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Towards a critical discourse on artificial intelligence and its misalignment in sub-Saharan Africa: Through an equality, equity, and decoloniality lens

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Abstract

There is some technological rationality in the discourse on artificial intelligence (AI) in the education sector outside the socio-economic realities of sub-Saharan Africa. We argue that the discourse on AI in education often concentrates on utopian perspectives from advanced industrial societies as a tool to resolve socio-economic crisis. Therefore, the aim of this study was to scrutinise the AI space in education, and unpack and delineate the AI concept because digital inequalities remain a crucial concern in developing economies. The dominant AI narrative from advanced industrial societies promotes the benefits of AI, and therefore, this article applied the digital equity and decolonial lenses to reflect on the multifaceted impact of AI in education and the consequences of digital inequity in sub-Saharan Africa. Our argument is that any technological rationality in the emergence of AI could worsen existing disparities instead of fostering inclusivity. The analysis of various frameworks and the imbalance AI narratives through an equality, equity, and decoloniality lens scientifically grounded this research.

Keywords: artificial intelligence, decoloniality, equality, equity, sub-Saharan Africa, technological rationality

Introduction

In sub-Saharan Africa, research and development in artificial intelligence (AI) in education seems to be taking place outside the socio-economic realities of the region. Inescapably, AI in the education context raises profound questions on teaching, learning, the role of educators, and the social and ethical implications of its application in the education sector. AI has

emerged as a challenge to traditional teaching and learning paradigms and has revolutionised various sectors, including education. Therefore, it is vital to understand the relationship between AI and education for equality and equity. However, in sub-Saharan Africa, the absence of necessary digital literacy, AI literacy, and digital skills marginalise education practitioners and create a variety of ethical issues (Dlamini, 2022a; Levinson et al., 2022; OECD, 2018). Moreover, the inadequate data quality and accessibility are the root causes of the "persistent colonial repercussions, leading to biases in AI solutions and disparities in AI access based on gender, race, geography, income, and societal factors" (Ayana et al., 2023, p. 1). Beyond the education sector, AI tools have become a priority; however, in education their application requires a curriculum and pedagogical rethink.

Under the influence of prevailing global frameworks, many countries in sub-Saharan Africa are embracing frameworks characterised by McGarr (2019) as "linear, decontextualized and deterministic" (UNESCO Institute for Information Technologies in Education et al., 2022, p. 3). In sub-Saharan Africa, success in education remains strongly linked to family socio-economic status (Dlamini, 2022a) and therefore, for transformative pedagogies characterised by learner-centredness, inclusivity and digital orientation are critical. The key frameworks in the education sector have been the Sustainable Development Goals (SDGs; Wennersten & Qie, 2018) and UNESCO's *Guidelines for ICT in Education Policies and Masterplans* (Miao et al., 2022). These frameworks have shaped the global discourse on information and communication technologies (ICT) in the education agenda that "combines often contradictory rights-based, social justice and economic competitive objectives" (Isaacs & Mishra, 2022, p. 2). In this case, AI is contemporary and requires multiple perspectives to explore its educational affordances and the understandings it engenders in the education sector about educational equality, equity, and decoloniality. While researchers have not universally agreed on a single definition for AI, there are several commonly accepted descriptions. However, the common understanding is that AI involves the creation of systems that simulate human intelligence to enable them to perform tasks such as reasoning, learning, and problem solving.

The potential of AI-infused education is well documented, but in sub-Saharan Africa, the digital divide remains a wicked problem (Dlamini, 2022a; Maringe & Chiramba, 2022; Ndzinisa & Dlamini, 2022; Wentrup et al., 2016). AI literacy is a requirement to experience the full benefits and make optimal use of AI-based tools in education to stop the reproduction of pre-existing inequalities across generations. However, there is insufficient literature in relation to AI and education in the sub-Saharan region, and hence, this study was necessary to bridge the AI literacy knowledge gap. With no known tools for predicting throughput, learner attainment, and personalised learning pathways, AI-driven education platforms could generate data that are not tied to a certain geographical or socio-economic status for analysis and decision-making. The inclusive data generated would bridge the gap on the inherent biases in training data (Ayana et al., 2023; Vibbi, 2024) and in the long run, dismantle existing inequalities in educational outcomes (Okoruwa et al., 2022).

