Chapter 9

Artificial Intelligence In Education: Africa's Prospects and Challenges

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Introduction

The application of AI (artificial intelligence) in education is not something new as it might appear to be because it has already been integrated in learning and education services for several decades. During COVID-19, Africa, like the rest of the world was faced with challenges associated with the emergence of the pandemic, such as lockdown and social distancing imposed by the WHO (World Health Organisation) to contain the spread of the disease. The lockdown and social distancing resulted in the closure of social spaces such as education institutions and public places. To counter these measures brought by the COVID-19 pandemic and to ensure that businesses continue, organisations immediately turned to remote working using the power of AI tools (UNICEF 2022). In fact, this was the first evidence of a mass application of AI tools to ensure that learning continues in both developed and developing economies (cf. Georgescu & Popescu 2015).

However, though the world adopted AI tools to deliver services for the purposes of business continuity, one notable thing

that has not been explained is whether such application of AI tools in learning institutions, specifically IHEs (institutions of higher education) were uniformly successful in achieving the purpose of education delivery without compromising quality and inclusivity *vis*-à-*vis* exclusivity in the rural parts of the world and explicitly in Africa where the infrastructure of ICT (information and communication technology) is still in a poor state. For education to benefit society, it must be delivered to the whole population without compromising the quality and accessibility. COVID-19 exposed the world's preparedness regarding the application of AI tools in delivering services to populations remotely, and this did not even spare the developed world.

Education is a human right and any application of AI tools should ensure that no one is excluded. AI is an interdisciplinary field of knowledge that was initiated in the 1950s and combines the achievements of computer science, cognitive science, and logic (UNESCO 2021a; UNICEF 2022; Wójcik 2021:437). AI is an umbrella term for various methodologies that are designed to provide computers with human-like abilities of hearing, seeing, reasoning, and learning (Güngör 2020:72). It aims to solve complex problems that are beyond the scope of simple algorithms, and it strives to reproduce and refine the functions of the human mind (Wójcik 2021:438). According to studies, some types of AI have been with humans for quite some time, such as Google search, reading our e-mails, scheduling a doctor's appointment, asking for driving directions, or receiving movie and music recommendations. People are constantly using the application of AI and its assistance in their daily lives (Akgun & Greenhow 2022:439). Similarly, several studies (Akgun & Greenhow 2022:439; Fernández-Batanero, Montenegro-Rueda, Fernández-Cerero, & Menéses 2023:297; Remian 2019) agree that the application of AI in education has substantial benefits to both students and educators. AI, for instance, has a wide range of algorithmic applications in education, including personalised learning systems to encourage student learning, automated assessment systems to assist educators in assessing what students know, and facial recognition systems to provide insights into students' behaviours or identities.

The advancement of ICTs has created chances to increase educational quality and employ various modes of learning, such as blended learning, which combines face-to-face and online learning, or fully online learning (Rugube, Mthethwa-Kunene, & Maphosa 2020:4). Online learning, also known as e-learning, is dependent on the availability of the internet and electronic devices such desktop computers, laptops, tablets, and smartphones. However, some of the main AI tools are not within the reach of most of the population in Africa. The use of computer technology for e-learning has widened access to education while also improving its quality. However, several questions remain unanswered regarding the much-acclaimed improved quality of education because of the application of AI tools to deliver education to students. Taking the application on its face value ignores the fact that AI tools can also open an avenue for misuse or abuse that can circumvent the very purpose of education (Veintimilla, Ulloa, & Veintimilla 2018).

Education is a human right for every child and adult through lifelong learning (Rugube *et al.* 2020:5). As a result, improving access to education opens opportunities for many people who would otherwise have been denied of it. The implementation of e-learning has become necessary, particularly in the wake of the COVID-19 pandemic, which has driven educational institutions to provide remote learning (Rugube *et al.* 2020:7; UNESCO 2021a; UNICEF 2022).

African Context

With around 1.5 billion people residing in its 55 countries, the African continent makes almost 20% of the world's land area and is home to nearly 18% of the globe's population (Worldometer 2024). While 50% of people worldwide reside in rural areas, the percentage is closer to 70% in Africa. With a median age of 19.7 years, Africa is now the youngest continent in terms of population (UN 2022). In SSA (Sub-Saharan Africa), high fertility rates combined with declining infant mortality have led to fast population increase. The emergence of an SSA urban structure and a drastic change in its agriculture are two significant effects of the region's rapid population expansion. This indicates that

Africa will continue to have a high demand for AI technologies and education.

With EdTech (educational technology) solutions, the continent is already utilising digital technology's potential to transform education for kids. The $1 XPRIZE winner RoboTutor, an open-source android tablet programme from Carnegie Mellon University, serves as an illustration of this. It helps youngsters aged seven to 10 who have limited or no access to schools and teachers to learn the fundamentals of reading, writing, and maths without the help of an adult (XPRIZE 2019). Tanzania is currently testing a Swahili version of the AI-enabled RoboTutor, which tackles the severe teacher shortage in developing nations. Although RoboTutor provides amazing prospects for learners who have access to it, it is also important to consider the limitations that might keep some kids from using it and the potential risks of it escalating inequality (Booyse & Sheepers 2024; Bu 2022). Todino, Desimone, and Kidiamboko (2022:240) opine that the governments of the countries of the Global South know that, for example, distance education is the facilitating tool *par excellence*, promoting access to education and ensuring social balance by providing educational content relating to each institution. In addition, there are some critical issues related to teachers' digital skills. Due to a lack of updating in teachers' digital training courses, they are not really prepared to face these new challenges. On the other hand, as the European institutions have repeatedly requested, it is necessary that schools are globally renovated both from a structural and a content point of view.

