODeL students* – It will improve learners engagement, motivation and academic performance.Recent systematic reviews show that AI-supported

personalised learning can improve learner engagement, motivation, academic performance and learning outcomes (Luo et al., 2025). Furthermore, AI-supported feedback can provide learners with timely information about their performance and areas requiring improvement, while learning analytics can assist institutions in identifying patterns of participation and academic performance for more responsive interventions.

ii. *Tutors/academic staff* – Through Al, tutors can be assisted with content development, assessment, feedback and learner support.

iii. *ODeL institutions* – The integration and utilisation of Artificial Intelligence (AI) can enhance the quality, flexibility and effectiveness of Open and Distance eLearning (ODeL) by supporting personalised and adaptive learning, strengthening teaching, assessment and learner-support services through intelligent tutoring, automated formative assessment, feedback generation, learning analytics and assistance with the development of instructional materials (Adewale et al., 2024). This becomes valuable in ODeL, where learners often study independently and have diverse learning needs.

iv. *Regulatory bodies such as NUC* – Al will help promote stronger mechanisms for monitoring, quality assurance and accreditation.

v. *Federal and State Ministries of Education* – Al will help in developing appropriate standards, guidelines and funding priorities. Moreover, it will help improve the scalability, responsiveness and efficiency of ODeL operations by supporting large numbers of learners, strengthening data-informed decision-making and facilitating continuous academic and administrative support.

vi. *Employers and the labour market* – Employment of graduates with AI-related competencies will be more enhance in the labour market.
vii. *Society and the wider economy* – Al will help in expanding educational opportunities, productivity and human-capital development.

Conclusion

Artificial Intelligence (AI) has substantially redefined the landscape of Open and Distance eLearning (ODeL) by creating opportunities to enhance

teaching and learning, develop digital learning resources, personalise learner support, strengthen assessment and feedback, improve institutional administration, and promote evidence-based decision-making. However, the sustainable integration and utilisation of AI in Nigerian ODeL institutions cannot be achieved with the existence of inadequate infrastructure, limited digital and AI competencies, concerns about academic integrity and data protection, ethical challenges, and the absence of comprehensive national standards for AI-enabled ODeL. Addressing these challenges requires coordinated action by the Federal Ministry of Education, the National Universities Commission (NUC), and ODeL institutions, with the Ministry providing a national policy and standards framework, the NUC establishing appropriate quality assurance, accreditation guidelines and benchmarks, and institutions developing institutional-wide governance structures, infrastructure, human capacity, and monitoring mechanisms for responsible AI utilisation. Consequently, Nigeria's ability to harness AI for ODeL will depend on moving towards a coherent, quality-assured, ethical, inclusive, and institutionally embedded approach that aligns AI adoption with national educational priorities and the needs of ODeL learners. When strategically and responsibly utilised, AI can become a transformative instrument for improving the quality, accessibility, effectiveness, and sustainability of ODeL in Nigeria.

The following recommendations are put forward which every ODeL institutionsmust implement to ensure effective integration and utilisation of Al in Open and Distance eLearning (ODeL) system in Nigeria

i. Composition of experts to develop national standards for Al integration in ODeL - The Federal Ministry of Education in Nigeria should constitute a multidisciplinary panel of experts to develop national framework for the integration of Al in ODeL, providing standardised guidelines for ethical use, academic integrity, data protection, assessment, quality assurance and institutional accountability.
ii. Development of NUC standards and benchmarks for Al adoption in ODeL – The National Universities Commission (NUC) should develop and institutionalise comprehensive quality assurance standards, accreditation guidelines and performance benchmarks for the adoption and utilisation of Al in universities offering ODeL programmes. These regulatory instruments should provide clear

criteria for evaluating Al infrastructure, digital learning resources, staff and learners competencies, Al-enabled teaching and assessment, academic integrity and institutional readiness for sustainable Al adoption.

iii. Institutional Strategies for Sustainable Al integration and utilisation in ODeL - ODeL institutions should develop institution-wide strategies for sustainable Al integration across teaching, learning, assessment, learner support, research, administration and institutional development. This requires clear Al governance policy, adequate digital infrastructure, continuous capacity building and alignment of Al applications with curriculum objectives, academic integrity, accessibility, learners needs and data protection. Regular monitoring and evaluation should be instituted to ensure responsible, effective, ethical and sustainable Al utilisation that enhances the quality and resilience of ODeL institutions in Nigeria.

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