The collection and analysis of extensive student data harvested in AI-driven systems in the sub-Saharan region could enable the customisation of educational content based on context. Therefore, the following research questions drove this study:

- To what extent would decolonial and contextual AI systems resolve the imperialist legacy of linear and decontextualised digital education solutions?
- How are the imbalanced imperialist-dominant narratives reproduced in the AI discourses in sub-Saharan Africa?

The relevant theoretical concepts used to adequately answer these questions are explained in the next section to dismantle the techno-romantic rhetoric of AI in education. We analysed the imbalanced narratives propagated by industrialised economies and thus, explained the potential affordances of AI through an equality, equity, and decoloniality lens.

The sub-Saharan Africa context

While sub-Saharan Africa has not been known for its rapid technological advancements and development, the region has renewed its focus to integrate and accelerate digitalisation. There is now therefore an ever-growing need to better understand how emerging technologies such as AI enable economic development and growth, especially in a linguistically and socio-economically diverse region. The majority of empirical literature acknowledges that technology in developed economies is at the forefront of economic growth and development (Saba et al., 2023). However, the peculiarities of sub-Saharan Africa in terms of low digital literacy and socio-economic and cultural diversity demand innovative ways to digitally include the region.

Even in 2024, AI in the sub-Saharan Africa region is still in its infancy and countries in sub-Saharan Africa "rank lowest on the government readiness scale for AI adoption" (Akpudo et al., 2024, p. 45). This is despite the AI's potential for equitable education, poverty alleviation and health services improvement (Akpudo et al., 2024; Gwagwa et al., 2021). Some governments are benefiting from international funders to integrate AI and data-optimisation technologies into governance activities; however, the education sector is ignored. In this context, the lack of readiness to integrate AI in education is a consequence of insufficient funding and low digital literacy skills. There are pockets of countries such as South Africa, Rwanda, Ghana, and Senegal having the highest levels of AI uptake in the business sector (Gwagwa et al., 2021). Currently generative AI such as ChatGPT dominates the discourse on AI in education and according to Zhang et al. (2023, p. 2), AI technologies "have the potential to significantly impact the education sector by providing personalized learning experiences for students and automating administrative tasks for educators." While the potential of AI in education is well documented, sub-Saharan Africa must be enabled first via digital assets to empower livelihoods of the poor.

The complexity of the sub-Saharan region demands deeper understanding of the interplay between digitalisation and the SDGs. We therefore argue that an interdisciplinary investigation of the articulation of the interplay between digitalisation and the SGDs is

critical especially its alignment to quality education. To start with, cross-country disparities in digital literacy, digital infrastructure, internet connectivity, and digital technologies have severe impact on adoption and appropriation of emerging technologies. Thus, in sub-Saharan Africa, the thriving AI ecosystem is driven by multinational companies such as Amazon, Google, Microsoft, and Huawei (Okolo et al., 2023). Hence, our argument on aligning AI ecosystems with sub-Saharan Africa's unique context and that the region would benefit from the support of international development partners and multinational companies. Notwithstanding, the possibilities of opening up to external agendas, local governments and leadership could own the AI initiatives.

Theoretical foundations: Equality, equity, and decoloniality

Equality "relates to the notion of sameness; in this, the provision that fairness and justice are achieved by giving everyone the same" education (Willems, 2019, p. 152), while equity in education means "that all schools and education systems provide equal learning opportunities to all students" (OECD, 2018, p. 22). Given the sharp increase in education inequalities, improving equity, which is about meeting people where they are with what they need to be successful (Levinson et al., 2022), has become more urgent. Decolonisation refers "to the process of transferring legal, administrative, and territorial power from colonial hands to indigenous local governments, and thus the establishment of modern nation states independent from European empires" (Adams, 2021, p. 179). Poor data quality and lack of technological resources in sub-Saharan Africa impact ethical AI systems, and this can be attributed to many years of exclusion from the digital revolution. Adams (2021) questioned the conception of intelligence within technology, and the way in which knowledge is built in AI.

