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**Addressing Barriers to Artificial Intelligence- Enhanced Instruction Delivery Among  
Mathematics Lecturers in Nigeria: A Scoping Review for Educational Innovation**

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### Abstract

The integration of Artificial Intelligence (AI) into Nigerian higher education has transformative power on the landscape of teaching and offers potent tools for enhancing instruction delivery and learning outcomes. However, Mathematics lecturers face significant barriers in adopting AI-enhanced instruction. This scoping review identifies the challenges and potential solutions. Four research questions guided the study and through theories of diffusion of innovation (DIT) alongside technological pedagogical content knowledge (TPACK), it reviewed relevant literature from peer-reviewed journals, conference proceedings, and policy reports on AI in higher education and Mathematics instruction in Nigeria. Insights from this study would be of critical importance to educational policymakers, institutional administrators, and lecturers themselves, as it would provide a roadmap for scaling AI-enhanced teaching innovations in Mathematics Departments. The study identified that technical challenges, pedagogical resistance, institutional limitations, and attitudinal barriers could be overcome through the implementation of national education policies establishing institutional AI support centres for lecturers; incorporating AI training in pre-service and in-service teacher education; and facilitating AI-enhanced curriculum development and review. It concluded that AI serves as a valuable resource for guiding educational innovation and helping institutions to improve teaching quality, address barriers, and enhance students' learning outcomes in Mathematics. It recommends among others that higher education institutions should invest heavily on digital infrastructure, frequent training programmes for lecturers, and institution-based policies that encourage the adoption of AI technologies while maintaining the core values of traditional teaching.

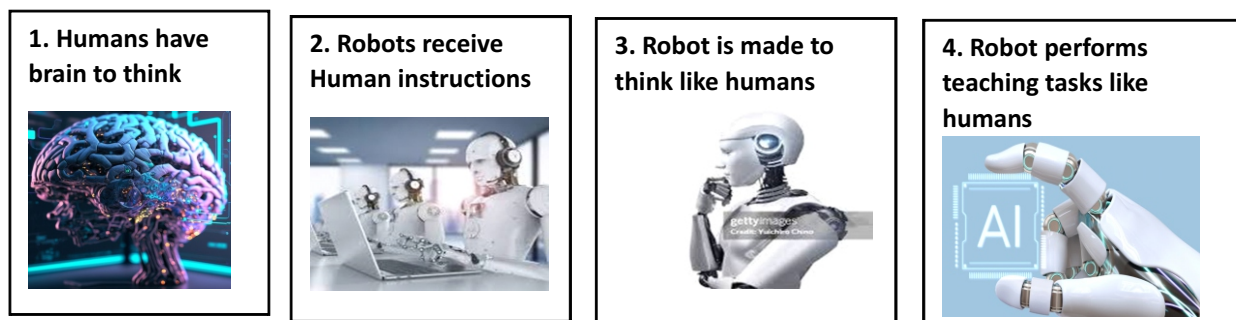
*Keywords: Artificial intelligence, barriers, educational-innovation, mathematics-lecturers, scoping-review.*

## Addressing Barriers to Artificial Intelligence- Enhanced Instruction Delivery Among Mathematics Lecturers in Nigeria: A Scoping Review for Educational Innovation

Artificial Intelligence (AI) has been increasingly prevalent in offering tools that promise personalized Mathematics instruction, automated grading, and intelligent tutoring insights into students' performance. As labeled by Mohammed and Shehu (2023) AI was created to simulate the human mind to make computers think and act like humans by performing learning tasks and problem-solving. In the same line of thought, Morohunfola (2024) termed it the ability of a computer-controlled machine to perform tasks done by intelligent humans, while Ndunagu (2021) saw it as a branch of science that deals with helping machines to resolve complex problems in a more human-like fashion. Hence, it would be considered in this review as the ability of computer programs and robots to execute cognitive tasks usually associated with human intelligence. AI is now better equipped with unlimited content that assists Mathematics lecturers with real-time feedback, providing problem-solving scenarios that appeal to students' demands and skills (Adeola *et al.*, 2023). It faces many mathematical challenges while delivering instruction in optimization, generalization, and model interpretability.

### Figure 1

*AI Using Artificial Human Body and Intelligence*



Source: Thompson (2022).

Despite these aided opportunities, Mathematics lecturers in Nigeria still face notable technical challenges, pedagogical resistance, institutional limitations, attitudinal factors, limited infrastructural provisions, hostile educational policy, cultural diversity, high cost of electricity

supply, unstable internet connectivity, non-availability of computing resources, and insufficient access to AI tools. These instructional roadblocks have prevented them from effectively adopting AI-enhanced instruction (Ogunode & Abubakar, 2021), in the 2020s when AI ultimately developed in Nigeria (Olaleye *et al.*, 2023). The Federal government of Nigeria has made a giant stride towards harnessing the AI issues. Following the creation of the Cross River State Ministry of Robotics and Artificial Intelligence in 2019, which empowered and fully equipped the youths towards the Fourth Industrial Technological Revolution, the Federal government of Nigeria invested in AI development through the creation of the National Centre for Artificial Intelligence and Robotics (NCAIR), which was commissioned in Abuja on the 13th of November 2020 (Effoduh, 2021). Through the activities of this center, several government agencies have emerged to issue mandates that would advance and regulate the use of AI across Nigeria. These agencies include: The National Information Technology Development Agency (NITDA), the National Office for Technology Acquisition and Promotion (NOTAP), the Nigerian Communications Commission (NCC), the Federal Ministry of Communications and Digital Economy (FMCDE), the Federal Ministry of Science, Technology, and Innovation (FMSTI), National Board for Technology Incubation (NBTI), Securities and Exchange Commission (SEC), and Corporate Affairs Commission (CAC).

