A Study of the Role of Artificial Intelligence (AI) in Promoting Educational Equity and Access in African Higher Education Institutions

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DOI: 10.22178/pos.117-33

LCC Subject Category: L7-991

Received 27.02.2025
Accepted 25.05.2025
Published online 31.05.2025

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Abstract. Artificial intelligence has been a revolutionary force for transformative change in higher learning, with significant potential for enhancing educational equity and access, particularly for African universities. This research aims to investigate how artificial intelligence can enhance and promote educational equity and access to higher education in Africa. An experimental basis for deploying artificial intelligence for educational initiatives was piloted here. The outcomes of this research suggest that artificial intelligence can serve as a primary agent for promoting equity in higher education through virtual classes and open access to learning materials, thereby enhancing social integration and providing equal opportunities for learning through automated teaching and adaptive learning tools. Research also highlights several challenges faced when implementing artificial intelligence in African universities, including data and security issues, as well as policy and techno-economic concerns. Furthermore, the study highlights that to ensure the successful implementation of artificial intelligence in African higher education, there is a need for robust policy frameworks on AI adoption and technological infrastructure.

Keywords: Artificial Intelligence; Institutions; Africa; Equity; Learning.

INTRODUCTION

Higher education supports socio-economic growth by advancing social mobility, alleviating poverty, and equipping individuals with essential skills for economic participation. Authors [1] indicate that inequalities in higher education opportunities exist worldwide, with the most significant disparities occurring in the developing world, where structural barriers to participation restrict marginalised groups. According to authors [2], just 6% of young adults in low-income countries pursue higher education, compared with 40% in high-income countries. This wide gap highlights the challenges that disadvantaged groups face in accessing opportunities for professional and academic growth. Millions are deprived of the opportunity to improve their standard of living due to inadequate access to higher education, further exacerbating social and economic inequalities.

In Sub-Saharan Africa, higher education remains largely inaccessible, with a gross enrollment ratio of only 9.4%, which is significantly below the global average of 38%. This limited access to higher education contributes to social stratification and hinders economic growth [3]. Several factors contribute to educational inequality, including financial constraints, inadequate infrastructure, and a lack of available resources, which make it difficult for students to access higher education. In South Africa, issues such as insufficient funding for students, academic preparedness, and linguistic barriers persist, continuing to hinder equal access to higher education [4]. Additionally, poor infrastructure, financial constraints, and a lack of qualified lecturers in Ghana have significantly restricted access to education among undergraduate students, potentially slowing the country's progress toward achieving a middle-income level and meeting its development goals [5].

Furthermore, Artificial Intelligence (AI) can make higher education accessible and equitable for Africans [6]. It can achieve this through machine learning, natural language processing, and data analytics. These tools can significantly enhance educational equity by ensuring that students from less advantaged backgrounds receive the necessary support to excel in colleges and universities [7].

To fully maximise the potential of artificial intelligence in higher education, African institutions

would need to invest in the necessary infrastructure for technology, increase AI literacy among educators, and implement policies that provide inclusive access to AI-enabled learning platforms. The utilisation of an inclusive platform for incorporating AI has the potential to bridge the education divide and make higher education more accessible and equitable on the continent [6]. The objective of this study is to examine the role of artificial intelligence in fostering equity and accessibility in African higher education institutions. The research will also cover various AI innovations and consider the challenges encountered by African institutions in the process of utilising this technology.

RESULTS AND DISCUSSION

Theoretical Framework for the Application of Artificial intelligence in education

Constructivist Learning Theories and Personalised Learning. The author [8] asserts that learning is constructed through meaningful interaction with the environment based on the prior experiences and cognitive abilities of the learner. This is supported by the principles of personalisation made possible by AI through adaptive learning and intelligent tutoring systems. AI tools also individualise learning experiences based on individual learning styles and paces, enabling learners to engage with educational content optimally.