While studies in a developing country context widely document the benefits of AI in education, there are still gaps in the literature on its adoption and usage in sub-Saharan Africa. Hence, this research sought to closely scrutinise the AI space in education and to extensively unpack and delineate the concept of AI while sending an open invitation to the discourse on AI's place in education in the region. Ayana et al. (2023, p. 1) argued that there have to be "deliberate efforts to deconstruct imperial structures governing knowledge production, perpetuating global unequal resource access and biases." Adams (2021, p. 177) concluded that the "statistical enumeration of people and land—were advanced by imperial powers to control and contain colonial populations." Therefore, the disparities in AI adoption and usage in sub-Saharan Africa are a cause for concern given the enduring legacy of colonialism that manifests itself in the global AI ecosystem (Ayana et al., 2023). The absence of valuable insights and experiences from sub-Saharan Africa contributes to the inherent biases of AI, which can lead to a significant exclusion of the region.

The sub-Saharan region is characterised by paradoxes such as increasing digital inequalities, educational inequalities, uneven access to digital education resources, low levels of teachers' digital competences, and inadequate digital development opportunities (Akpudo et al., 2024; Gwagwa et al., 2021; Okolo et al., 2023). Miao et al. (2022, p. 6) pointed out that SDG 4 was

adopted to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all"; however; the sub-Saharan Africa region, without well-resourced ICTs in education, continues to be left behind. AI for transformational change in education is critical as it "offers academic administrators' insights into learners' profiles and predictions, admission decisions and course scheduling, attrition and retention and student models and academic achievements" (Tan, 2023, p. 335). With the aim of achieving SDGs 4 and 10, quality education and reducing inequalities, respectively, overcoming educational challenges such as inadequate digital infrastructure, digital exclusion, and lack of professional development opportunities is critical to maximise the potential of AI.

Problem statement and overall argument

Many scholars have noted the digital divide in sub-Saharan Africa. In essence, digital literacy plays an important role in accelerating the adoption and usage of digital technologies (Dlamini, 2022a; Maringe & Chiramba, 2022; Radovanović et al., 2020). Wentrup et al. (2016, p. 77) described the digital divide as "an emblematic term for the inequality of information and communication technology access." An important point to remember is that the sub-Saharan region faces multifaceted challenges on digitalisation, including ICT and digital literacy. As such, many of the digital device distribution programmes do not equate to adoption and integration, leaving most sub-Saharan countries to remain digital deserts. Interestingly, countries in sub-Saharan Africa score high on mobile technology distribution yet remain low on digital literacy, which is a key performance indicator for sustainable development (Deen-Swarray, 2016; Okpe, 2022). In this case, we refer to SDG 10, which is reducing inequalities within and among countries (United Nations, 2015).

While the gap in digital access has been narrowed via mobile devices, the divide between those able to access the internet and those still in the internet desert is wide (Ndzinisa & Dlamini, 2022). Deen-Swarray (2016, p. 29) asserted that "the absence of necessary skills marginalizes even those who can access and afford to use ICT services." At the technological frontier, AI tools are positioned to carry out numerous tasks that were the sole preserve of human beings. Notwithstanding AI educational affordances, two important factors must be considered when positioning AI as a magical tool to resolve educational challenges in the sub-Saharan region, namely context and complexity. Radovanović et al. (2020, p. 151) explained that the "lack of solutions such as local language digital interfaces, locally relevant content, digital literacy training, as well as the use of icons and audio excludes a large fraction of illiterate people." While we acknowledge that in the education sector, AI has the potential to revolutionise education systems, in this article, AI literacy and techno-solutionism were our biggest concerns.

At the same time, we argue against technological rationality because of the existing disparities and social gaps in the sub-Saharan region. Along with efforts to implement AI in the education sector, much of the academic discourse has been on ethical concerns. In the words of Schiff (2021, p. 332), with new technology "come[s] utopian reformers and dystopian cynics." However, sub-Saharan Africa cannot afford to be left behind because of

perceived ethical concerns about AI. In the past, Plato, speaking through Socrates in Phaedrus, "feared that writing would lead to forgetfulness and the appearance of wisdom without the reality" (Schiff, 2021, p. 332). In this case, we argue that "history is a useful lens with which to understand" (Schiff, 2021, p. 332) the educational affordances of AI. Therefore, this research article used a forward-thinking educational lens that can help to situate the educational affordances of AI in the bigger picture. The objectives of the study are:

- To closely scrutinise the AI space in education and extensively unpack and delineate the concept of AI.
- To explore the dominant narrative on AI from the digital equity and decolonial lenses regarding implied hegemonies.