The establishment of these agencies is a step in the right direction of actualizing Section 18 (2) of the Nigerian constitution which stipulates the government's policy direction towards the promotion of science and technology (FRN, 1999). But amidst this determination, Thompson (2022) alleged that the emergence of these agencies is not enough to lead Nigeria toward a technological revolution because there is still no exclusive body of law that regulates AI in Nigeria. Rather, there are subsidiary legislations that serve in the short-term, which include the Start-up Act 2022 that streamlines the process of resource and fund gathering for start-ups; the Data Protection Act 2023 that complements the legal framework that aids impending regulation of AI by classifying and provide a legal context within which data rights are regulated; while the Advertising Regulatory Council of Nigeria Act (ARCON) 2022 issues mandatory license

requirement for content advertisers. The absence of a sole regulatory body overseeing AI adoption at the tertiary level makes it puzzling to holistically address emerging gaps in the delivery of Mathematics instruction. However, the complexity of mathematical problems and the need for a deeper understanding make AI adoption even more challenging (Adeoye *et al.*, 2022). In this study, the major barriers facing the use of AI in the delivery of Mathematics instruction in Nigeria tertiary institutions would be unlocked viz-a-viz strategic investments in infrastructure, targeted training programs, curriculum reform, ethical guidelines, and collaborative efforts involving policymakers, educational institutions, technology providers, and lecturers themselves.

Unlocking the gap in skill development calls for AI pedagogical integration into Mathematics curricula, which requires serious but intentional alignment with national educational standards and frameworks (Ogunlana *et al.*, 2021). It is believed that implementing AI pedagogies requires a shift in existing practices to lessen the resistance from lovers of traditional teaching methods (Akanbi *et al.*, 2022). For instance, the right channel of communication would motivate lecturers who think that AI is irrelevant to cultural contexts and may negatively impact traditional teaching methods (Ezeani *et al.*, 2022). Such culturally related attitude emanating from both urban and rural settings is seen as cultural-attitudinal factors influencing AI adoption, which highlights the importance of cultural orientation, consultation, and community engagement in promoting AI literacy and acceptance among lecturers (Onyema, 2021). In fact, the scoping review would be an invaluable tool for identifying key barriers and solutions, as it allows for a comprehensive overview of existing evidence on specific research questions.

A **scoping review** is a special type of literature review that focuses on mapping key concepts, evidence, and research gaps in a specific field. It explores broad topics and emerging research fields with fragmented evidence (Munn *et al.*, 2018). Unlike systematic reviews, which focus on answering specific, narrow research questions and evaluating study quality, it takes a more inclusive approach, aiming to provide an overview of existing literature without necessarily assessing methodological quality. Typically, it addresses general questions such as '*What are the barriers of AI?*' Or '*What types of solutions can the government provide?*' It often includes diverse

study designs and methodologies that capture the length and breadth of research. It maps the available literature, categorizing findings to identify themes, gaps, or emerging trends. It is commonly guided by frameworks like Arksey and O'Malley's five-step process (2005), which involves identifying the research question, selecting studies, charting data, and summarizing findings.

The study leveraged the Diffusion of Innovation Theory (DIT) (Everett-Rogers, 2003) as well as the Technological Pedagogical Content Knowledge (TPACK) model (Mishra & Koehler, 2006). Rogers, a sociologist, and a communication expert, explained that new technologies are adopted within a social system. Five key elements were identified: **Innovation** (new idea or technology); **Communication Channels** (how innovative information is disseminated); **Time** (the rate at which the innovation is adopted), **Social System** (the context in which the innovation is introduced); and **Adoption** (the decision to adopt or reject the innovation). Furthermore, five categories of adopters were identified, such as Innovators or first adopters (2.5%); early or quick adopters (13.5%); early majority or gradual adopters (34%); Late majority or cautious adopters (34%); and Laggards or last adopters (16%). The theory is useful in contexts like marketing, public health, education, technology, and organizational change, as evident in the work of Ogunode and Abubakar (2021), who examined how, why, and at what rate new technologies spread within a population and helped to understand how AI adoption occurs among lecturers, focusing on variables such as perceived usefulness, ease of use, and social influence.