Diffusion of Innovations Theory and AI Adoption. This theoretical framework evaluates crucial determinants that influence the adoption and utilisation of AI technology in schools, including perceived usefulness, compatibility with values, and usability [9]. From this model, we gain strategic knowledge on how to best facilitate the universal adoption of AI for teaching, making technology available, accessible, and valuable for many students.

Equity Principles in Education. According to the author [10], who argues that learning equity is the basis on which the theoretical framework relies, with AI technology designed and implemented with accessibility and inclusivity in mind. With the use of predictive analytics and AI-based interventions, students can be identified and provided with targeted solutions, thereby offering them equal opportunities and access to learning assets. These initiatives are crucial for ensuring social integration so that all students, regardless of socio-economic status, geographic location, or learning capacity, can participate in and benefit from AI-based forms of learning [11].

Education in Africa

Education in Africa is at a crossroads, facing a two-fold challenge: universal access and the quality of learning. The application of Artificial Intelligence (AI) in education presents a revolutionary opportunity to revolutionise learning environments all over the continent. Cultural considerations continue to play a significant role in shaping learning among learners worldwide, and in Africa specifically, Indigenous languages remain an integral part of school curricula from childhood to adulthood [12].

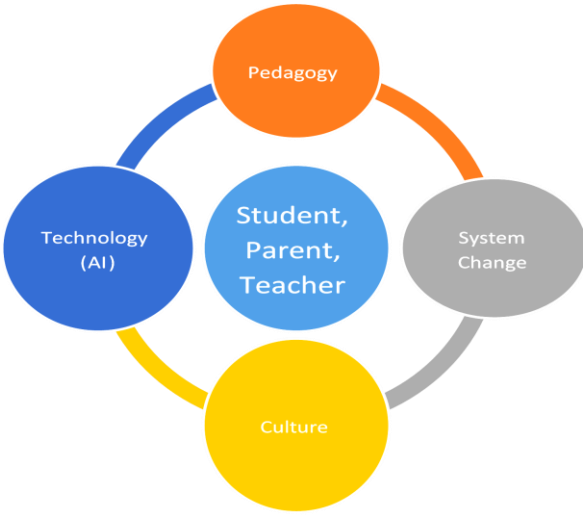

Figure 1 – Schematic Landscape of Education [13]

The context of education in Africa is complex and shaped by a range of social, economic, and cultural factors. Despite the expansion of educational opportunities, significant challenges persist in achieving equity and quality in education for all [14]. Universal primary education has been completed, with notable progress in most countries in Africa; however, persisting inequalities in access to education persist in rural areas and areas affected by conflict.

According to authors [15], disparities in educational access are higher in marginalised communities with high dropout rates and inadequate infrastructure – e.g., few classrooms, libraries, and technology – still being a limiting factor. Access to learning resources, such as textbooks and instructional materials, is often limited, thereby hindering effective learning.

Furthermore, the quality of education varies between regions, with some curricula becoming

outdated when compared to modern educational standards. Another serious issue in some regions across Africa is a shortage of qualified teachers, particularly in remote areas with poor access to professional development and teacher training programs. Improving such programs is essential to equip educators with skills to manage diverse classrooms [4].

Author [16] also noted that linguistic diversity also hinders education delivery as Africa boasts a very high number of languages. It is challenging to find a suitable language of instruction that can enhance learners' comprehension of lessons. There is still limited access to higher education due to financial constraints for institutions, as well as a limited capability for research and development of infrastructure. There is also a digital divide, characterised by low internet and technological penetration, that hinders the adoption of emerging education technologies and practices.

AI in Higher education as a tool for Educational Equity

The application of Artificial Intelligence (AI) in higher education has the potential to increase educational equity while also presenting significant challenges and complexities. Authors [17] argue that AI has the potential to personalise learning, improve accessibility to learning materials, and provide individualised support to disadvantaged learners. In contrast, challenges of algorithmic bias, online accessibility, and reinforcement of existing inequalities suggest a requirement for a balanced and properly managed application of AI in higher education.