Artificial intelligence: Key features

Chen et al. (2022, p. 28) described AI as a "machine-based technique with algorithmic power for making predictions, diagnoses, recommendations, and decisions." Kelly et al. (2023, p. 2) defined AI as "an unnatural object or entity that possesses the ability and capacity to meet or exceed the requirements of the task it is assigned when considering cultural and demographic circumstances." Accordingly, because AI and data are foundational in building a data-driven culture and intelligent organisations, these characteristics can be leveraged in the building of intelligent education systems to meet the needs of learners with disparate learning styles that do not benefit from current schooling systems (Chen et al., 2022; Guan et al., 2020; Limna et al., 2022). Datasets are fundamental to building accurate and reliable AI systems that can make informed decisions and predictions.

Chen et al. (2022, p. 28) defined AI as "a machine-based technique with algorithmic power for making predictions, diagnoses, recommendations, and decisions." These intelligence education systems have the capacity to analyse and assess each learner's strengths and weaknesses, and then recommend learning content to better meet the unique needs and abilities of each student (Alam, 2023; Guan et al., 2020; Ouyang et al., 2022). Cost-effective automated AI solutions make it imperative to anticipate an AI ecosystem that can help overcome the various challenges linked to SDGs 4 (quality education) and 10 (reduced inequalities). The predictability of AI could promote education platforms that "evaluate student progress and recommend specific parts of a course for students to revisit or additional resources to consult" (Pedró, 2020, p. 64). Importantly, AI-based systems could promote digital education innovations that are socially and economically inclusive.

Another application of AI is predictive analysis. According to Pedró (2020, p. 64), predictive analysis "is being used in student support is in early warning systems, analyzing a wide range of data—academic, non-academic, operational—to identify students who are at risk of failure or drop-out, or who have mental health problems." AI-based education systems provide information on students' performance and behaviour that is critical in decision-making processes. Incorporating AI-based technologies in education ensure ongoing analysis of

student progress to provide timely educational resources and support such as learning pathways and cognitive scaffolding (Fu et al., 2020; Guan et al., 2020; Pedró, 2020).

Literature review

It is predicted that "AI will saturate most industries, with an estimated US $15.7 trillion contribution to the global economy by 2030" (Kelly et al., 2023, p. 1). Given that AI is estimated to contribute significantly in the global economy, it is critical to understand AI in the education sector. However, most of the literature reviewed focused on the technology and not on educational needs (Ng et al., 2023; Sen et al., 2021). There are different types of AI, but in this study, we looked beyond the narrow definition of AI associated with generative AI tools and also considered AI tools that perform analysis, interpret data, customise digital learning interfaces at all levels of education, and prepare smart content (Chatterjee & Bhattacharjee, 2020; McKinsey Consultant, 2024).

In the education sector, there is no appropriate definition of AI except for definitions of specific AI-driven tools such as generative AI, whose common example is the tool, ChatGPT (McKinsey Consultant, 2024). This could be the gap to fully understand real AI instead of the idea of AI. Therefore, a critical consideration is the inclusion of AI literacy in curriculum design to better prepare learners for the digitally driven economy. AI literacy is defined as the "digital competencies necessary in which AI transforms the way that we communicate, work, and live with each other and with machines" (Ng et al., 2023, p. 8446). Among the 17 SDGs established by the United Nations (2015), Goals 4 (quality education) and 10 (reduced inequalities) are expected to ensure all students will have access to quality and equitable education.

Many studies adequately discussed the importance of AI in education but did not derive contextually specific insights on AI's place in education, especially in the developing world context (Fu et al., 2020; Guan et al., 2020; Ouyang et al., 2022; Pedró, 2020). It is important to note that in other industries where AI has been strategically positioned, the affordances of AI are clear. Therefore, with the imminent benefits of AI in education, it could be embedded in learning management systems to provide a competitive advantage and enhance student performance (Dlamini & Ndzinisa, 2020). In the education sector, learning management systems harvest a lot of students' data yearly and, given the complexity of educating a diverse population of students, emerging technologies such as AI can be useful to share insightful information on current students derived from the processed data.