AI has the potential to expand applications and enhance and expedite procedures. When implementing AI solutions in the real world, the chance for failure must be weighed against the many benefits of the technology (De Klerk & McLean 2024). Inadequate models, flawed datasets, and a lack of time to test and evaluate AI solutions could harm the field's reputation (cf. Grama & Vogel 2016). Among the challenges already associated with AI are the spread of false information and biased scoring and grading of members of minority groups (Dixit, Stefańska, Musiuk, & Singh 2021; Svärd, Guerrero, Balogun, Saurombe, Jacobs, & Henttonen 2024; UNESCO 2021b). Therefore, the moment is right to think

about AI's ethics and how it will affect the lives of various social groups in addition to its crucial role in providing individualised education to ensure that everyone has equal admission to it (Willcocks 2024).

Politicians, corporate executives, and regulators must make difficult choices as they embrace AI's immediate potential while taking society's long-term effects into account. It is hoped that many negative effects can be avoided, and that AI can be used for the greater good by preparing educators and students in the field with a deeper awareness of the risks (Chatelier & Voicu 2018). With a population of about 1.5 billion, Africa accounts for a sizeable share of the global population and ICT is an essential instrument for unleashing the knowledge and creative potential that are ingrained in her people.

In the following section, the prospects of AI tools in Africa's education systems are discussed. The subsequent paragraph begins with prospects and winds up with strategies to overcome the challenges that confront the continent's readiness and ability to roll out and implement AI tools in the delivery and management of education in Africa.

Prospects of AI in Education in Africa

Table 9.1 presents a snapshot of the benefits that AI applications in education can offer to both students and educators, besides other uses. Table 9.1 does not offer exhaustive AI features that are currently in use. As AI keeps evolving every day, it becomes unpredictable to what the next day would be regarding its application with consequences on the users (Meunier, Pikhart, & Klimova 2022).

Table 9.1: Summary of AI technologies currently in use for learning and educational service (UNESCO 2021a; Roschelle, Lester, & Fusco 2020)

AI technologies	Applications
NLP (Natural Language Processing)	For the use of AI to automatically interpret texts, including semantic analysis used in translations, and for generating texts of learning contents, and supporting personalisation processes.
Speech recognition	Covers the application of NLP to spoken words, including smartphones, and provides AI personal assistants within games and intelligent tutoring systems, and for conversational bots on learning platforms.
Image recognition and processing	Employs AI for facial recognition (e.g., for electronic documents and processes in classroom situations), handwriting recognition, text analysis (e.g., to detect plagiarism), image manipulation (e.g., for recognising deepfakes), and for autonomous scoring and grading.
Autonomous agents	Use AI in computer game avatars, software bots, virtual learning spaces, and smart robots.
Affect detection	Employs AI to analyse sentiment in text, behaviour, and faces.
AI underlying	Data mining algorithms for predictive learning diagnoses, progress forecasting, socio-emotional wellbeing analysis, financial predictions, and fraud detection.
Artificial creativity	Uses AI in systems that can create new kinds and exemplars of photographs, music, artwork, or stories.

In the following paragraphs, we will underscore some of the prospects of AI tools in education systems that African countries could capitalise on to promote and deliver education to the marginalised communities. The summary of these prospects is already highlighted in Table 9.1.

Personalised Learning

AI can tailor educational content to individual students' needs, helping them to learn at their own pace and with their personal style, supporting the very essence of the ODeL (open distance

e-learning) philosophy. In an ODeL institution, students are utilising online classes because they want personalised and customised learning, the reason being that each student learns at a different rate and seeks personalised sessions in which they work at their own pace. As a result, e-learning systems can employ AI chatbots to resolve students' course-related enquiries with their recognised educators in real time (Einarsson, Lund, & Jónsdóttir 2024; Ellikkal & Rajamohan 2024). Hence, students have the freedom to speak up, obtain a better understanding, and learn at their own pace. This can aid in ODeL delivery specifically for students who are slow at learning or suffer from dyslexia.

Evidence suggests that AI can help tailor learning in a variety of ways to deliver education to all students from diverse backgrounds (Pedró, Subosa, & Rivas 2019:1579; Kabudi, Pappas, & Olsen 2021:7 of 12). AI assists in creating a better professional atmosphere for instructors to work with students who are struggling. Tutors devote a significant amount of time to routine and administrative duties such as creating assignments and answering frequently requested inquiries in educational settings (Gray, Alma Rahat, Crick, & Lindsay 2024; Kabudi *et al.* 2021:10 of 12). A dual-tutor model, which includes an instructor and a virtual teaching assistant who can take over mundane tasks for the educator, frees up the educator's time, allowing them to focus on student supervision and one-on-one contact (Hidayat-ur-Rehman 2024; Isiaku, Muhammad, Kefas, & Ukaegbu 2024). Tutors have already begun collaborating with AI assistants to achieve the best results for their students.

Furthermore, AI can assist in mapping each student's specific learning plans and directions as well as their strengths and weaknesses – subjects that are more expensive but quickly assimilated or taught – and learning preferences and activities (Jacobs 2024). AI can customise learning and increase possibilities for students by using algorithms to help students navigate diverse topic paths with the assistance of their instructors and classrooms. According to recent assessments, intelligent tutoring systems are part of the new technical options for expanding educational learning in the Global South (Pedró *et al.* 2019; Ouyang & Jiao 2021:5 of 6). In addition, given the enormous amount of

time spent on grading tests and homework, AI as an assessment tool can be used to learn how an educator grades, freeing up the latter's time. AI is being utilised not only to evaluate multiple-choice examinations but also to grade essays (Jina, Yana, Echeverriaa, Gaševića, & Martinez-Maldonadoa 2024). These opportunities are beginning to materialise in the industrialised countries of the Global North. A plethora of applications are now being tested in both public and private enterprises (Pedró *et al.* 2019).