AI can provide personalised learning through instruction that complements individual student requirements and learning rates. Adaptive learning platforms are highly effective for disadvantaged student groups, including low-income students and those with disabilities. By adapting content delivery, AI can eliminate disparities in engagement with faculty and ensure that students receive the academic support they need [18]. Author [19] argued that AI personalisation might perpetuate inequalities in the process by using biased or inaccurate data in the underlying algorithms.

Aside from personalisation, AI-based tools play a significant role in making educational assets more accessible to everyone. According to authors [20], virtual assistants and chatbots powered by AI can provide academic assistance 24/7, filling gaps for students who lack direct access to instructors or school resources; this benefits non-traditional students, as well as those who learn online or work full-time and pursue academic work on the side. However, the author [21] warns that although AI presents various learning opportunities, it also has the potential to exacerbate the digital divide. Learners from lower socio-economic backgrounds or those living in rural areas may lack the necessary technology infrastructure, including high-speed internet and high-end computing devices, to utilise AI-empowered learning spaces fully.

Role of AI in Providing Equity and Access in Education

Artificial intelligence in education can bridge the community divide by offering quality education, offering learning opportunities and facilitating social integration. With AI technology, educational institutions can make learning more inclusive and dynamic by catering to the various needs of students [22].

Access to Quality Education. AI learning platforms provide high-quality learning materials to remote and disadvantaged students, increasing access to education through online courses, virtual classrooms, and interactive learning modules [23]. Not only do online platforms increase learning acquisition, but they also enhance learner engagement and interaction. Moreover, AI-based systems are inclusive in terms of learning style, as learners can learn at their own pace with personalised instructions and feedback.

One of the strengths of AI for learning is that it can analyse students' learning data and identify areas where there are gaps in learning, offering customised assistance to fill these gaps and enhance academic achievement. AI technology has the potential to bridge learning inequalities by providing equal quality learning opportunities for students from diverse socio-economic and geographic backgrounds [22]. Due to the greater emphasis on technology's role in influencing learning in modern times, technology-driven innovations, including virtual tutors and adaptive learning platforms, offer transformative learning possibilities [24].

Equal Learning Opportunities. AI has the potential to identify and bridge gaps in learning for students through regular learning progress monitoring, thereby pinpointing areas that require

support. With targeted interventions and additional learning materials, AI-based systems have the potential to improve educational equity by providing all students, regardless of their geographical location or socio-economic background, with equal opportunities for achievement [25].

While AI can precisely identify learning gaps, overdependence on AI can overlook and lead to personalised, human-centred interventions that consider the specific situations and requirements of individual students [26]. Moreover, disparities in access to AI-based learning materials across different regions and schools can exacerbate existing learning disparities. Teachers should, therefore, balance AI use with personalised teaching methods to provide inclusive support to students [27].

Social Integration. AI facilitates social integration by enabling co-learning and peer-to-peer engagement with students from different backgrounds. Virtual classrooms and online study forums would allow students to interact with peers from diverse regions and communities, fostering a sense of community and facilitating the exchange of knowledge and learning. AI monitoring of student learning patterns and engagement assists with social integration through personalised recommendations for study sessions and group work, fostering cooperation and participation [28].

By filling gaps in cooperation and communication, AI facilitates diversity and inclusion in the classroom, thereby improving the learning environment for students. Kamalov et al. [26] argue that this transition in education enables learners to acquire the required social competencies and cultural sensitivity to succeed in a global world. AI-powered tools also facilitate easy engagement between learners and those who are different, helping them broaden their worldview and perception of the challenges that confront the world.

AI-Driven Innovations in Higher Education

Artificial Intelligence, or AI, has been transforming various fields, and higher education institutions are no exception. The application of AI in the academic environment has been revolutionising teaching practices, administrative functions, student learning, and research activities.