Learning management systems are online educational platforms that give learners the power over their own educational pace and provide multiple entries to cognition (Dlamini & Ndzinisa, 2020). In today's context, mass technification and technological rationality are a reality, but it is critical to explore the extent to which AI systems can resolve educational inequality. The dystopian point of view on AI is that it is a crossroads, especially in sub-Saharan Africa, which is characterised by ethnic and socio-economic diversity. The intersection of AI and education could perpetuate educational inequalities, thus requiring careful consideration around ethical, social, economic, and cultural implications (Farahani &

Ghasemi, 2024; Ouyang et al., 2022). Disparities in digital access can create digital divides. Sub-Saharan Africa is at the periphery of AI-based algorithms to support new emerging pedagogies that transcend socio-economic barriers so "educational systems can be responsive to all learners' needs" (Bulathwela et al., 2024, p. 1). Increasingly treated homogeneously, sub-Saharan Africa could benefit from AI-based systems in terms of social inclusion, economic growth, poverty reduction, equality, and equity.

However, the importance of sub-Saharan African datasets to train algorithms to promote inclusivity is critical to benefit from AI-based systems. Farahani and Ghasemi (2024, p. 1) confirmed that "algorithmic biases embedded in AI systems can perpetuate discrimination and inequity, particularly against marginalized communities." In sub-Saharan Africa, the digital divide limits participation and benefiting from AI-driven innovations because AI technologies are closely linked to digital literacy, and inadequate access to stable internet access is a deterrent to optimal adoption and usage of AI-based technologies (Farahani & Ghasemi, 2024). Thus, a national AI strategy is a requirement for any country to benefit from AI affordances to promote equity, inclusivity, and accessibility (Li, 2023; Salas-Pilco et al., 2022). The transformative potential of AI in education is premised on its capability to present complex concepts with greater clarity and efficacy (Li, 2023), and on allowing teachers to focus on teaching instead of overextended responsibilities.

The status of AI in sub-Saharan Africa

Globally, AI is multifaceted and continues to evolve. In Africa, the status of AI is dynamic and constitutes "social and material conditions that actively configure and shape" (Pargman et al., 2024, p. 74) an increasingly complex teaching and learning environment. The adoption of AI in Africa requires the development of a vibrant digital ecosystem that needs digitally competent teachers, better digital capacity opportunities, and the development of appropriate digital capacity-building initiatives that integrate AI-rich educational settings (Dlamini, 2022b; Gentile et al., 2023; Mhlongo et al., 2023). Africa is not on the radar when it comes to AI in education because of insufficient digital literacy, inadequate digital infrastructure, inadequate digitalisation policies, and lack of funds (Eke et al., 2023; Okolo et al., 2023). Digital literacy skills remain a stumbling block in the adoption and implementation of AI in Africa (Okolo et al., 2023). The ultimate reality test for AI in Africa is its adoption and usage in administration, pedagogical activities, and learning. While in developed countries, AI "played an essential part in altering education during the COVID-19 pandemic by gathering and analyzing student data for adaptive learning in education" (Zhang et al., 2023, p. 2), sub-Saharan Africa battled with issues of digital access and skills.

Therefore, there is substantial demand for research on AI in the sub-Saharan region given the diversity of the education systems with unique education challenges that are characterised by resource constrained contexts. This research would contribute to digital innovations and adaptive AI solutions tailored to the sub-Saharan Africa context. The percentage of individuals using the internet in Africa is estimated at 37%, compared to the global average of 73% (International Telecommunication Union, 2023). The capacity-building pyramid in

Africa, especially surrounding AI, can be ascended by addressing the AI knowledge gap and understanding the benefits of AI in promoting inclusive and equitable education solutions. Unsurprisingly, the sub-Saharan region continues to lag behind other regions by a sizeable margin, despite some improvement in the percentage of individuals owning a mobile phone (International Telecommunication Union, 2023). The complexity of the sub-Saharan region requires an AI research agenda grounded in the regional context. However, several countries, such as South Africa, Kenya, Mauritius, and Nigeria, are emerging as frontrunners within the global AI ecosystem (Shao et al., 2023).