Improved Efficiency

Administrative tasks like enrolment, grading, and scheduling can be automated, saving time and resources. The crucial aspect of having a successful ODeL institution is helping students through the enrolment process. Because the process differs from university to university, it gets cumbersome for candidates. Every student wants easy and quick answers. An AI-powered chatbot that has been 'educated' and set to learn a prospect's admission cycles effortlessly simplifies the admission experience (Kajiwara & Kawabata 2024; Kumar, Kumar, Bhoyar, & Mishra 2024). These chatbots give an admission exam, follow students' performances, shortlist those who qualify, notify them about the next steps and course selections, and answer all their enquiries without requiring human participation (Fleckenstein, Meyer, Jansen, Keller, Köller, & Möller 2024; Kabudi *et al.* 2021:11 of 12). This expedites the procedure by eliminating the customary waiting period required by a human agent.

Enhanced Research

AI assists researchers in data analysis, pattern recognition, and simulations, advancing scientific discoveries. AI can be used in information retrieval for librarians using augmented intelligence solutions, which allow an increase in their natural capabilities in the acquisition, analysis, and processing of information in meeting users' information needs (Kabudi *et al.* 2021:8 of 12; Wójcik 2021:442). The application of augmented intelligence increases the speed and accuracy of the process of retrieving information, missing bibliographic data, or the provenance

of information that is necessary for the precise description of resources (Maniyan, Ghousi, & Haeri 2024; Wójcik 2021:442). Using this feature of AI can enhance the way in which ODeL is delivered to remote and rural areas where physical libraries are, hence assisting in the promotion of teaching and learning. Moreover, AI tools such as chatbots, ChatGPT 3 (Chat Generative Pre-Trained Transformer 3), NOVA AI, IZI AI, ChatGPT 4, and many others have all revolutionised how education can be delivered to the students in real time (Kajiwara & Kawabat 2024; Kumar *et al*. 2024). Chatbots are regarded as one of the most significant advances in the field of AI that can be harnessed to deliver and promote learning to students (Knoth, Tolzin, Janson, & Leimeister 2024; Svärd *et al*. 2024). Currently, these AI chatbots may be found in practically every service; they are present in every field, always assisting in some way – education is one of them.

The majority of AI-powered chatbots in education help students and educators with a variety of duties, including answering questions, offering study materials, measuring progress, and much more. These chatbots can be implemented into educational platforms and learning management systems for student support, tutoring, and overall learning experience enhancement (Kabudi *et al*. 2021:8 of 12; Lee & Kwon 2024). Through the integration of natural language processing and machine learning capabilities, these educational chatbots can converse with students and provide personalised real-time support (Lee, Latif, Wu, Liu, & Zhai 2024; Mitha & Omarsaib 2024). These chatbots are designed to comprehend the user's inquiries and respond with relevant and helpful information (Kabudi *et al*. 2021:9 of 12). Educational chatbots can give answers to questions, study materials, feedback, and even assist in personalised coaching. They make studying more enjoyable and interactive for students and can help educators save time by automating tedious tasks.

Accessibility

AI-driven tools can make education more accessible to students with disabilities, providing them with customised support. Assuring inclusive and equitable educational quality

and encouraging possibilities for lifelong learning for all are the objectives of ODeL. Most people in the countries of the Global South still live in isolated, rural settings with little to no infrastructure supporting AI (Lundall & Howell 2000). These people are therefore marginalised (Pedró *et al.* 2019). AI integration in ODeL, however, can give marginalised individuals and communities, refugees, individuals with disabilities, out-of-school individuals, and residents of remote areas access to suitable learning opportunities. Telepresence robots, for instance, enable students with special needs to continue their education during catastrophes or crises or to attend classes from home or the hospital. It can therefore promote universal access and inclusion for all (Aly 2022; Pedró *et al.* 2019). AI chatbots can be integrated in ODeL education to aid students 24/7 with personalised learning, rapid feedback, cost-effectiveness, accessibility, stress reduction, and enhanced student engagement (Kabudi *et al.* 2021:10 of 12; Nemorin, Vlachidis, Ayerakwa, & Andriotis 2022). As technology improves, AI chatbots will become an increasingly significant element of the educational setting, supplying students with the tools they need to achieve their academic goals and flourish in their chosen areas (Kabudi *et al.* 2021:9 of 12).

Predictive Analytics

AI can predict students' performances and identify those at risk of dropping out, enabling early intervention. While IHEs are hoping for increased efficiency, productivity, and performance because of the use of such advanced technology, both the need for shifting skill sets and a shortage of personnel are frightening the public, which leads to strong opposition to the AI implementation process. Furthermore, the complete adoption of AI in IHEs in developing nations like Africa is being hampered by a lack of experience and exorbitant costs (Mukherjee 2022:161). Communication procedures between students and educational providers are a part of any training and education, and it is crucial to discover which communication modalities are best suited for a given teaching and learning process (Ammah, Lütge, Kriebitz, & Ramkissoon 2024; Frans & Pather 2021). According to Frans and Pather (2021), technologies are becoming increasingly important

in helping educational providers, especially with their daily management and administration. One of the most important ways that technology may help with training and education is by facilitating the transmission of educational resources, specifically course materials (Nemorin 2024). Course materials are a crucial component of the teaching and learning process in all forms of education and training, whether they are delivered in-person or virtually.