Another model that relates to the mathematical adoption of AI is the Technological Pedagogical Content Knowledge (TPACK). Mishra and Koehler (2006) provided additional insights into how lecturers' knowledge and skills in both Mathematics and AI technologies interact to influence adoption decisions. This review would identify key barriers and help lecturers to better understand what needs to be addressed to make AI an effective part of their teaching toolkit. It will help universities and governments to make informed policy changes for professional development programs, helping institutions support their staff in transitioning to AI-enhanced teaching. For researchers, the review would highlight gaps in the current literature, offering a

foundation for future research on AI in education, particularly in Mathematics. The review was guided by the following research questions: *What are the barriers to AI-enhanced instruction concerning Mathematics education across tertiary institutions in Nigeria? How do government and privately owned universities vary in AI-enhanced instruction barriers concerning Mathematics education in Nigeria? What impacts do AI-enhanced instruction barriers have on the Teaching of Mathematics in Nigerian Universities? How can government and private universities overcome the barriers to AI-enhanced instruction in Mathematics education in Nigeria?*

### **1. Barriers to AI-Enhanced Instruction Concerning Mathematics Education Across Tertiary Institutions in Nigeria.**

**Technological Barriers: Delivery of AI enhanced instruction has been affected by limited access to infrastructure** in states with underdeveloped ICT infrastructure, reliable access to AI tools, high-speed internet, and power supply. For example, urban states like Rivers, Lagos and Abuja have better infrastructure but are still constrained by cost and overburdened systems. On the other hand, rural states like Zamfara and Ekiti experience severe infrastructural deficiencies. The technological barriers include *limited Access to AI tools* owing to the lack of necessary AI software, hindering lecturers' ability to integrate AI into their teaching practices in many Nigerian institutions. The cost of AI systems and software can be alarmingly expensive to acquire, especially for underfunded Nigerian institutions (Ogunode & Abubakar, 2021), as occasioned by the absence of sufficient external funding for technological upgrades (Onyema *et al.*, 2021). This is worsened by frequent power outages which is a significant barrier in Nigeria although AI technologies require stable power supply to run effectively, and intermittent electricity can disrupt both teaching and learning processes (Aina, 2019; Obaseki, 2020). Closely connected to power supply is *poor connectivity* consistently experienced across different regions in Nigeria even though reliable internet is an indispensable AI-driven tool (Adeoye *et al.*, 2022). Finally, there is a digital divide which reveals that unlike urban students, many rural dwellers lack the digital devices

needed to participate fully in AI-enhanced learning environments which creates disparities in student engagement and effectiveness of AI-based instruction (Olanrewaju, 2021). This **has resulted in urban-rural** disparities or unequal opportunities to access and use AI tools effectively. Obviously, these are evidence of the paucity of technological infrastructure affecting the effective use of AI-based tools. These deficits are largely due to high costs of AI-compatible devices or prohibition for institutions and individuals. Many Mathematics lecturers are unfamiliar with AI technologies due to poor training in application of AI to teaching. States with fewer teacher development programmes, like some northern regions, face this issue more acutely. In some conservative states, there may be resistance to adopting new technologies due to fear of job displacement or unfamiliarity.

**Culturo-Attitudinal Barriers:** Many lecturers are critically concerned about the cultural implications of AI as a result of their attitudinal fear of its emergence (Akinmolayan *et al.* (2021). Apart from the fact that some lecturers are hesitant to adopt AI due to fears of job displacement, there are varying levels of digital literacy among lecturers and students which can affect its successful implementation (Aina, 2019). This fear can lead to reluctance to engage with AI-enhanced teaching methods. *Lack of Awareness and Exposure revealed that in some cases,* lecturers are not fully aware of the potential benefits of AI-enhanced instructional delivery, which can foster misconceptions and reduce interest in adopting AI tools (Omodan, 2020). Addressing these challenges requires a collaborative approach involving government agencies, educational institutions, and private sector partners to develop comprehensive strategies for effective AI integration in Mathematics education in Nigeria. Some believe that AI tools may not accommodate local languages or cultural contexts, affecting their acceptance in linguistically diverse states like Kano or Kaduna.

**Pedagogical Barriers:** Many lecturers are resistant to AI due to concerns about its impact on their teaching style. Some worry that AI weaken traditional teaching methods or replace human instruction (Oguche, Egharevba & Okon, 2020). Hence, several lecturers struggle to integrate AI into their curricula in ways that align with pedagogical goals (Eze, Chinedu-Eze & Bello, 2018).

Some instructors find it difficult to bring AI technologies in line with existing strategies (Omodan, 2020). *With respect to curriculum integration*, incorporating AI into the existing Mathematics curriculum requires careful planning to ensure alignment with educational objectives and a standardized framework to avoid complicated processes (Olatunde-Aiyedun, 2024). There is also *incompatibility of pedagogies with existing curriculum* in many Nigerian universities which is largely traditional and rigid, leaving little room for the integration of AI-based tools (Odunaya, 2023). AI-enhanced teaching often requires a shift in teaching methodologies and curriculum design, which many lecturers may find difficult to navigate (Alabi & Fagbenro, 2022). Furthermore, *poor alignment with pedagogical beliefs* has moved many lecturers to resist adopting AI-enhanced tools because they perceive these technologies as being incompatible with their teaching philosophy, thereby preferring conventional face-to-face methods to effective use of AI in Mathematics instruction (Adebisi, Alabi & Fagbenro, 2021).