Mauritius is credited with having the first fully formalised national AI strategy in Africa (Jaldi, 2023). According to Jaldi (2023), the two top sub-Saharan countries in the 2022 global Government Artificial Intelligence Readiness Index are Mauritius (57th in the world) and South Africa (68th in the world). The sub-Saharan region is missing out on revolutionising its economies and benefiting from the AI contribution of "$15.7 trillion to the global economy by 2030" (Shao et al., 2023, p. 1). According to Eke et al. (2023, p. 2), "people's contextual understanding of reality must be represented in the design and implementation of the technology to improve acceptability." In Africa, the biggest challenges are resource-constrained contexts, the digitalisation knowledge gap, and the lack of standardised interoperability between different AI systems and e-learning platforms (Eke et al., 2023; Mhlongo et al., 2023; Okolo et al., 2023). However, progress has been made in Tunisia, Rwanda, Ghana, Kenya, South Africa, Nigeria, and Mauritius on the use of various AI tools in the education and health sectors.

According to Diallo et al. (2024, p. 2), "African nations face unique challenges in their path to utilizing AI-enabled technologies to improve their governance and economic outcomes." These challenges include data access, digital infrastructure limitations, inadequate digital skills, limited AI regulatory frameworks, and AI strategies at national government level (Diallo et al., 2024; Okolo et al., 2023; Shao et al., 2023). Okolo et al. (2023, p. 40) stated that "the lack of investment by African governments into infrastructure necessary for supporting digital economies has hampered the growth of digital literacy." The disparity in digitalisation in Africa, "has limited the ability of artificial intelligence applications to be effective, meaning that these tools are able to operate in a functional manner that does not compound existing inequities, within such contexts" (Okolo et al., 2023, p. 35). Mboa-Nkoudou (2023) emphasised the need for Africa to move away from technocoloniality. Mboa-Nkoudou explained technocoloniality as "when the use of technology in a particular way causes a colonial way of thinking that seeks to exert power, control and domination, often to replicate colonial patterns of oppression" (2023, p. 1810).

Shao et al. (2023, p. 2) provided examples of how some sub-Saharan African countries have used AI: Rwanda uses "AI chatbots to triage scarce resources," South Africa employs "AI-driven drought forecasting tools for more reliable predictions," Ghana and Rwanda use "drone-based blood delivery systems," Togo uses "AI to analyze satellite imagery and identify the most vulnerable citizens for effective economic aid," and lastly, Ethiopia pioneered "the development of natural language processing and translation tools for local

languages." However, for effective adoption and implementation of AI in Africa, the following requirements must be met: locally trained workforce, sufficient digital infrastructure, representative datasets, frameworks appropriate for fair use of digital technologies, and AI policies (Ade-Ibijola & Okonkwo, 2023; Kiemde & Kora, 2020).

In sub-Saharan Africa, the disengagement between systems and lack of standardised frameworks hinders the seamless exchange of information to generate representative datasets. Despite the myriad challenges in the sub-Saharan Africa region, higher education institutions and policy makers are developing strategies to maximise AI potential to enable individualised and adaptable educational experiences, and data-driven decision-making (Hamza et al., 2025). By leveraging AI-powered learning management systems, higher education institutions can modernise traditional approaches to teaching and learning (Sharma & Singh, 2024) and improve continuous professional development opportunities (Hamza et al., 2025). A majority of the literature confirms the affordances of AI in education such as enhancing teacher professional development, student data analysis to support personalised learning, and automation of administrative tasks (Hamza et al., 2025; Khlaif et al., 2025; Sharma & Singh, 2024). According to Khlaif et al. (2025, p. 1), AI "is now able to perform a range of complex tasks, including conducting text analysis, understanding natural language, and even demonstrating creativity in writing and problem solving." The ability to conduct text analysis will benefit the sub-Saharan Africa's linguistically diverse context and revolutionise interactive educational practices and digital education resources development (Ouahani & Mahraj, 2025). Text analysis is an advantage to sub-Saharan Africa given the biases in AI especially on issues of plagiarism. AI can also be used by teachers to create inclusive instructional activities and provide timely feedback to students (Molefi et al., 2024). However, our biggest worry is the dearth of empirical research addressing AI in education in the sub-Saharan region.