As there is much technology that could help with different teaching and learning methods, some of these, like whiteboards or overhead projectors, can be used universally in any kind of educational or training programme, while others like language labs or woodworking equipment may be referred to as specialised technology (Frans & Pather 2021:1580). Once more, this group covers a wide range of technology, from the most basic – like pen and paper – to the most advanced, like computerised simulations. Individual interaction between educators and student groups, as well as in certain cases, between students and their educators, is made possible *via* face-to-face contact (Frans & Pather 2021:1584). Additionally, it enables students to be transported to other sites where the learning environment is centred around the group's immediate surroundings. Examples of these instructional uses include field trips and excursions. When used effectively, human interaction is its strongest point. Contact sessions allow for social engagement, which is often outside the purview of the course subject. During sessions, social interactions and associated learning experiences can be observed, and instructional design can be promptly modified as needed (Frans & Pather 2021). It is possible that both educators and students can sense how a scenario is developing and decide to step in during class. Face-to-face interaction makes it relatively easy for educators to keep an eye on their students' attitudes, involvement, attendance, and engagement levels (Frans & Pather 2021). There are two kinds of technologies:

- *Asynchronous*: Technologies known as asynchronous (or postponed time) do not require participants to be present at the moment of presentation. Postal correspondence,

electronic mail, and computer conferences are a few examples.

- *Synchronous*: Technologies, often known as real-time technologies, necessitate simultaneous interaction between users and are typically planned. Multi-user object-oriented environments like MOOCs (massive open online courses), video conferencing, audio-graphic conferencing, telephony, and audio-conferencing are some of these technologies.

The studies above present several prospects of AI tools in education that policymakers and educators need to be realised. From the literature there is no doubt that AI tools have the potential to address several challenges in African education today. However, in the following paragraph, we will present some of the challenges that currently face the continent's ability and readiness for the roll-out of the AI tools for innovative teaching and learning practices, and finally accelerate the progress towards SDG (sustainable development goal) 4.

Challenges

The concept of AIED (artificial intelligence in education) includes everything from AI-driven, step-by-step personalised instructional and dialogue systems, through AI-supported exploratory learning, the analysis of student writing, intelligent agents in game-based environments, and student-support chatbots, to AI-facilitated student/tutor matching that puts students firmly in control of their own learning process. It also includes students interacting one-on-one with computers, whole-school approaches, students using mobile phones outside the classroom, and much more (De Klerk & McLean 2024; Holmes, Bialik, & Fadel 2019). In Table 2 we highlighted some of the applications of AI in education against the possible challenges and their vulnerability in the society that needs to be addressed wholistically for a smooth implementation. These are challenging issues that require the commitment of everybody involved, as AI is going to stay with humanity.

The present transition from I4R (industry 4.0) to I5R (industry 5.0) is one example. While I4R began in Germany in

2011, I5R began in Japan in 2019. A development of I4R and I5R blends the efficiency, intelligence, and accuracy of robots with the inventiveness of human specialists (Xu, Yuqian, Vogel-Heuser, & Wang 2021). For instance, the world is currently moving forward with I5R, including E5.0 (Education 5.0), which is an advancement over I4R. The inconsistencies found in the previous I4R were the impetus behind the creation of I5R (Breque, De Nul, & Petridis 2021; Moola, Dhurumraj, & Ramaila 2024). The idea behind I5R stems from the observation or presumption that I4R has put more emphasis on digitalisation and AI-driven technologies to increase production efficiency and flexibility than it did on the original principles of sustainability and social justice (Breque *et al.* 2021; Xu *et al.* 2021).

To support the industry in its long-term service to humanity within planetary bounds, the idea of I5R offers a distinct focus and point of view and emphasises the significance of research and innovation. There are several obvious distinctions between I4R and I5R, even though both promote the use of AI-related technology in businesses. I5R, for instance, aims to allay concerns that were connected to the use of AI in education in I4R. It puts equal emphasis on human expertise and technical inventiveness, emphasising sustainability and coexistence (Ajani, Tella, & Oladokun 2024; Moola *et al.* 2024). With human values at the centre of education, I5R has now made it necessary for educators and students to collaborate, think critically, think analytically, and be creative. Thus, E5.0, where technology is seamlessly integrated to tailor and improve learning experiences, is ushered in by I5R. With a focus on creativity, critical thinking, and adaptability, an educator can provide students with the tools they need to succeed in a world that is increasingly driven by technology (Moola *et al.* 2024) – hence, the rise of digitally enabled human-to-non-human connectivity exchanges as well as cooperative human-to-machine interactions utilising AI and machine interfaces. The goal is to establish a synergy that uses digital technologies and data-driven insights to address difficult social issues while promoting economic success through technical developments (Breque *et al.* 2021; Moola *et al.* 2024). These

components of I5R have the potential to improve Africa's chances of advancing education through teaching and learning.

Arakpogun, Elsahn, Olan, and Elsahn (2021:375) contend that while AI capabilities offer Africa some significant advantages, there are several potential drawbacks and unforeseen repercussions that policymakers should be aware of. These issues vary from the risks of automation and job displacement that could impact numerous industries to structural inequality brought on by digital gaps and the low level of digital skills across a sizable section of the African population (Africa Union 2024). Due diligence is therefore required to take these issues into consideration. For instance, this can be done by concentrating on AI technologies that can empower rather than replace workers (educators) and by creating programmes that aim to close the digital divide in African economies (De Klerk & McLean 2024). Additionally, the necessity for a workforce with digital skills is the foundation for AI advancements – hence, closing the digital divide is essential if African nations are to be better positioned to gain from these innovations.