**Institutional Barriers:** Nigerian Universities face institutional challenges, such as inadequate training programs for lecturers and insufficient vision for AI integration in instruction (Olaleye *et al.*, 2023). Regarding the *poor regulatory framework*, the Nigerian education system is currently deficient in comprehensive policies and guidelines for AI integration, leading to uncertainty and inconsistent adoption across institutions. Efforts are ongoing to develop a national AI roadmap to deepen higher learning, but its implementation remains a work in progress. *There is limited funding and allocation of educational resources*, which impede the widespread adoption of AI tools. In fact, there is no clear funding roadmap dedicated to helping lecturers adopt AI-enhanced tools (Okeke, 2021). *A key barrier is bureaucratic red tape or slow administrative procedures* that impede the procurement and implementation of new technologies, thereby making it challenging to keep up with technological advancements (Iloanusi & Osuagwu, 2018). Some states in certain geopolitical zones are fond of making policies that are rigid on educational curricula which often lack the flexibility to integrate AI-enhanced methodologies. For instance: Southern states like Rivers and Lagos may have initiatives that promote innovation, while northern states like Zanzara and Kaduna may prioritize basic educational access. In some cases, a slow decision-making

process is often due to budgetary Constraints. Public universities in Nigeria often operate under limited budgets, which makes it difficult to invest in AI infrastructure, tools, and training programs for lecturers (Ogunode, 2020). Moreover, *inadequate professional development* hinders institutional efforts to offer ongoing professional development for lecturers in the use of AI-based tools in teaching (Omodan, 2020). Consequently, there is a significant gap in professional development programs that focus on AI integration, resulting in lecturers' low preparedness to utilize these technologies effectively. A study assessing university lecturers' readiness in North-East Nigeria highlighted this deficiency, noting a general unpreparedness to adopt AI in teaching and administrative tasks. Lack of regular training on new educational technologies further exacerbates the problem. This results in resistance or hesitation to adopt AI tools for instruction (Eze, Chinedu-Eze & Bello, 2018). All of this gave birth to the techno-culturo-peda-institutional-barriers (TCPIB) model. As opposed to Roger's theory this model implies that before introducing new technologies, there is a need to ascertain appropriate *communication channels*, the pedagogic and institutional or *social* context in which the innovation is introduced.

Other barriers include non-proportionate teacher-students' ratios which reduces opportunities to implement AI personalized learning tools, coupled with economic inequalities within states with low revenue generation that underfund education, limiting AI investments. Some states have experienced absence of state-policies with clear funding frameworks to support AI integration in education. On one hand, skepticism about data protection can hinder adoption, especially where regulatory policies are weak. In states with limited exposure to innovative teaching, AI might be seen as unnecessary for a traditionally abstract subject like Mathematics due to misconceptions. It is believed that addressing these technological barriers; skill deficits; educational system constraints; socioeconomic challenges; cultural and language barriers; policy and regulatory gaps; perceived irrelevance to Mathematics require tailored approaches that account for the specific challenges and opportunities within each state. Collaboration among government agencies, educational institutions, and tech providers is essential to bridge these gaps. Addressing these barriers requires targeted investment in infrastructure, extensive teacher training

programs, supportive policies, and collaborative efforts between government agencies, educational institutions, and private sector partners.

## **2. Variation between government and privately owned universities in AI-enhanced instruction barriers concerning Mathematics education in Nigeria.**

Having explored the fact that many institutions lack the basic digital infrastructure required to support AI-based learning environments (Donatus *et al.*, 2024), it is pertinent to iterate that government-owned universities constantly face significant internet challenges in accessing reliable and advanced technological infrastructure, which limits AI instruction delivery and adoption. Even when pilot AI projects are introduced, long-term sustainability becomes a concern due to limited funding (Ogunleye *et al.* 2021). This is because most government-owned universities rely heavily on government funding, which is often insufficient to meet the technological demands of AI integration. On the contrary, private universities are better funded and tend to have more consistent access to digital resources, giving them an implementation advantage in AI-enhanced learning environments (Olaleye *et al.*, 2023). Conversely, private universities have access to more flexible funding from tuition and private donors, enabling them to invest in cutting-edge technologies like AI-powered platforms and tools. Without adequate training, the potential benefits of AI would not be fully realized (Akanbi *et al.*, 2022), since private universities are more likely to provide specialized training and professional development due to their greater access to resources, while government-owned universities are constrained by budget and bureaucracy and often struggle to keep up with these advancements (Ogunlana *et al.*, 2021).

There is skepticism toward AI in both government and private universities, with concerns about potential misuse (plagiarism). Government universities may face more resistance due to a lack of exposure to innovation compared to private institutions, which are more open to experimenting with AI-enhanced teaching methods (Omodan, 2020). Policy frameworks are needed to guide AI adoption and ensure consistency in practice across institutions (Olaleye *et al.*, 2023). Addressing these challenges will require strategic planning, and policy reform to ensure equitable access and responsible use of AI technologies in education, public-private partnerships,

increased investment in digital infrastructure, and focused teacher training programs to ensure equitable and effective AI adoption across both sectors.

