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Abstract
Artificial Intelligence (AI) has transformed numerous sectors of the global economy including education. In Kenya for instance, its integration in teacher education has enhanced learning experiences thereby improving pedagogical outcomes and fostering innovation. This study examines the potential risks and benefits of incorporating AI into various facets of teacher education in Kenya. By leveraging AI, teacher education programmes can harness advanced technologies to transform teacher training. Personalised learning powered by AI algorithms allows educators to address their strengths and weaknesses and tailor content and methodologies to their needs. Furthermore, immersive technologies such as virtual and augmented reality enable educators practice real-world classroom scenarios in a controlled environment. The experience of integrating AI in teacher education in South Korea demonstrates a proven blueprint that Kenya can replicate. Despite the merits of deploying AI in teacher education, there are challenges that its use poses such as ethical concerns and inequitable access to technology among others. This study underscores the importance of strategic planning and stakeholder involvement to ensure AI's responsible deployment in Kenyan Teacher Education ultimately transforming teaching and learning outcomes across the country.

Introduction

While AI holds immense potential to revolutionise teacher education in Kenya, its implementation is fraught with challenges. The Kenyan education system grapples with infrastructural, financial, and technical constraints that could impede the effective adoption of AI technologies. Furthermore, ethical concerns and the potential displacement of teachers pose significant risks (Gwagwa *et al.*, 2021). Despite these challenges, limited research exists on the implications of AI integration in teacher education within the Kenyan context. This study aims to bridge this gap by providing a comprehensive analysis of the potential benefits and risks associated with AI deployment in teacher education in Kenya.

AI is revolutionising education systems worldwide by introducing innovative tools and methodologies that enhance teaching and learning processes (Makinde *et al.*, 2024). AI encompasses technologies such as machine learning, natural language processing, and data analytics, which enable systems to adapt and respond to the individual needs of learners. It has been employed in a variety of educational applications, from intelligent tutoring systems to predictive analytics

concerning student performance. Additionally, it fosters personalised professional development, adaptive assessment systems, and simulation-based training environments for teacher education.

Countries such as South Korea have harnessed AI to transform teacher education by providing both pre-service and in-service teachers with adaptive learning platforms that facilitate real-time feedback, skills assessments, and personalised learning paths (Park & Kwon, 2024). Furthermore, technologies like Augmented Reality (AR) and Virtual Reality (VR) create immersive simulation environments that offer practical teaching experience in a controlled, risk-free setting (Kayyali, 2024). These advancements ensure that teachers are well-equipped to effectively meet the diverse needs of learners.

In Kenya, the adoption of AI in education remains in its early stages (Fundi *et al.,* 2024). The Kenyan Competency-Based Curriculum (CBC) is undergoing significant reforms to align learning outcomes with the demands of the 21st century (Chisom *et al.,* 2021). However, the integration of AI in teacher education has not been thoroughly examined. This presents a unique opportunity to utilise AI technologies for teacher preparation and professional development. As Kenya endeavours to achieve the Sustainable Development Goal (SDG) of inclusive and equitable quality education, AI could help to address teacher shortages, bridge competency gaps, and enhance pedagogical practices.

Kenya has launched an AI strategy for 2025–2030, aiming to position the country as a leader in AI across various sectors, including education (Ministry of Information, Communications and the Digital Economy, 2025). This strategy emphasises the importance of AI in modernising the education sector, particularly in enhancing teacher training and competency development. The success of this strategy could be crucial in ensuring that Kenyan teachers are prepared to meet the demands of contemporary classrooms.

Despite Kenya's efforts to integrate AI technologies into education, numerous challenges hinder the process, including limited access to electricity and internet connectivity in rural areas (Makala *et al.*, 2021). Additionally, inadequate funding, outdated curricula, and insufficient access to modern teaching tools have further contributed to the issues surrounding AI integration. To address these challenges, the government has initiated programmes such as the Digital Literacy Programme (DLP) and has partnered with private sector organisations to promote digital learning and teacher training.

Significance of AI in the Context of Teacher Education in Kenya

Teacher education is the cornerstone of any effective education system. In Kenya, the education sector encounters significant challenges that can be addressed through AI. For example, personalised learning platforms can cater to the individual needs of teachers (Kaswan *et al.*, 2024), while AI tools such as VR and AR can enhance teacher preparation by simulating classroom environments, enabling pre-service teachers to practise and refine their skills in realistic yet controlled settings (Kayyali, 2024). Moreover, data-driven decision-making powered by AI can assist teacher training institutions in identifying skill gaps and designing targeted interventions.