The first challenge is creating a wholistic perspective on AI-related public policy for sustainable development. The intricate technological environment required to progress in this subject necessitates the cooperation of numerous entities and elements. The establishment of an AI ecosystem that supports sustainable development requires collaboration between national and international public policy (Arakpogun *et al.* 2021:380). Creating a sustainable AI connection is included and equitable in education as the second challenge. With the emergence of AI, the least developed nations should see new technological, economic, and societal divides. Establishing the prerequisites for putting novel tactics that use AI to enhance learning into practice requires overcoming certain major challenges, such as the need for fundamental technology infrastructure (Arakpogun et al. 2021:385).

Table 9.2: Concept matrix of the five AI trust challenges and the respective vulnerabilities each creates for stakeholders (Adopted from Lockey, Gillespie, Holm, & Someh 2021:5468)

AI trust challenges	Domain experts	End-users	Society	Overcoming challenges
Transparency and explainability	Ability to know and explain AI output and provide human oversight: Manipulation of erroneous explanations.	Ability to understand how decisions affecting them are made: Ability to provide meaningful consent and exercise agency.	Knowledge asymmetries: Power imbalance and centralisation; Scaled disempower-ment.	Diverse participation from different segments of the communities at the development of stage of the AI tools.
Accuracy and reliability	Accountability for accuracy and fairness of AI output: Reputational and legal risk.	Inaccurate/harm-ful outcomes: Unfair/discrimina-tory treatment.	Entrenched bias/inequality: Scaled harmed to select populations.	Inclusive of diverse race, ethnicity in the development of the AI tools.
Automation	Professional over-reliance and deskilling: Loss of expert oversight; loss of professional identity; loss of work.	Loss of dignity (humans as data points; de-contextualisation; loss of human engagement; over-reliance and deskilling.	Scaled deskilling: Reduced human connection; scaled technological unemployment; cascading AI failures.	Retraining and development of employees.
Anthropo-morphism and embodiment	Professional over-reliance: Psychological wellbeing.	Manipulation through identification: Over-reliance and over-sharing.	Manipulation through identification: Human connection and identity.	Policy to restrict the users.
Mass data extraction.	Accountability for privacy and use of data: Reputational and legal risk.	Personal data capture and loss of privacy: Inappropriate re-identification and use of personal data. Loss of control.	Inappropriate use of citizen data: Mass surveillance; loss of societal right to privacy; power imbalance and societal disempowerment.	Privacy laws on the use of personal data.

Lack of Infrastructure in General and Network Infrastructure

Notably, the adoption of the AI ethics frameworks, the desire to adopt AI technologies, and the awareness of AI ethics issues are all influenced by a variety of factors, including aspects as commonplace as access to electricity, civil and political stability, internet penetration, and quality education (Ruttkamp-Bloem 2023:18). Africa is struggling with other basic and pressing issues affecting its population which made the investments and financing of AI infrastructure roll out nearly impossible.

According to David and Grobler (2020:1415), most African nations have poor fixed line and internet access telecommunications penetration rates. While internet penetration is higher in Algeria, Botswana, and South Africa respectively, fixed line telecom penetration is higher in Mauritius, Libya, and Egypt (David & Grobler 2020:1415; Patel & Ragolane 2024; Roschelle *et al.* 2020). The slope of the curves showing the relation between ICT penetration, economic growth, and development in Africa indicates that, overall, the CIT (computers and information technology) – a measure of ICT penetration – has a positive impact on economic growth and development in Africa (Owusu-Agyeman 2024). However, the positive impact is greater in economic growth than in economic development (David & Grobler 2020:1415).

It is necessary to spend more in fixed line and internet access telecommunications because these services are not widely available in most African nations. This will increase fixed line and internet access subscriptions to lower the cost of electronic communication and advance Africa's digital economy (David & Grobler 2020:1415). In addition, Ade-Ibijola and Okonkwo (2023:110) believe that the deployment of AI technologies in Africa is beset by other obstacles, including a lack of technical expertise, uncertainty, structured data, government regulations, ethics, and user attitudes (Table 2). According to Asongu and Le Roux (2017), AI can increase educators' efficiency in the classroom while also helping them to stay competitive and learn more about their students. Today, Africa has the lowest ICT usage rate globally, although SSA has the highest ICT growth rate. Our

findings consolidate the need to promote ICT penetration and/or the adoption of more inclusive development. While the findings of this inquiry demonstrate the relevance of ICT for socio-economic benefits, we concede that the affordability and lack of relevant infrastructure constitute substantial barriers to access (cf. Asongu & Le Roux 2017:47). The governments of sampled countries should formulate and implement policies that enable universal access mechanisms via low pricing and sharing schemes and increase the infrastructure needed for ICT penetration (Asongu & Le Roux 2017:48).

Of all the continents, Africa has the youngest population. It is also the second largest and second most populous continent in the world. A younger population means greater potential for innovation and economic progress as well as a larger future workforce (Africa Union 2024). Therefore, it is essential that every nation has the AI skills necessary to prepare people for workplaces where human-AI collaboration is the norm (Africa Union 2024; Sanusi, Oyelere, & Omidiora 2021:5 of 10). The factors listed below in sections, prohibit South African schools from utilising computers for instruction and learning (cf. Lundall & Howell 2000).

Insufficient Funds

The educational and nonformal educational systems in Africa would have to be more generously funded and managed by people who understand how technology can be applied the best at minimal costs, since many African countries are still struggling in terms of national incomes (Oduaran 2019:35). Adult and distance learning in Africa would have to drift more rapidly towards ensuring that the continent has an easier penetration of technology into what is existing now. The personnel who plan and manage this goal would have to be provided with better equipment and technology in many parts of Africa (Oduaran 2019:38).