### ***3. Impacts of AI-enhanced instruction barriers on the Teaching of Mathematics in Nigerian Universities.***

AI-enhanced instruction barriers have posed significant hindrances to the teaching of Mathematics in Nigerian universities. For instance, *limited access to advanced AI tools* and inadequate digital infrastructure hinder its integration into Mathematics education, thereby creating un-even access for interactive and personalized learning experiences (Afolabi (2024). Lecturers are often limited in exposure to requisite skills for the adoption of AI-driven instructional strategies and innovative pedagogical approaches *due to a lack of training in AI technologies and computational Mathematics* (Olaleye *et al.*, 2023). Besides, *slow adaptation of Mathematics curricula* to AI concepts and applications constantly limits students' exposure to emerging AI tools and techniques relevant to modern mathematical research and industry demands (Ogunlana *et al.*, 2021). There is also *resistance to transitioning from traditional teaching methods* to AI-enhanced pedagogies which hinders the development of critical thinking and problem-solving skills among Mathematics students (Akanbi *et al.*, 2022). Issues surrounding *cultural attitudes toward technology* and socioeconomic disparities affect AI acceptance and create access disparities among Mathematics students, potentially widening educational inequalities (Adeyemi *et al.*, 2020). Stakeholders often raise concerns over *data privacy and ethical implications* of AI in education which increases challenges in deploying AI responsibly and ethically within Mathematics curricula (Donatus *et al.*, 2024). Nevertheless, there are *limited funding and resources* for AI infrastructure and educational initiatives which bring constraints to the implementation of AI technologies that could enhance Mathematics education outcomes (Ezeani *et al.*, 2022).

### ***4. Overcoming the barriers of AI-enhanced instruction in Mathematics across government and privately owned universities in Nigeria.***

All tertiary institutions in Nigeria can foster a prosperous AI environment by establishing a

solid foundation for effective computing capacity. Once this is achieved there would definitely be affordable high-performing computing resources for scaling local AI developments, leading to increased AI research and development capacity and fostering faster innovation cycles and reduction in the cost and dependence on virtual AI environments. Eventually, there would be enhanced national technological capabilities in AI to support job creation opportunities in the AI hardware and software sectors (National Artificial Intelligence Strategy, 2024). It is also believed that through government and private sector collaboration, digital infrastructure, investment in campus-wide internet connectivity and cloud computing resources can improve access to reliable internet, including affordable and subsidized devices to bridge the infrastructure gap (Akanbi *et al.*, 2022). Ajiboye and Daramola (2021) reported that professional development programs focus on AI literacy for lecturers can be in the form of free workshops, AI-mentorship frameworks, and online courses designed to empower educators to integrate AI tools in Mathematics classes, where more experienced faculty members guide others in ensuring knowledge transfer. Such training programs could focus on AI literacy and software for practical demonstrations to increase lecturers' confidence and competence in AI usage. Obviously, government and privately owned institutions face financial constraints that limit their ability to adopt AI-enhanced learning solutions. While government-owned universities rely heavily on government funding to cover technology upgrades, private universities, though more flexible, still need external support to sustain long-term AI projects. For the successful design of online workshop programs, institutions can apply for grants from international organizations to fund AI initiatives and provide scholarships for students and lecturers pursuing research in AI applications in education (Omodan, 2020). Through corporate social responsibility initiatives, tech companies can sponsor AI adoption projects by donating software licenses, and cloud devices to universities (Olaleye *et al.*, 2023).

Regulatory frameworks from policymakers could enhance AI adoption by means of guidelines for data privacy and ethical uses of AI in education. By updating Mathematics curricula to reflect the use of AI tools, such as personalized learning platforms and predictive analytics for

student performance (**Donatus et al.**, 2024), course-related barriers could be overcome. This calls for policy frameworks that discourage heavy reliance on the government for support but rather encourage institution-based provision and sustenance. The absence of clear policies guiding AI adoption has also been identified as a key barrier. Institutions with supportive leadership and well-defined AI implementation policies tend to experience better outcomes in AI integration (Ogunleye *et al.* (2021). Other concerns related to data privacy and the ethical use of AI in education require awareness campaigns to demonstrate the complementary role of AI in enhancing teaching and learning processes, rather than replacing traditional methods (Awolaye, Siyanbola & Oladipo, 2008). By hosting open discussions involving students, faculty members, and administrators, institutions could foster acceptance of AI as an enhancement to education (Olaleye *et al.*, 2023).