This study is pertinent to Kenya's education system as it offers insights into how AI can tackle challenges in teacher training and enhance pedagogical outcomes. By identifying the opportunities and risks linked with AI deployment, the study provides valuable recommendations for policymakers, educators, and technologists to ensure that AI integration in teacher education aligns with the country's educational objectives and values.

Teacher Education and AI: Lessons from South Korea

South Korea offers valuable insights into the transformative impact of AI on teacher education. AI-powered platforms provide customised training modules that enable teachers to address their specific weaknesses (World Bank, n.d.). VR environments simulate classroom challenges, such as

managing disruptive students or incorporating inclusive practices (Kayyali, 2024). Real-time analytics monitor teachers' performance, offering actionable insights for improvement. These innovations have led to better-prepared teachers, enhanced student outcomes, and a more resilient education system (Park & Kwon, 2024). Kenya can learn from these experiences to develop and implement AI-driven solutions tailored to its unique context.

Theoretical Frameworks Related to AI in Education

The integration of Artificial Intelligence (AI) in education can be understood through various theoretical perspectives that provide insights into how technology transforms teaching and learning processes (Funid *et al.,* 2024). Constructivist theories emphasise the significance of active learning, where knowledge is acquired through interaction with the environment. AI tools align with this perspective by facilitating personalised and adaptive learning experiences tailored to individual needs, thus enabling students to engage deeply with content at their own pace (Wang'ang'a, 2024).

Socio-cultural theories, particularly Vygotsky's Zone of Proximal Development (ZPD), emphasise the significance of guided learning and social interaction. AI reinforces these principles by providing collaborative learning platforms, intelligent tutoring systems, and virtual agents that act as facilitators. These systems scaffold learning by delivering timely support, promoting peer collaboration, and bridging the gap between what learners can achieve independently and with assistance (Irshad *et al.,* 2021).

Connectivism, a theory that centres on learning in the digital age, also provides a pertinent framework (Mukhlis et al., 2024). It emphasises the significance of technology in connecting learners with diverse sources of information and facilitating knowledge-sharing across networks. AI technologies enhance connectivist learning by aggregating resources, analysing data, and creating networks that link learners with experts and peers around the globe.

Global Trends in AI Deployment in Teacher Education

On a global scale, AI has emerged as a transformative tool in teacher education, reshaping traditional methods of professional development and instructional preparation. In developed countries like the United States and Finland, AI-powered platforms are employed to assess teacher competencies, deliver targeted training modules, and automate administrative tasks. These systems not only enhance efficiency but also promote a more personalised approach to teacher development.

Simulation-based training utilising Virtual Reality (VR) and Augmented Reality (AR) has become increasingly popular as a means to deliver immersive teaching experiences (Cheng *et al.*, 2015). For example, TeachLivE, a mixed-reality platform, enables pre-service teachers to practise classroom management and instructional strategies in a controlled environment. Such simulations help educators to develop confidence and competence prior to entering actual classrooms.

Initiatives are underway in developing countries to explore the potential of AI, despite existing infrastructural challenges. Nations such as India and South Africa have begun to integrate AI into teacher training programmes, concentrating on scalable solutions like mobile-based learning platforms and AI-enabled learning management systems (Arakpogun *et al.,* 2023). These technologies assist in bridging the gap between resource constraints and the need for quality teacher education.

Potential Benefits of AI in Education

Numerous studies have underscored AI's transformative potential in education. Personalised learning, facilitated by AI algorithms, enables students to receive customised content and feedback tailored to their unique learning profiles (Ojo, 2024). Another significant advantage is the capacity to provide real-time feedback. Intelligent tutoring systems, such as those developed by companies

like Squirrel AI, analyse student interactions and offer instant feedback, allowing learners to swiftly address misconceptions (Ojo, 2024).

Furthermore, AI can automate routine tasks such as grading and attendance tracking, allowing educators to concentrate on more impactful activities. Immersive technologies, including VR and AR, improve teacher preparation by simulating real-world classroom scenarios (Shikokoti & Reuben, 2024). These tools enable educators to experiment with various teaching methods, manage diverse classrooms, and develop strategies for addressing challenging situations.

Risks Related to AI

The deployment of AI in education is associated with significant risks and challenges. Data privacy concerns and algorithmic bias take centre stage (Micheni *et al*., 2024). The potential for teacher displacement also raises questions about the role of AI in education. While automation can alleviate the administrative burden on teachers, it may also amplify fears of job insecurity. Furthermore, the digital divide presents a considerable challenge, as access to AI technologies often depends on the availability of reliable internet connectivity, electricity, and financial resources (Nyaaba, 2024). This disparity risks exacerbating existing educational inequities between urban and rural areas, as well as between developed and developing countries. Ethical considerations, including the transparency and accountability of AI systems, remain critical (Mauti & Ayieko, 2024). Stakeholders must therefore ensure that AI applications in education are designed and implemented in ways that prioritise fairness, inclusivity, and respect for human autonomy.