An Insufficient Number of Computers

Education challenges are mounting in Africa. These include limited access to quality education, language barriers, skills gaps, gender disparities, a lack of investment, political instability,

brain drain, and global economic disparities (Adediran, Adedeji, Nwosu, Nwugo, & Nnamani 2023). In African countries one finds a limited adoption of technology in the education sector (Adeniran *et al.* 2023; UNESCO 2015). For instance, EdTech initiatives deployed by the Kenyan government largely exclude marginalised and vulnerable groups (Ngware & Ochieng 2020). This is attributed to the high number of students residing in rural areas without electricity or internet connection. This is a common experience in several countries in SSA. The effectiveness of EdTech for improving learning largely depends on supporting infrastructure, political commitment, digital literacy, and educator training. EdTech adoption is facilitated by the presence of key infrastructure, such as electricity and internet coverage.

While there has been progress in electricity coverage over the past two decades, less than half of the population in SSA is connected to an electricity supply, with lower rates in rural areas. For instance, only 47.7% of the population in Africa were connected to the electricity grid in 2018 (Ibrahim Forum Report 2021). Additionally, access to the internet and digital devices is also low on the continent (World Development Indicators 2022; UNICEF 2022). About 89% of learners in SSA do not have access to computers in their households, while 82% lack internet access, and around 20 million live in areas without mobile network coverage (Ibrahim Forum Report 2021). Consequently, innovation in EdTech is likely to have limited impact, especially among vulnerable groups (poor households and rural dwellers), since a greater fraction of these groups lack electricity and internet access.

There were several obstacles to overcome while using technology for online and technology-enabled learning (Song, Weisberg, Zhang, Tian, Boyer, & Israel 2024). The obstacles impede the thorough investigation and utilisation of technological prospects. Across nations, infrastructure, expenses, and a lack of technological expertise and abilities for both teachers and learners seem to be the most prevalent issues. In public institutions with inadequate physical facilities and infrastructure, this kind of bad infrastructure is typical.

Lack of Computer Literacy among Teachers

A common fact is that there are not enough individuals with the necessary expertise and abilities to operate AI tools. To develop an AI technology with good content, system, and service qualities, one needs a solid skill set; to implement the technology effectively, one needs sufficient product knowledge. These abilities go beyond fundamental technology understanding and could help with other issues like inadequate managerial expertise or even the creation of business concepts. According to Ade-Ibijola and Okonkwo (2023:111), AI tools need regular upkeep and upgrades, which necessitate specialist programming skills.

The lack of ICT literacy among most African educators makes the roll out of AI in education more difficult beside other factors. Teachers and learners are unable to produce data that are used to create and validate algorithms that inform instruction and other decisions when a sizable portion of them lack the hardware, software, and connectivity required to access and interact with digital learning platforms. There is a representational gap since those learners are from vulnerable groups (such as low-income households, learners with special needs, and learners from remote areas).

Insufficient Training for Subject Teachers to Include Computers in Classrooms

According to Lukose, Kantore, and Fosu (2023), one of the characteristics of the global information-intensive era of the 21st century is the incorporation of technology in the HE (higher education) teaching and learning environment. This has made technological skills, or e-skills, an implicit prerequisite for participation in the teaching and learning environment in IHEs. Access to the internet and technological devices are two of the major enabling factors for learners' e-readiness in embracing e-learning as an attractive tool. These abilities go beyond fundamental technology understanding and can help with issues like inadequate managerial expertise or even the creation of company concepts. According to Ade-Ibijola and Okonkwo (2023:111), AI tools need regular upkeep and upgrades, which necessitates specialist programming skills. Put another way,

a business that wants to adopt AI technologies must have an internal engineer or a reliable supplier for upkeep and servicing. Therefore, to adapt, learn, govern, and use the technology in their respective fields of work, education leaders, other stakeholders, and members of the public who may be involved in the deployment and usage of any form of AI must acquire the necessary fundamental skills (Frans & Pather 2021). Teachers are also identified as influential others in the lives of respondents. Teachers in this context refer to those in the education profession who have contributed positively to the choices made by the young individuals during their schooling years. Accordingly, the evidence shows that teachers could substantially influence the decision-making of learners to adopt ICTs at school level.

Ruxwana and Msibi (2018) have assessed the readiness of South African universities to adopt BYOD (bring your own device) for education and have identified technological and organisational readiness factors as the major influencers for BYOD adoption. Once all the relevant sub-factors of technological and organisational readiness have been identified and assessed and are all in sync with the objectives of BYOD in education, an institution will be ready to adopt BYOD. Based on the outcome of the findings, there is only a partial readiness in South African universities to adopt BYOD, as notable barriers such as a lack of comprehensive policies for mobile device use, a lack of supporting infrastructure, and unclear strategies and support from top management are still lingering. It is imperative therefore that those universities consider these factors to be ready to adopt and implement the best BYOD policy successfully. In a similar study, Krönke (2020) who did research on open, distance, and e-learning in Kenya identified instructors' lack of skills to teach online, insufficient electronic content, limited access to computers and the internet, and frequent electricity blackouts as common obstacles to distance and remote learning. Moreover, approaches to technology enhanced learning in HE have been slow to change and must often play catchup with emerging technologies used by learners, even in some of the continent's wealthiest nations such as South Africa.