Partnerships among governments, educational institutions, and private technology companies have been instrumental in addressing infrastructure deficits. For example, Google and IBM partnerships provide AI-related tools, platforms, and cloud computing resources to universities. Google's AI for Social Good program and IBM's AI Academic Initiative support institutions by offering free access to AI development platforms and training (Adeyemi *et al.*, 2020). Besides, the Nigerian National Information Technology Development Agency (NITDA) collaborates with international tech companies to improve digital and AI literacy by providing grants for ICT infrastructure in public universities (NITDA, 2021). There are also government-led initiatives designed to enhance technological access. For example, Nigeria's National Broadband Plan (2020-2025) aims to improve internet penetration, particularly in educational institutions. On the other hand, the Tertiary Education Trust Fund (TETFund) provides financial support to higher education institutions for infrastructure development, including investments in digital and AI-related technologies (**Donatus et al.**, 2024). For example, the Artificial Intelligence for Educators (AIEd) initiative offers workshops and training on how to apply AI in Mathematics education (Adebisi, Alabi & Fagbenro, 2021).

The TPACK (Technological Pedagogical Content Knowledge) Framework has been

widely used to help Mathematics lecturers understand how to integrate technology (AI tools) with pedagogy and content. Peer-supported communities of practice have been established in several institutions to foster ongoing development in AI-enhanced teaching (Mishra & Koehler, 2006). Incorporating AI-based problem-solving tools: Mathematics programs have been redesigned to integrate AI-enhanced tutoring systems like ALEKS (Assessment and Learning in Knowledge Spaces), which adapts to students' learning progress and offers personalized feedback. Many lecturers resist AI adoption because of concerns about pedagogy and assessment. Tools like Google, Gradescope, and CleverExam are AI-powered systems that assist lecturers with grading and feedback. These tools reduce the workload of Mathematics lecturers and improve the speed and accuracy of grading while maintaining the rigor of assessments.

Awareness campaigns within institutions have been used to highlight the benefits of AI for education, demonstrating how AI can complement rather than replace lecturers' roles. Collaborating with students to co-create AI-enhanced learning experiences can help reduce resistance. Lecturers who involve students in the design and implementation of AI tools often experience less resistance because it fosters a shared responsibility for innovation. This approach also helps address concerns about AI replacing human interaction (Olaleye *et al.*, 2023). To overcome the major barriers faced by Mathematics lecturers in adopting AI-enhanced instructional delivery in Nigeria, strategies must focus on building technological infrastructure, enhancing AI literacy, redesigning curricula, providing institutional support, and addressing cultural resistance. Frameworks like TPACK, change management models, and government policies on AI adoption in education provide a structured approach to overcoming these challenges. These strategies will promote sustainable AI adoption across government-owned and private universities, ensuring that both sectors can effectively leverage technology for enhanced Mathematics education. Public-private partnerships, policy reforms, and continuous investment in teacher development will be critical to ensuring equitable and impactful implementation.

Not to be excluded is comprehensive digital literacy and AI-specific training programs for Mathematics lecturers which include hands-on experience with AI tools that empower lecturers to

integrate AI into their teaching practices effectively. This can only thrive in an environment with policies that prioritize AI in education which promote funding, public-private partnerships, and collaborations with tech companies, along-sides government provision of subsidies or grants to reduce the financial burden on schools. There is need to encourage the development of AI tools tailored towards Nigeria's educational context, considering language diversity, cultural nuances, and local challenges. Government needs to establish clear guidelines on data privacy, transparency, and ethical AI use in education. There should be provision of financial incentives or recognition programs for schools and lecturers that adopt and successfully utilize AI tools, encouraging widespread acceptance and use. Moreover, the conduct of nationwide campaigns to highlight the benefits and potential of AI in education, addressing fears or misconceptions among educators and stakeholders. So by implementing infrastructure development; training and capacity building; government and policy support; localized AI solutions; ethical and regulatory frameworks; incentivizing AI adoption; awareness campaigns strategies, Nigeria can overcome existing barriers and leverage AI to enhance educational outcomes, including personalized learning, efficient teaching processes, and broader access to quality education. For a detailed exploration, refer to insights provided by educational experts and policy advocates in recent reports.

This scoping review examined the barriers to adopting AI-enhanced instruction among Mathematics lecturers in Nigeria. Key obstacles identified include insufficient infrastructure, inadequate training for educators, funding constraints, data privacy concerns, skepticism toward AI tools, weak institutional support, and cultural-attitudinal resistance which gave birth to a new model called techno-culturo-peda-institutional barriers (TCPIB). Government-owned universities experience more challenges related to unreliable internet and funding compared to private universities, which tend to have better digital infrastructure but still face resistance from lecturers unaccustomed to AI. Despite these challenges, AI offers significant potential to improve Mathematics instruction by enabling personalized learning and automating administrative tasks. Addressing these barriers is essential for fostering educational innovation and equity across

Nigerian higher education institutions, which require a multi-faceted approach that addresses both the technical and human dimensions of AI adoption in education.

### **Conclusion**

AI-enhanced instruction can transform the teaching and learning of Mathematics in Nigeria, but both structural and cultural barriers hinder its adoption. Without addressing the digital divide between institutions and equipping educators with the necessary skills, the benefits of AI integration may remain limited to only well-resourced private universities. A holistic approach that combines investments in technology, continuous training, and supportive policies is essential to ensure that all lecturers, regardless of institution type, can leverage AI tools effectively. Strategic collaborations between government, academia, and the private sector will be critical in overcoming these barriers and achieving sustainable educational innovation. Considering the theory propounded by Everett-Rogers (2003) who believed that the identified issues could be harnessed by ensuring communication channels and down social systems in the adoption of AI, just as the TPACK theory by Mishra and Koehler (2006) calls for compatible interaction between Mathematics curriculum and AI pedagogies.