Methodology

This study utilised a desk review approach to examine the opportunities and risks associated with deploying Artificial Intelligence (AI) in teacher education in Kenya. By focusing exclusively on secondary sources, the research aimed to provide a comprehensive understanding of existing knowledge and to identify gaps in the literature. The exploratory nature of this study sought to evaluate AI's potential applications and challenges within the Kenyan education system by synthesising insights from a variety of documents. The review prioritised sources published between 2015 and 2025. Emphasising recent and relevant sources ensures that the study remains up to date and contextually significant while offering valuable insights into the rapidly evolving field of AI and its implications for education.

Data Sources

The desk review utilised a variety of secondary data sources to provide a comprehensive perspective on the research problem and ensure a well-rounded analysis. It encompassed documents such as policies and strategic plans, insights into Kenya's educational goals, and the integration of technology within learning environments. Academic literature, including peer-reviewed journal articles, conference proceedings, books, and industry reports from technology firms and non-governmental organisations (NGOs), was also incorporated.

Data Analysis Methods

The data collected was analysed thematically to uncover patterns, opportunities, and risks associated with the integration of AI into teacher education. Each theme was assessed for its relevance and applicability to the Kenyan context. The analysis also aimed to identify gaps in the existing literature. By synthesising findings from various sources, the study seeks to construct a cohesive narrative on the potential and challenges of AI in teacher education.

Ethical Considerations

This study adhered to ethical research standards. All sources were meticulously cited to ensure proper acknowledgement of the original authors and to avoid plagiarism. The credibility and reliability of data were prioritised by focusing on peer-reviewed and official documents from

reputable institutions. Objectivity was maintained throughout the research process to ensure that interpretations and conclusions were unbiased and supported by credible evidence. Transparency in methodology and source selection was also upheld.

Results and Discussion

Opportunities AI Provides for Teacher Education in Kenya

AI presents numerous opportunities to enhance teacher education in Kenya by tackling longstanding challenges and paving the way for a more effective and inclusive educational system (Langat, 2025). A significant opportunity lies in the utilisation of adaptive assessments, where AI-driven tools analyse the strengths and weaknesses of individual teacher trainees, facilitating tailored learning pathways. These assessments also deliver targeted feedback, ensuring that pre-service teachers receive support in their most critical areas, thereby promoting skill development at an individualised pace.

Virtual Reality (VR) teaching simulations, provided through platforms such as TeachLivE and other AI-driven VR tools, enable pre-service teachers to engage in immersive classroom scenarios (McGarr, 2020). These simulations mimic real-world teaching environments, allowing trainees to practise classroom management, interact with virtual students, and refine their instructional techniques. Such experiences are invaluable in preparing educators for diverse classroom dynamics, particularly in a country like Kenya, where classrooms range from under-resourced rural schools to well-equipped urban institutions.

AI also facilitates professional development through personalised learning platforms (Kioko, 2022). These systems analyse teaching behaviours, monitor progress, and recommend customised training modules that promote continuous professional growth while equipping educators with the essential tools to adapt to evolving pedagogical demands (Nyaaba, 2024). Furthermore, AI can assist in alleviating the administrative burden on educators by automating tasks such as grading, attendance tracking, and scheduling (Makala *et al*., 2021). In a context like Kenya, where teacher-student ratios are frequently high, minimising the administrative workload can significantly enhance teaching effectiveness and job satisfaction.

Risks Associated with AI Deployment

The implementation of AI in teacher education in Kenya is not without its risks. A primary concern is the widening of equity gaps. Access to AI-driven technologies often relies on dependable internet connectivity, electricity, and financial resources, which are unevenly distributed throughout the country (Samuel-Okon *et al*., 2024). Rural schools and disadvantaged communities may lack the necessary infrastructure to adopt AI solutions, further exacerbating the educational divide between urban and rural areas.

Another challenge is a lack of technical support and expertise. Implementing AI systems demands a skilled workforce capable of maintaining and troubleshooting these technologies. In many Kenyan institutions, the absence of sufficient technical support can lead to underutilisation or abandonment of AI tools, negating their potential benefits (Arakpogun *et al*., 2024). Furthermore, teachers may lack the digital literacy needed to engage effectively with AI platforms.

