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LEVERAGING ARTIFICIAL INTELLIGENCE TO ENHANCE LEARNING ENGAGEMENT: OPPORTUNITIES AND CHALLENGES

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Abstract

Artificial intelligence (AI) is revolutionizing education by offering innovative tools to enhance learning engagement, a critical factor in academic success. This paper explored the potential of AI to transform traditional learning environments through personalized, adaptive and interactive technologies, such as intelligent tutoring systems, gamified platforms and virtual labs. These tools address key challenges in education, including disengagement, lack of personalization and limited feedback, by tailoring learning experiences to individual needs and fostering deeper student involvement. However, the integration of AI in education is not without challenges. Issues such as inadequate infrastructure, high implementation costs, low digital literacy and ethical concerns must be addressed to ensure equitable and effective adoption. The study also highlighted the opportunities AI presents for improving learning engagement, such as real-time feedback, personalized learning experiences and collaborative learning support, while also examining the barriers to its implementation. Furthermore, it offered actionable suggestions, including investing in infrastructure, training programs for educators and students, bridging the digital divide and establishing ethical frameworks. These strategies aim to maximize the potential of AI while mitigating risks, ensuring that its benefits are accessible to all learners. Ultimately, this paper underscored the transformative potential of AI in education and calls for collaborative efforts among stakeholders to create inclusive, engaging and effective learning environments for the future.

Keywords: Artificial Intelligence (AI), Learning Engagement, Personalized Learning, Adaptive Learning, Educational Technology.

Introduction

Artificial Intelligence has been a catchword that is impacting the educational system in the world. Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. These systems are designed to perform tasks that typically require human intelligence, such as visual perception, speech recognition, decision-making and language

translation (IBM, 2023). Also, Russell & Norvig (2021) defined Artificial intelligence (AI) as a multidisciplinary field focused on creating systems capable of performing tasks that typically require human intelligence. These tasks include learning, reasoning, problem-solving, perception and natural language processing. AI systems leverage algorithms, data and computational power to simulate cognitive functions and improve their performance over time through machine learning. However, Holmes *et al* (2019) view Artificial intelligence in education as the use of algorithms and computational models to analyze educational data, personalize learning experiences and provide adaptive feedback to learners. AI systems can identify patterns in student behavior, predict learning outcomes and recommend tailored resources to enhance engagement and performance.

Learning engagement is a multifaceted construct that reflects students' active involvement, emotional connection and cognitive investment in their educational experiences, playing a pivotal role in shaping academic success and lifelong learning. Behavioral engagement refers to students' active participation in learning activities, including attendance, task completion and involvement in classroom discussions. It is a measurable indicator of how invested students are in their academic work and is often linked to positive educational outcomes (Wang & Degol, 2014). While emotional engagement involves students' affective reactions to their learning environment, such as interest, enjoyment and a sense of belonging. It plays a critical role in sustaining motivation and fostering a positive attitude towards learning (Reschly & Christenson, 2021). Also, Fredricks *et al* (2011) view Cognitive engagement as the mental effort and strategies students employ to deeply understand and master academic content. It includes critical thinking, self-regulated learning and the use of metacognitive strategies to achieve meaningful learning outcomes.

Artificial intelligence (AI) is increasingly transforming education by enabling personalized learning experiences, automating administrative tasks and providing real-time feedback to students. At the heart of this transformation lies learning engagement,

which is critical for fostering motivation, improving academic outcomes and ensuring that students remain actively involved in their educational journeys.

Statement of the Problem

The integration of artificial intelligence (AI) into education has opened new possibilities for enhancing teaching and learning processes. AI-driven tools, such as adaptive learning platforms, intelligent tutoring systems and chatbots, promise to personalize education, provide real-time feedback and streamline administrative tasks. However, despite these advancements, there is a growing concern about whether these technologies are effectively fostering sustained learning engagement. While AI has the potential to revolutionize education, its impact on keeping students motivated, emotionally connected and cognitively invested remains underexplored. This raises critical questions about how AI can be designed and implemented to truly enhance engagement rather than merely automating tasks.