### **Recommendations**

The study recommended that:

#### **1. The government should:**

- i. Collaborate with the private sector to improve internet access, particularly in rural areas to create an enabling environment for AI adoption.
- ii. Establish policies that encourage responsible AI use, addressing ethical concerns such as data privacy, plagiarism, and algorithmic bias.
- iii. Ensure that all universities, including those in rural areas, have access to the necessary AI technologies and internet bandwidth to prevent the digital divide.
- iv. Set standardized AI tools that align with national educational goals, ensuring quality and relevance for the Nigerian university system.
- v. Dedicate funds to be allocated to support universities in acquiring AI-related

infrastructure, such as cloud computing services, AI-driven platforms, and adequate internet connectivity.

- vi. Incorporate AI training in pre-service and in-service teacher education programs to address the lack of technical skills and training among Mathematics lecturers.
- vii. Introduce mandatory courses on AI-enhanced pedagogy in pre-service teacher training programs to ensure that upcoming Mathematics educators are familiar with AI tools from the outset of their careers.

**2. National Universities Commission should:**

- i. Make policies that could promote the integration of AI into curriculum design to overcome pedagogical and curriculum barriers
- ii. Encourage universities to adopt a more flexible curriculum structure that allows for the gradual integration of AI-based tools. Mathematics courses should include modules on how AI can be used to improve problem-solving, data analysis, and other mathematical concepts.
- iii. Establish curriculum review committees in universities to ensure that existing courses are periodically reviewed and updated to include AI-enhanced instructional methods.
- iv. Foster an environment for developing interdisciplinary teams made of AI experts, instructional designers, and Mathematics lecturers to collaboratively design AI-based instructional models that would align with course objectives.
- v. Aid institutions to offer competitive grants specifically for research on AI in education, enabling lecturers to investigate new ways of enhancing Mathematics instruction using AI.
- vi. Create mentorship programs across institutions where lecturers experienced with AI tools can mentor less experienced colleagues.
- vii. Encourage collaboration between universities by forming AI-focused teaching networks, where lecturers can share best practices, challenges, and resources.

**3. Universities should:**

- i. Provide regular AI training programs for Mathematics lecturers to develop their skills and familiarity with technology.
- ii. Engage with tech companies to secure resources such as software licenses, devices, and cloud services, ensuring long-term sustainability.
- iii. Organize workshops and open forums to address skepticism, showcasing the benefits of AI as a supportive tool for teaching and learning.
- iv. Secure public-private partnerships and grants from international organizations to address these challenges.
- v. Introduce grants, fellowships, and awards to encourage Mathematics lecturers to explore and apply AI in their teaching practices.
- vi. Create AI support centers within their faculties of education and Mathematics departments that would offer ongoing technical support to Mathematics lecturers in setting up and using AI tools for teaching. AI specialists could be hired to train and assist lecturers with the practical challenges they face in integrating AI tools.
- vii. Develop a centralized repository of AI-enhanced learning materials (e.g., adaptive problem-solving tools, automated grading systems, AI-based tutoring platforms) that lecturers can access and customize for their teaching needs.
- viii. Establish a controlled environment where lecturers can experiment with AI technologies before full-scale classroom implementation.
- ix. Offer regular in-service training workshops, webinars, and certification programs on AI in education that should focus on the practical use of AI-driven software, adaptive learning platforms, and data-driven instructional strategies.
- x. Ensure that lecturers understand the ethical implications of AI, including data privacy, fairness, and transparency in algorithmic decision-making.
- xi. Provide financial incentives, such as stipends or grants, to encourage Mathematics lecturers to pursue further training in AI-enhanced teaching.

### References

- Adebisi, T. A., Alabi, O. T., & Fagbenro, J. A. (2021). Teacher perceptions on artificial intelligence and its potential impact on teaching and learning. *Journal of Educational Technology Systems*, 50(1), 3-16.
- Adeola, A., *et al.* (2023). Ethical and legal issues in the deployment of artificial intelligence in Nigerian education. *International Journal of Law and Education*.
- Adeoye, O. A., Fakorede, F. O., & Dada, O. T. (2022). Data privacy and ethical issues in AI-enabled educational platforms: *African Journal of Information and Knowledge Management*, 12(2), 51-65.
- Adeyemi, B., *et al.* (2020). Cultural perspectives on the adoption of artificial intelligence in biology education: Insights from Nigeria. *International Journal of Educational Development*.
- Afolabi, A. (2024). Ethical issues in artificial intelligence adoption in african higher education institutions in Nigeria: *African Journal of Information and Knowledge Management*, 2 (2 no 3): 22-33
- Aina, A. A. (2019). Barriers to adopting AI in Nigerian education: *Journal of Educational Innovation in Developing Countries*, 4(1), 23-38.
- Akanbi, B., *et al.* (2022). Integrating artificial intelligence into Mathematics education in Nigeria: Prospects and challenges: *Journal of Educational Technology Systems*.
- Alabi, T., & Fagbenro, S. (2022). Challenges of integrating AI in higher education: A case study of Nigerian universities: *Nigerian Journal of Educational Research and Evaluation*, 22(2), 87-105.
- Arksey, H., & O'Malley, L. (2005). *Scoping studies: Towards a methodological framework*. *International Journal of Social Research Methodology*, 8(1), 19-32.
- Awolaye, O. M., Siyanbola, W. O., & Oladipo, F. O. (2008). Adoption assessment of internet usage amongst undergraduates in Nigeria: A case study approach. *Journal of Internet and Information System*, 1(1), 2-10.