Hence, this analysis broadens the understanding of how AI can be harnessed to address sub-Saharan Africa's education disparities. Critically, the study holds the potential to inform the adoption, appropriation, and integration of AI in the education sector in sub-Saharan Africa. Notwithstanding the progress made, the AI-driven technology adoption literature in the developing context is still in its infancy stage, meaning little is known about the critical success factors that could affect the adoption of AI in sub-Saharan Africa with its multifaceted disparities and social gaps.

Landscape of artificial intelligence in education

The adoption of AI in the education sector can address unique challenges of content creation, curricular creation, student support, and traceability. Put succinctly, AI deals with the extraction, transformation, and processing of data to make accurate predictions and drive decision-making (Pancha & Prabhakar, n.d.). The COVID-19 pandemic accelerated the need for digitally innovative solutions with AI-enabled applications to optimise educational endeavours (Almarzooq et al., 2020; Fu et al., 2020). Importantly, AI is a collection of different technologies, algorithms, and multimodal data, and therefore, teaching and human

cognitive functions may be enhanced through smart content, data, intelligent systems, automatic tutoring systems, and adaptive systems. Fu et al. (2020, p. 1675) confirmed that "sophisticated AI algorithms have been applied in the innovative educational products to support automated instructions as a supplement of face-to-face lecturing." In pedagogical contexts, there are many examples of the effective use of a wide range of types of AI-enabled applications in the developing world.

Although there are many potential benefits of using AI in education, it remains largely underutilised in sub-Saharan Africa because of limited resources, understanding, and skills. Before the COVID-19 pandemic, AI-enabled applications served as an add-on, but these applications have become a catalyst for educational equity. AI-enabled applications provide support for learners' cognitive development and enhance instructional activities to ensure inclusivity (Dlamini, 2022b; Fu et al., 2020; Mhlongo et al., 2023). However, a sustainable framework for teachers' professional practice to embed AI-enabled education platforms is critical to ensure a systematic integration. The pedagogical possibilities with AI-based systems in a wide range of teaching contexts are extensive but need careful consideration from teachers. However, generative AI is creating increased concern across the education sector, especially ChatGPT given that it violates academic integrity when used inappropriately. Generative AI refers to technology that can create new content such as text, images, or code based on user input (UC Berkeley, 2024).

Interestingly, in another context, generative AI technologies were cited as an example that, "learners can connect the knowledge they acquire with real-world problems" (Chang et al., 2024, p. 216). However, the implementation of AI-enabled innovative education solutions depends on structural and cultural characteristics, supportive organisational culture, and a collegial work environment (Dlamini, 2023; Tondeur et al., 2017; Yu & Dlamini, 2024). The reality of educational practice is a complex pedagogical task that requires the analysis of various analytics to provide appropriate educational support and resources. Hence, from the perspective of precision education, AI could do the following:

> AI technologies could analyze and predict learners' academic achievement, and intelligent tutoring systems could provide personalized instruction or support to students by understanding learners' learning status and behaviour, diagnosing students' learning status and giving feedback automatically, to assist teachers with instructional assessment. (Wang et al., 2021, p. 116)

AI can become an educational application because of its "ability to personalize experiences, reduce workloads, and assist with the analysis of large and complex datasets" (Educause, 2019, p. 27). Rizvi (2023, p. 2) confirmed that AI has the potential to revolutionise education by "providing personalized learning experiences, automating tedious administrative tasks, and boosting student involvement." However, the potential of AI in education remains somewhat unexplored. For example, according to Schiff (2021, p. 332), distance education "typically replicates existing classroom structures such as textbooks and lectures, often putting them into a video format, and lacks 'intelligent' features that characterize AI in

education" (p. 332). This indicates the need to make ethical, equitable, inclusive, and effective use of AI to support education.

The potential benefits of AI in education have been well documented to include "tailored instruction, adaptive assessments and clever tutoring systems" (Rizvi, 2023, p. 2). These benefits are substantial and therefore, the education sector needs to invest in smart learning platforms and digital technologies. Smart learning platforms may assist in tracking learners' progress, flagging areas of concern, enabling adaptive assessment, and "AI-powered transcription services, audio and video materials can be converted into accessible formats such as text-to-speech features, closed captioning, and audio descriptions" (Rizvi, 2023, p. 2). The opportunities that AI brings in education include (1) learning analytics to improve personalisation, (2) intelligent tutoring systems to improve cognition, (3) prediction and profiling to improve learning pathways, (4) intelligent systems supporting administrative activities, and (5) evaluation and assessment (Alam & Mohanty, 2022; Almaiah et al., 2022; Jaldi, 2023). This indicates that AI applications have many potential benefits in education, especially smart teaching and learning environments to enhance pedagogical activities.