According to Tsegay (2016), education is a process of changing the behaviour patterns of learners. This implies using behaviour in the broad sense to include thinking and feeling as well as overt action. It is through this personal development that HE affects the national and global awareness of citizens. Despite many challenges, currently the situation is changing as many countries are focusing on ICT as a main tool of progress and an effective and efficient delivery of services in many sectors including education. Nonetheless, access to ICT and its integration in education differ from country to country and within the different regions and socio-economic statuses of the people. Rural areas and people with low socio-economic status have lower access than urban areas and the rich. Moreover, schools use ICT to supplement the teaching-learning by finding some materials mainly from the teacher's side. The study discovered that there is a mixed perception among people whether Africa could ensure all learners to have access to connected digital devices and a relevant and responsive digital learning environment by 2030. The situation is a challenge for many countries with the current level of progress, while many of the challenges which are critical for ICT development such as electricity will not fully be achieved by 2030. Tsegay (2016) found that the level of ICT in education in SSA is much lower than in the developed world. Besides, there are various issues such as food and other basic social services that the least developed countries have not yet fulfilled.

The Lack of Adequately Designed Computer Skills Education Curricula

Most African countries are struggling to develop curricula to teach the basic computing skills to both teachers and learners. According to studies, universal and equitable access for learners and teachers has not yet been achieved in both developed and developing nations (cf. Dieterle, Dede, & Walker 2022). This falls short of the objective of educational equity, which states that all learners should have access to the resources they require regardless of their gender, race, ethnicity, language, disability, sexual orientation, family background, or family income. Furthermore, the digital divide, which includes unequal access to technology and the internet as well as a gap between the 'haves'

and 'have nots,' hinders learners' and teachers' abilities to collaborate and access information over time and distance. It also makes it harder for them to build social capital and get ready for success in a knowledge-based economy (Dieterle *et al.* 2022). This type of scenario represents most of if not the entire continent's reality regarding technological developments (Dieterle *et al.* 2022). It must be noted that most African countries are still in need of basic requirements meeting the demand of education to their population, yet they are expected to embrace technologies which do not fall under their priority lists. This questions their readiness in implementing AI tools in their education systems.

Exorbitant Phone and Internet Bills

Software acquisition, installation, and replacement come at a high cost (Krönke 2020). Along with the lack of appropriate spaces or buildings to house the technology, most African nations still lack a dependable supply of electricity, telephones, internet services for online education, and access to computers in communities, schools, and universities (cf. Krönke 2020). It is not just difficult but nearly impossible to create AI apps for workplaces and schools that are equally comprehensible and accessible. Although it may be theoretically feasible, AI applications do not consider cultural differences, specific needs, or alternative learning paths because they are based on the data of the average learner (Kousa & Niemi 2022; Krönke 2020).

Limited Expertise and ICT Skills Levels

These skills go beyond fundamental technology understanding and can help with issues like inadequate managerial knowledge or even the creation of company concepts. This suggests that everyone involved, including the government, should create a system for training individuals from the very beginning of primary school until the professional level. Technology adoption and utilisation are hampered by a lack of technical expertise (Ade-Ibijola & Okonkwo 2023:111). There are several ethical issues with the use of AI technologies, especially when it comes to role, privacy, transparency, trust, personality, and culture. It is crucial to take user privacy into account when integrating AI

tools into any area of life. Therefore, it is best to let people know if an intelligent machine is AI-capable so they may decide how to engage with the system.

The human-to-human interaction is not the same as the human-machine relationship. Users will understand and trust an AI system more if they are aware of its nature. When designing and developing AI technologies, it is important to consider the needs of various user groups, users, interests, characteristics, and contexts (Ade-Ibijola & Okonkwo 2023:111). Culture is a significant factor in ethics. It focuses on how people behave in social situations in a particular location. The multilingualism and cultural diversity of African countries may influence their adoption of technological innovation (Ade-Ibijola & Okonkwo 2023:111). Governments ought to accelerate the development of their infrastructure and network connectivity, particularly in Africa's rural areas. In addition, to guarantee appropriate AI system development, deployment, and acceptance in Africa, African governments and stakeholders – including the African mobile ecosystem – must set up well-organised rules and policies (Ade-Ibijola & Okonkwo 2023:111). For instance, the continent's digital literacy rate is 31%, according to the Afrobarometer (Krönke 2020), whereas its digital non-readiness score is 56.6%. The marginalisation of some demographic groups is another feature of the continent's low adoption of EdTech projects. In their research of ICT use in HE in India, Dixit *et al.* (2021) identified the main obstacles as ICT infrastructure, language and content, a lack of funding, and a shortage of qualified professional educators because most of the population lacked technological expertise.

Lack of an Enabling Policy Environment

When rolling out AI tools, policy becomes imperative to guide its implementation. The absence of any sound policy may jeopardise the whole process. Ethically, AI tools have been criticised for intruding into people's private lives (cf. UNESCO 2021a). In Africa where the literacy level is low compared to other continents, the application and the implementation of AI tools in education without a sound policy to protect the end-users may put both the teachers and learners at risk (König, Karrenbauer, & Breitner

2023). However, it should be mentioned that governments, academics, and students are begging for greater data privacy to receive less advertising. In practice, this means that users need to be urged to act responsibly and consider disclosing their personal information (König *et al.* 2023).

This section highlighted the challenges that currently face the continent's readiness for AI tool application in educational systems, specifically in schools. The following section offers possible solutions to those challenges identified above that Africa needs to tackle to realise the full potential provided by AI tools in education systems.