Personalised Learning. AI adaptive learning platforms such as Coursera, Edraak, and ULesson are offering adaptive study materials to students across Africa. They identify students' learning patterns, areas of strength and weakness and offer them customised study materials [29]. These platforms improve student engagement and retention. Also, AI-powered personalised learning platforms are gaining acceptance by African institutions as these e-learning platforms are capable of tracking students' progress and adjusting learning by individual learning patterns [30]

Artificial Intelligence-based personalised learning has also bridged the class size limitation in African higher learning institutions, whose student attention is limited – AI platforms, such as those of Tutor. AI, adopted by the University of Nairobi, presented students with personalised study guides and interactive exercises, which translated to improved academic performance [31].

Chatbots for Student Support. Student support systems are now enhanced with AI-powered chatbots that provide immediate responses to inquiries about admission, course enrollment, study advice, and general administrative issues. African institutions are now adopting chatbots to bridge communication gaps and enhance student engagement [32]. The University of Cape Town has an Advisor who assists students on a 24/7 basis and offers responses to queries on application processes, financial support, and study choices. Additionally, Stellenbosch University offers Smart Recruit, which assists potential students with information on how to apply and program suitability, thereby decreasing staff administrative burden [33].

Several institutions have implemented AI chatbots on student platforms to provide efficient interaction with the administrative departments for students [34]. AI chatbots free human counsellors from routine and repetitive queries by responding to them, allowing the university staff to handle more complex student-related issues.

Research and Academic Writing. AI facilitates research by instantly processing large amounts of data, enabling the recognition of patterns and the creation of valuable insights. IBM Watson and Google Scholar AI are part of the software used in literature reviews and predictive analytics. AI-powered research software has been implemented by African institutions, such as the University of Dar es Salaam and Cairo University, to facilitate manageable data-intensive studies in

fields related to climate change, epidemiology, and agricultural studies [35].

According to the author [36], AI tools aid learners and researchers in improving work quality through grammar and style suggestions, auto-summary, and translation. This is particularly helpful for African multilingual nations, where academic texts have been translated into other languages with the aid of AI-based translation software. South African, Kenyan, and Nigerian universities have utilised AI-based language processing software to assist students with diverse linguistic backgrounds in learning and achieving academic success with ease [36].

Furthermore, AI plagiarism detection tools such as Turnitin encourage academic integrity by identifying research works or papers that are not authentic and providing originality reports. Authors [35] have indicated that institutions such as the University of Lagos and Addis Ababa University are utilising these tools to enhance academic quality and promote student originality. These Universities have adopted policies that mandate AI plagiarism detection to prevent academic dishonesty and enhance the quality of scholarly work.

Case Studies and Success Stories

Various studies on AI research indicate how AI can bridge gaps across systems, drive better learning outcomes, and make learning more inclusive. Opportunities presented by AI aside, infrastructure, digital literacy, and regulation continue to influence AI adoption in higher education.

In Uganda, authors [37] examine the opportunities and challenges that the adoption of AI presents in higher education. The study highlights the potential for AI to usher in a technological revolution that will drive industrialisation and innovation on the continent. AI-powered chatbots, virtual teaching assistants, and intelligent learning platforms are being explored as tools to provide students with immediate academic support, thereby reducing the need for traditional classroom interactions. The study also examines the infrastructural constraints that hinder the widespread adoption of AI in African universities, underscoring the need for targeted investments in online learning.

The issue of AI governance in African higher education institutions has also garnered significant attention. Authors [38] conducted a study on AI ethics in higher education, with an emphasis on insights from Africa and beyond. The study addresses the primary challenge of integrating AI ethics into university curricula, particularly in African computer science and engineering programs. The research also explores current and future conditions for AI ethics education, provides best practices for teaching in the classroom, discusses organisational concerns, and reflects on real-world applications of several theoretical frameworks for AI ethics.