- Donatus, U. O., Obinna, V. O., Samuel, U. O., Odera, C. U., & Nkechi, F. O. (2024). The ethical implications of artificial intelligence in education: *Journal of Applied Philosophy*, 22 (2), 1-9.
- Effodoh, J. O. (2021). Policy brief towards a rights-respecting artificial intelligence policy for Nigeria: Paradigm Initiatives by Global Partners Digital,
- Eze, S. C., Chinedu-Eze, V. C., & Bello, A. O. (2018). The utilization of e-learning facilities in the educational delivery system of Nigeria: A study of M-University. *African Journal of Business Management*, 12(8), 196-205.
- Ezeani, C. (2022). Harnessing artificial intelligence for inclusive education in Nigeria: Challenges and opportunities. *Journal of Educational Technology Research*.
- Federal Republic of Nigeria (FRN, 1999). Constitution of the Federal Republic of Nigeria.
- Iloanusi, N. O., & Osuagwu, F. C. (2018). ICT in education: Achievements so far in Nigeria. *Journal of Educational and Social Research*, 8(3), 21-30.
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054.
- Morohunfola, A. (2024). Legal liability of artificial intelligence (AI) in Nigeria.
- Mohammed, K. & Shehu, A. (2023). A review of Artificial Intelligence (AI) challenges and future prospects of explainable AI in major fields: A case study of Nigeria: *Open Journal of Physical Science (OJPS)*, 4 (1), 1- 18.
- Munn, Z., Peters, M. D., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). *Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach*. *BMC Medical Research Methodology*, 18(1), 143.
- Ndunagu, J. N. (2021). Artificial Intelligence: National Open University of Nigeria.
- NITDA. (2021). AI Policy Framework for Education. Nigerian National Information Technology Development Agency.
- Obaseki, R. (2020). The challenges of AI in Nigerian universities: Access, training, and

- implementation. *Journal of Educational Leadership in Africa*, 4(1), 14-25.
- Odunaya, M. O. (2023). Impact of Artificial intelligence in Curriculum Development in Nigerian Tertiary Education: *International Journal of Educational Research* 12 (2), 192-211.
- Oguche, T. O., Egharevba, M. E., & Okon, A. E. (2020). The role of AI in bridging the learning divide in Nigerian higher education. *Nigerian Journal of Artificial Intelligence and Educational Innovation*, 5(1), 45-59.
- Ogunlana, S., et al. (2021). Curriculum adaptation for artificial intelligence integration in Mathematics education: A Nigerian perspective. *Educational Research and Reviews*.
- Ogunleye, F., et al. (2021). Cultural perspectives on the integration of artificial intelligence in basic science education: Insights from Nigeria. *International Journal of Educational Development*.
- Ogunmodede, T., et al. (2021). Curriculum adaptation for artificial intelligence integration in basic science education: Perspectives from Nigeria. *Educational Research and Reviews*.
- Ogunode, N. J. (2020). Educational financing in Nigeria: Challenges and the way forward. *International Journal of Educational Research*, 6(1), 23-31.
- Ogunode, N. J., & Abubakar, M. (2021). Cost analysis of integrating AI technologies in Nigerian higher education: *Journal of Higher Education in Africa*, 10(2), 120-136.
- Okeke, F. A. (2021). Institutional policies on AI adoption in Nigerian universities: Challenges and strategies: *Higher Education Policy Journal*, 10(4), 123-145.
- Olaleye, S., et al. (2023). Building capacity for artificial intelligence in Mathematics education: Insights from Nigeria: *International Journal of Educational Development*.
- Olanrewaju, S. I. (2021). The digital divide in Nigeria's educational system: Implications for AI in education: *Journal of African Digital Education*, 3(2), 72-84.
- Olatunde-Aiyedun, T. G. (2024). Artificial Intelligence (AI) in Education: Integration of AI into science education curriculum in Nigerian Universities: *International Journal of Artificial Intelligence for Digital*, 1 (1), 1-14.

- Onyema, E. (2021). Cultural implications of artificial intelligence in education: Perspectives from Nigeria: *Journal of Educational Technology Trends*.
- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.
- Thompson, A. (2022). Artificial intelligence: What does this mean for Nigeria and Africa? Africa Law Practice Nigeria & Company.