Learning engagement is a cornerstone of academic success, encompassing behavioral, emotional and cognitive dimensions. Behaviorally engaged students participate actively in learning activities, emotionally engaged students feel connected and interested, and cognitively engaged students invest mental effort to deeply understand concepts. However, traditional educational systems often struggle to maintain high levels of engagement due to large class sizes, limited resources and a one-size-fits-all approach to teaching. AI offers a potential solution by enabling personalized and adaptive learning experiences, but its effectiveness in addressing the multifaceted nature of engagement is not yet fully understood. Without a clear understanding of how AI impacts engagement, there is a risk of deploying technologies that fail to meet the needs of diverse learners or, worse, exacerbate existing inequalities.

Furthermore, the rapid adoption of AI in education has outpaced research on its long-term implications for learning engagement. While some studies highlight the benefits of AI tools, such as increased student motivation and improved performance, others point to challenges like algorithmic bias, data privacy concerns and the potential for over-reliance on technology. These issues underscore the need for a balanced

approach that leverages AI's strengths while addressing its limitations. This paper seeks to address this gap by exploring how AI can be effectively utilized to enhance learning engagement, identifying both opportunities and challenges, and providing suggestions for educators, policymakers and technology developers.

Purpose of the Study

The primary purpose of this study is to explore how artificial intelligence (AI) can be leveraged to enhance learning engagement in educational settings. By examining the intersection of AI technologies and the behavioral, emotional and cognitive dimensions of engagement, this paper aims to identify innovative strategies for fostering deeper student involvement and motivation. The study seeks to provide a comprehensive understanding of the potential of AI to transform traditional learning environments into more dynamic and personalized experiences.

A key focus of this paper is to evaluate the effectiveness of AI-driven tools, such as adaptive learning systems, intelligent tutoring systems and gamified platforms, in promoting sustained engagement. The study will state how these technologies address common challenges in education, such as disengagement, lack of personalization and limited feedback. By analyzing both the opportunities and challenges of AI, this paper aims to offer insights for educators, policymakers and technology developers on how to maximize the benefits of AI while mitigating potential risks.

Ultimately, this study aims to contribute to the growing body of knowledge on AI in education by providing suggestions for implementing AI tools that prioritize learning engagement. By bridging the gap between technological innovation and educational practice, this study seeks to empower stakeholders to create more inclusive, engaging and effective learning environments for all students.

AI Tools for Enhancing Learning Engagement

Artificial intelligence (AI) is revolutionizing education by offering innovative tools that enhance learning engagement through personalization, interactivity and real-time feedback. These tools include, but not limited to:

Adaptive Learning Platforms (e.g., DreamBox, Knewton): These platforms use AI algorithms to personalize learning paths based on individual student performance, ensuring that content is tailored to their needs and pace (Holmes *et al*, 2019).

Intelligent Tutoring Systems (e.g., Carnegie Learning's MATHia, Third Space Learning): AI-powered tutors provide real-time feedback and guidance, simulating one-on-one tutoring to help students master complex concepts (VanLehn, 2011).

Virtual Labs (e.g., Labster, PraxiLabs): Virtual labs powered by AI simulate real-world experiments, allowing students to explore scientific concepts in a safe, interactive and engaging environment (Makransky & Petersen, 2021).

Speech Recognition and Language Learning Tools (e.g., Duolingo, Rosetta Stone): AI-powered language learning apps use speech recognition to provide real-time feedback on pronunciation, making language learning more interactive and engaging (Godwin-Jones, 2021).

Collaborative Learning Platforms (e.g., Microsoft Teams, Google Classroom): These tools use AI to facilitate group work, track participation and provide insights into team dynamics, fostering collaborative engagement (Luckin *et al*, 2016).

Feedback Tools (e.g., Turnitin Revision Assistant, Grammarly): AI provides instant, actionable feedback on assignments, helping students improve their work and stay motivated through continuous improvement (Shute & Rahimi, 2017).

Chatbots for Learning Support (e.g., IBM Watson Tutor, Jill Watson): AI chatbots answer student queries, provide reminders and offer personalized support, enhancing engagement through instant interaction (Winkler & Söllner, 2018).

Gamified Learning Platforms (e.g., Kahoot!, Classcraft): AI-driven gamification tools use game mechanics to make learning more interactive and engaging, motivating students through rewards and challenges (Dichev & Dicheva, 2017).