Barriers to AI Implementation in African Higher Education

Policy. One of the significant challenges to implementing AI in African universities is the absence of a comprehensive policy framework. For African countries to effectively implement AI in learning and teaching, a thorough policy overhaul is necessary, including amendments to existing laws and the enactment of new regulations that cater to the special needs of the education system [39]. There must be a structured policy framework that ensures industry engagement and the long-term use of AI in the education sector.

Additionally, authors [40] noted that the actualisation of potential AI value depends on strong systems of governance that must be incorporated into a transparent and effective policy framework. While the identification of the role played by AI in enhancing the competitiveness of institutions has gained momentum, the majority of Africa's higher education institutions lack explicit data strategies to assist AI in performing at its optimum capacity [41].

Techno-Economic Issues. The deployment of AI in African higher education is hindered by significant techno-economic factors, including inadequate infrastructure, limited access to advanced data centres, and a lack of AI proficiency [42]. Optimisation of AI for learning requires a strong technology base; however, many African institutions and governments are characterised by unreliable IT infrastructures. AI deployment requires stable networks, high-performance computing, and stable internet connectivity – facilities that remain scarce on much of the continent [42].

Additionally, the lack of technical infrastructure, AI capabilities, and integrated data structures, as well as weak regulatory environments, significantly limits the application of AI in the educational system. These disparities generate unbalanced opportunities, affording intellectual and economic advantages to some countries, societies, and individuals relative to others, at least in the short term [43].

Security and Data-related Issues. Although AI has the potential to enhance teaching and learning significantly, its application in African higher education institutions raises significant concerns regarding security and data privacy. Authors [17] assert that AI systems rely on the collection and analysis of personal data on students and employees, and thus, data protection becomes a significant issue. Sustaining the ethical and secure handling of information presents a vital concern, particularly in jurisdictions where laws on data privacy and the means to implement and enforce them are inadequate.

In addition to privacy concerns, educational systems based on AI must be designed with safety and security in mind. Verification, validation, and self-awareness in adversarial environments are necessary to ensure the responsible use of AI [44]. As more academic institutions incorporate AI, the participants in the educational programs may be at heightened risk, with their personal information compromised and their data potentially abused.

The efficiency of AI systems is directly impacted by the quality and reliability of the data on which they operate. When input data are biased, incorrect, or ill-informed, AI output will similarly be imperfect, leading to unexpected results for decision-making and academic assessment [45].

CONCLUSIONS

There is tremendous potential for Artificial Intelligence (AI) to bring access and equity to African universities by addressing long-documented challenges, including a lack of resources, teacher shortages, and disparities in learning opportunities. AI technology can provide personalised learning, adaptive tests, and intelligent tutoring systems that adapt to diverse learner needs, making learning inclusive and accessible for all, regardless of geographical and socio-economic limitations.

AI can make higher education more accessible to underprivileged students by utilising AI-enabled assistive technologies, thereby making learning more inclusive. AI can help bridge the digital divide by offering new learning models, such as mobile-based learning, which is especially relevant in areas with limited traditional learning centres. However, AI adoption in African higher education has been hindered by several challenges, including inadequate infrastructure, low AI literacy, data privacy concerns, and a lack of coordinated policy guidelines. These factors will require addressing through cooperation by governments, institutions, technologists, and policymakers. Investment in AI infrastructure, human capital development, and the establishment of ethical norms for AI applications in education will play a crucial role in fostering inclusive and responsible AI adoption.

Furthermore, AI can restructure higher education access and equity in Africa to make it scalable, inclusive, and personalised. Its effective adoption in higher learning institutions depends on strategic investment, policy, and willingness to address infrastructural and ethical dilemmas. If African nations apply AI responsibly, they can establish a more inclusive and technologically advanced higher education system that empowers learners and advances long-term socio-economic development.

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