Conclusion

This study has provided a nuanced understanding of the intersection between AI and education, and located AI in education in its broader social, economic, and cultural settings. Given the realities of sub-Saharan Africa, AI should be embraced as a strategic pillar to achieve the SDG goals. However, the Western domination of AI systems results in the exclusion of sub-Saharan Africa because digital resources and capacity constraints are a reality in this region. Given the low level of financing for digitalisation in education, especially in sub-Saharan Africa, there is an urgent need for research to inform the implementation of the latest technologies like AI. Administrative, teaching, and learning activities in the schooling sector need to be refreshed with smart and customisable content (Chatterjee & Bhattacharjee, 2020). The highly contested definition of AI, "the nature of AI promises to bring about fundamental socio-cultural changes in Africa" (Jaldi, 2023, p. 5), requires new ways of thinking to expand public-private collaboration for ethical AI development.

These new ways of thinking will also dismantle the techno-romantic rhetoric of AI in education and replace it with a more balanced narrative. AI is looked at "as an important vector of revival of the traditional sectors of the economy, as well as for creating a new pillar for the development of the country in the next decade and beyond" (Jaldi, 2023, p. 8). The literature reviewed showed that there are four categories in which AI tools have been positioned in the education sector for administrative services, academic support services, as well as assessment, and evaluation.

The study aimed to answer the following research question: "To what extent would decolonial and contextual AI systems resolve the imperialist legacy of linear and decontextualised digital education solutions?" Sub-Saharan Africa is a complex and diverse region, and therefore, an educational solution is necessary to overcome the geographic and

content access challenges. With the increase of mobile devices, AI technology informed learning platforms can be implemented so "learners can read the materials, practice and collect information at any time" (Wang et al., 2021, p. 117). In addition, AI-based applications in education "can analyze learners' learning process, provide adaptive learning resources, and provide evaluation and suggestions based on learners' performance, which can serve as a learning diagnostic tool" (Wang et al., 2021, p. 116). However, the existing biases in AI-based systems and disparities in the education system could perpetuate stereotypes in an unequal context. Hence, the contextual datasets used in the training, validation, and testing of AI algorithms are important to avoid building AI systems based on a context outside sub-Saharan Africa. Thus, there must be a framework to operationalise AI-enabled tools and systems to maximise their benefits for the effective and ethical use of AI. The framework or guiding principles to operationalise AI-enabled tools and systems are critical, especially in sub-Saharan Africa where there are enormous inequities in education. In such a diverse and unequal context, inequities can be exacerbated if the datasets to be used by AI systems are biased towards developed countries. However, if well used, AI can promote an equitable and inclusive education sector. Datasets from developing economies would democratise AI-based technologies to empower people and increase inclusive innovations.

This study also aimed to answer this research question: "How are the imbalanced imperialist-dominant narratives reproduced in the AI discourses in sub-Saharan Africa?" The advancement of technology is challenging the education sector to prioritise the development of various literacies, such as digital literacy, AI literacy, and data literacy, among education practitioners to adequately cater for the diversity of learners. With the potential to reduce educational inequalities, AI-supported education needs to be pursued to help achieve SDGs 4 and 10. Access to various contemporary literacies would bring a more realistic response to the diverse learner population that needs access to the right content and at the right level of difficulty. This will lead to a wide range of multifaceted instructional resources that will lead to relevant and effective learning outcomes. Notwithstanding the widely recognised affordances of AI, we referred to the absence of classroom-based and ethnographic studies on the multifaceted impact of AI in education and the consequences of digital inequity.

Finally, the synergy between AI and education has the potential to address bureaucratic administrative activities and individual learners' needs, enhance learning experiences, and optimise learning outcomes. However, responsible AI implementation must be ensured through the equitable distribution of AI-enhanced educational resources. Ethnographic-based research on AI in the education sector in sub-Saharan Africa is critical to understand teachers' standpoints on employing AI in their professional practice, and to document AI-based education innovations in a complex and unequal context.

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