Ethical concerns also emerge significantly in the discourse surrounding AI in education. Data privacy, for instance, remains a critical issue (Mauti & Ayieko, 2024). Furthermore, algorithmic bias poses a risk to fairness and inclusivity. Another concern is the potential over-reliance on AI, which may result in the marginalisation of human judgement in teaching (Zhai *et al*., 2024).

Implications for Teacher Preparation Programmes and Curriculum Design

The integration of AI into teacher education requires a re-evaluation of traditional teacher preparation programmes and curriculum design. To fully harness AI's potential, programmes must include digital literacy and technology as fundamental components. This involves training pre-service teachers to use AI tools effectively, interpret data analytics, and assimilate technology into their instructional practices.

Curriculum design must also evolve to accommodate the capabilities of AI. Adaptive learning systems, for instance, can provide personalised learning pathways for teacher trainees. This necessitates a shift from standardised curricula to more flexible and individualised approaches that cater to diverse learning needs. Furthermore, the curriculum should emphasise the ethical use of AI, equipping teachers with the knowledge to navigate issues such as data privacy and algorithmic bias.

Capacity building is essential for the successful integration of AI. This involves equipping teacher educators with the skills and knowledge needed to assist trainees in utilising AI tools. Professional development programmes should concentrate on enhancing educators' digital literacy and ensuring their familiarity with the pedagogical applications of AI. Such initiatives can cultivate a culture of innovation and continuous learning within teacher education institutions. Policymakers and educational leaders must also take part in establishing an enabling environment for AI adoption. This requires investing in infrastructure development, particularly in underserved areas, to ensure equitable access to AI technologies. Furthermore, forming partnerships with technology providers can help reduce costs and supply schools with the resources necessary to implement AI solutions effectively.

It is crucial to recognise that, although AI presents transformative opportunities for teacher education in Kenya, its successful integration requires addressing various challenges. By promoting collaboration among stakeholders and prioritising equity, capacity building, and ethical considerations, Kenya can harness AI's potential to enhance teacher preparation and cultivate a more effective and inclusive educational system.

Recommendations for Policymakers, Educators and Technologists

To maximise the opportunities offered by AI while minimising its associated risks, targeted recommendations for policymakers, educators, and technologists are essential. The recommendations are as follows:

Policymakers

Policymakers play a critical role in fostering an enabling environment for the successful integration of AI in education. Therefore, investments in infrastructure development should be prioritised to enhance internet connectivity, ensure reliable electricity, and provide access to digital devices, especially in rural and underserved areas. These foundational improvements are essential for equitable access to AI technologies. Developing robust regulatory frameworks is equally important, as they promote fairness, inclusivity, and the responsible deployment of AI systems in education.

Fostering public-private partnerships can also mobilise resources and expertise for AI integration. Collaborations among government agencies, educational institutions, and technology providers can accelerate the adoption of innovative solutions and ensure that AI technologies are designed to meet the specific needs of the education sector. Furthermore, funds should be allocated for capacity-building initiatives that enhance educators' and technical staff's digital literacy.

Educators

To promote the potential of AI, educators must embrace continuous learning and engage in professional development opportunities that deepen their understanding of AI tools and their pedagogical applications. Familiarity with these technologies is crucial for effective implementation.

Technologists

Technologists play a vital role in designing and deploying AI systems that meet the specific needs of the education sector. User-friendly platforms that are intuitive and accessible can enhance adoption rates and maximise the impact of AI technologies. Furthermore, robust measures should be implemented to protect the sensitive information collected by AI systems, thereby fostering trust among educators and stakeholders. Providing ongoing technical support and training is also essential to ensure the continued functionality and relevance of AI tools.

Policymakers, educators, and technologists must work together to establish a supportive environment for AI integration (Maina & Kuria, 2024). This entails investing in infrastructure, promoting public-private partnerships, and advancing research to develop innovative solutions.

Conclusion

This study highlights that integrating AI into teacher education in Kenya presents a substantial opportunity to transform the teaching profession and tackle long-standing challenges within the education sector. By utilising adaptive assessments, VR simulations, and personalised learning platforms, AI can enhance teacher preparedness, improve professional development, and bridge resource gaps.

Future research could investigate the long-term effects of AI integration on teacher performance, student outcomes, and overall educational quality. Studies into AI-powered education models for rural and marginalised communities, as well as the ethical challenges of AI integration in teacher training, may also be conducted. An assessment of the feasibility of scaling AI-driven solutions across diverse educational contexts, while identifying best practices and potential barriers, could further be explored. In addition, interdisciplinary research that combines education, technology, and social sciences might be pursued to develop holistic solutions for the deployment of AI in education.

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