Automated Essay Scoring Systems (e.g., e-rater, intelligent essay assessor): These tools use AI to provide instant feedback on written assignments, helping students improve their writing skills and stay engaged in the revision process (Zawacki-Richter *et al*, 2019).

Personalized Recommendation Systems (e.g., Coursera, Khan Academy): AI recommends learning resources, courses and activities based on individual preferences and progress, keeping students engaged with relevant content (Zhang *et al*, 2022).

Opportunities and Challenges

Opportunities

Artificial intelligence (AI) presents transformative opportunities in education, which include:

Personalized Learning Experiences: Personalized learning refers to AI-driven educational systems that continuously adapt content, pace and instructional approaches based on real-time analysis of individual learner needs, performance patterns and engagement behaviors (Holmes *et al*, 2019)**.** Personalized learning experiences are characterized by machine-curated educational pathways that dynamically adjust to both cognitive requirements (skill gaps, learning objectives) and affective states (motivation, preferences) through iterative feedback loops (Zhang *et al*, 2022)**.** Therefore**,** AI tailors educational content to individual learning styles, paces and preferences, ensuring that each student receives a customized learning journey.

Real-Time Feedback and Assessment: Real-time feedback in AI-enhanced education refers to the immediate, automated evaluation of student performance (such as quizzes, writing tasks or problem-solving exercises) delivered through intelligent systems that analyze errors, provide corrective guidance and adapt subsequent content to address learning gaps (Zawacki-Richter *et al*, 2019). Therefore, AI provides instant feedback on assignments, quizzes and projects, helping students identify areas for improvement and stay motivated.

Adaptive Learning Paths: Adaptive learning paths refer to AI-curated educational trajectories that automatically adjust content sequencing and difficulty levels based on real-time analysis of a learner's demonstrated competencies, misconceptions and engagement patterns (Holmes *et al*, 2019). Also, Zhang *et al* (2022) viewed adaptive learning paths as dynamic instructional routes generated through machine learning algorithms that optimize knowledge acquisition by continuously modifying lesson flow

in response to individual performance data and behavioral indicators. Therefore, AI adjusts the difficulty and focus of learning materials based on student performance, ensuring optimal challenge and engagement.

Enhanced Accessibility: Enhanced accessibility in AI-driven education refers to technology's ability to break down learning barriers through tools like speech-to-text, real-time captioning and personalized interfaces that accommodate diverse needs (including physical, sensory and cognitive differences) ensuring equitable participation (Zawacki-Richter *et al*, 2019). AI-enhanced accessibility involves adaptive systems that automatically modify content presentation (e.g., text simplification, audio descriptions) and interaction modes (e.g., voice control, gesture recognition) to match individual learner requirements and create inclusive digital learning environments (Luckin *et al*, 2016). Therefore, AI-powered tools, such as speech-to-text and text-to-speech, make education more accessible for students with disabilities or language barriers.

Automation of Administrative Tasks: AI systems can be used to handle routine educational operations (such as attendance tracking, grading and scheduling) using algorithms that process institutional data with minimal human intervention, thereby increasing efficiency and reducing educator workload (Zawacki-Richter *et al*, 2019). Therefore, AI streamlines grading, attendance tracking and scheduling, freeing up educators to focus on teaching and student engagement.

Collaborative Learning Support: AI-powered collaborative learning support refers to intelligent systems that facilitate group learning by analyzing team dynamics, suggesting optimal group compositions and providing real-time feedback on collective problem-solving processes to enhance peer-to-peer knowledge construction (Luckin *et al*, 2016). These tools mediate group interactions through features like task allocation algorithms, conflict detection systems and shared knowledge mapping to promote equitable participation and productive teamwork in digital learning environments (Zhang *et al*, 2022). Therefore, AI facilitates group work and peer interactions by providing tools for communication, project management and collaborative problem-solving.

Challenges

While artificial intelligence (AI) offers immense potential to transform education, it also presents significant challenges. These include:

Limited Access to Technology: Azubuike *et al* (2021) found that during the COVID-19 lockdown, a significant number of students in Nigeria could not participate in remote learning because they lacked access to digital devices such as smartphones, laptops and stable internet connections. This highlights how many learners are excluded from technology-enabled opportunities, including the use of AI tools. Therefore, many schools and students in Nigeria lack access to computers, smartphones and reliable internet connectivity, which are essential for using AI tools.

High Cost of Implementation: Adeleke (2020) notes that regional disparities in digital infrastructure and affordability in Nigeria create a digital divide, with rural and underserved schools facing high costs of acquiring and maintaining technological tools. Therefore, the cost of acquiring and maintaining AI-powered systems is prohibitive for many Nigerian schools, particularly in rural and underserved areas.

Inadequate Power Supply: Mutiso (2024) points out that basic infrastructure, including reliable electricity, remains a major barrier to AI adoption across Africa. In Nigeria, frequent power interruptions mean that even when digital or AI tools are available, their effective and continuous use is severely limited. Therefore, frequent power outages and inconsistent electricity supply hinder the effective use of AI technologies in classrooms and homes.

Inadequate Infrastructure: Holden & Harsh (2024) argued that weak digital infrastructure across Africa (including outdated hardware and insufficient internet bandwidth) creates systemic challenges for AI deployment. In Nigeria, such constraints reduce the effectiveness of AI initiatives and hinder their expansion to larger populations. Therefore, poor technological infrastructure, such as outdated hardware and slow internet speeds, limits the scalability and effectiveness of AI solutions.

Low Digital Literacy: Adeleke (2020) explained that Nigeria's digital divide is not only about access to technology but also about the capacity to use it effectively. He also

highlighted that many educators and students lack adequate digital literacy and training, which limits the adoption and meaningful use of AI tools in schools.

Resistance to Change: Adeleke (2020) noted that gaps in digital awareness and uneven exposure to new technologies in Nigeria contribute to hesitation among educators and decision-makers. This lack of understanding often results in skepticism about the usefulness of advanced tools like AI in the classroom. Therefore, educators and policymakers may be hesitant to adopt AI due to a lack of understanding, fear of job displacement or skepticism about its benefits.

Data Privacy and Security Concerns: Mutiso (2024) observed that many African countries, including Nigeria, lack the legal and institutional safeguards needed to manage the risks of AI adoption. In education, the absence of strong data protection laws raises concerns about how sensitive student data collected by AI systems could be misused. Therefore, the collection and use of student data by AI systems raise concerns about privacy, security and potential misuse, especially in the absence of robust data protection laws.

Ethical and Bias Issues: Mutiso (2024) explained that AI systems developed outside Africa often fail to reflect the continent's social, cultural and educational realities. In Nigeria, this mismatch can result in algorithms producing biased or ineffective outcomes that do not adequately address local classroom challenges. Therefore, AI algorithms can perpetuate biases or fail to account for Nigeria's unique educational challenges, leading to unfair or ineffective outcomes for certain groups.

Conclusion

In conclusion, artificial intelligence (AI) holds immense potential to revolutionize education by enhancing learning engagement through personalized, interactive and adaptive tools. However, realizing this potential requires addressing significant challenges like low digital literacy, inadequate power supply and limited access to technology, as they pose formidable obstacles. By fostering collaboration among educators, policymakers and technology developers, and by prioritizing inclusive and

ethical AI solutions, we can harness the transformative power of AI to create more engaging, equitable and effective learning environments for all students.

Suggestions for Improvement and the Way Forward

The following suggestions were made for leveraging artificial intelligence (AI) to enhance learning engagement:

1. There is need for the federal government and private stakeholders to prioritize improving access to reliable electricity, internet connectivity and affordable digital devices to enable the effective use of AI tools in schools.
2. Government at all levels need to prioritize the deployment of AI tools in underserved and rural areas to bridge the digital divide and ensure that all students, regardless of socioeconomic status, benefit from AI-driven education.
3. The ministry of education needs to offer comprehensive training programs for educators and students to improve digital literacy and ensure they can effectively use AI-powered tools in teaching and learning.
4. There is need for the National Universities Commission (NUC) and National Commission for Colleges of Education (NCCE) to incorporate AI literacy and tools into teacher training curriculum to equip educators with the skills needed to effectively integrate AI into their teaching practices.
5. The ministry of communications and digital economy needs to develop clear policies and guidelines to address data privacy, security and ethical concerns, ensuring that AI tools are used responsibly and transparently.

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