Overcoming Challenges

Investment in ICT Infrastructure

It is proposed that policymakers should focus their efforts on improving the continent's ICT capabilities, accessibility, and adoption. This can be achieved if entities engaged in the SSA agenda for prosperity, such as the ADB (African Development Bank) and the World Bank (2022) provide the support needed to complement different governments' efforts in advancing ICT penetration in the continent. Additionally, legislative actions are needed to help grow the continent's tech hubs to aid in the marketing of high-tech products, as well as to help establish patents so that the continent's young and innovative population may help build the continent (Africa Union 2024; Al-Maskari, Al Riyami, & Ghnimi 2023; Roger, Shulin, & Sesay 2022:12 of 17).

Literature suggests that both ICT development and innovation diffusion would foster sustainable economic growth in Africa. ICT development, innovation diffusion, and sustainable growth reinforce each other, and compared to innovation diffusion, ICT development is more effective in driving sustainable economic growth in SSA. Considering progress made by most Western and East Asian countries in recent times through ICT development and innovation, diffusion can offer and sparks confidence in promoting collective prosperity in Africa (Roger *et al.* 2022:12 of 17). First, ICT can offer policymakers concerned

with the growth agenda of African countries, convincing means of addressing challenges associated with ICT infrastructural development to induce sustainable growth through enhanced ICT access, use, and skills. Innovation diffusion and ICT development show that making shared prospects in Africa may not just be about improving infrastructural investment, but an innovative ICT infrastructure that gears toward sustainable growth and transformation in the continent's education sector (Roger *et al.* 2022:12 of 17).

Gaffley, Adams, and Shyllon (2022) argue that the development of ethical principles and guidelines governing the usage of AI technologies that are formulated based on African values and standards may generate responsible AI perspectives that extend beyond common understandings of fairness, transparency, and accountability, to address the specific AI-related challenges experienced on the continent. Mangundu (2023) asserts that an AI embedment in HE's information systems is on the rise, leading to an improved provision of HE services. However, for its benefits, AI brings with it risks that need to be governed. The study further recommends an establishment of AI governance structures, processes, and mechanisms. By improving AI governance maturity levels, IHEs can manage AI risks and ensure that AI aligns to university strategies.

Training and Development

Despite the numerous efforts to promote diversity in the field of STEM (science, technology, engineering, and mathematics), African people are still under-represented in these fields. According to a report by the National Science Foundation (2017), only 13.4% of African people in the USA earned bachelor's degrees in STEM fields in 2017. This lack of representation has serious consequences, as it limits the pool of talent available in these fields and reinforces societal inequalities (Mbalaka 2023:382). IHEs face a challenge in adopting training and professional development, but these institutions and their professionals must be committed to integrating these resources into the classroom and supporting digital training for educators to equip them to take on complex IoT (internet of things) projects that

will drastically alter the teaching-learning model to be more creative and in line with students' new realities. To guarantee the efficient and moral application of IoT in HE, these issues need to be proactively and thoroughly addressed. By conquering these challenges, educational establishments may utilise the IoT's potential to enhance instruction, learning, and the general student experience. This would help the African continent to prepare for the full introduction and integration of AI tools into their educational systems.

Building prediction models that recognise employment and skill patterns and provide retraining programmes for workers in jobs at risk from AI automation is advised (UNESCO 2021a). African countries are still struggling with providing quality education and employment creation for their youthful population; hence, the continent's readiness for AI technologies needs to be approached cautiously. It is necessary to determine the social costs of job automation and raise public awareness of the ensuing changes in the need for skills on a national and international level to benefit from AI tools in providing education to its population (UNESCO 2021a). Therefore, to deal with the methodical and long-term restructuring of the labour market, African governments must set a national priority on improving future-proof skills at all educational levels, offer choices for reskilling routes, and foster workforce resilience. According to UNESCO (United Nations Educational, Scientific, and Cultural Organisation) (UNESCO 2021), older workers should have extra protection because they could have a harder time picking up new skills and adjusting to new work settings. This involves encouraging training programmes to include a focus on how AI will impact every facet of the profession (cf. Soja & Soja 2020).

African governments must strive to harmonise their education and training and networks. The pace of the development of technologies is so fast, for instance, the time between the two generations of technology is much shorter than that for human life – recently, the switch from paper to digital technology, and from analogue phones to smartphones. Therefore, citizens and workers must adapt positively to these technological challenges. This means investment in continuous learning while creating

social awareness about the importance, risks, and perspectives of new technologies (Molfino, Cepolina, Cepolina, Cepolina, & Cepolina 2023).

AI Ethics and Governance

What are the obstacles for IoT integration in HE? IoT technology adoption occurs when many elements are somehow in harmony with one another. To put it another way, integrating IoT can offer a lot of advantages, but there are also issues that must be resolved. Some of the elements or obstacles affecting the adoption of IoT in HE have been identified by this study.

The use of IoT technology in education has created a new learning environment that necessitates the integration of several technical resources in terms of infrastructure and connectivity. However, one of the biggest challenges for HE is that there are not enough smart devices in HE, which makes it difficult for them to create innovative and high-quality education (Veintimilla *et al.* 2018). IoT applications in HE have also brought additional security and privacy-related issues. As more smart devices are networked, institutions are more vulnerable to cyberattacks (Georgescu & Popescu 2015), which prompts the adoption of cybersecurity measures. The educational community is concerned about identifying who owns the data created, who uses it, and how they use it because many of the linked devices will gather student data, including their movements (Grama & Vogel 2016). As a result, a transparent privacy policy that outlines the collection, storage, and use of data obtained from IoT devices should be put in place.

Inclusive AI Policy Development

The inclusive AI policy development could help overcome the issues such as privacy invasion and mass data extraction that are synonymous with the application of AI tools in education. It is in the public domain that most of the African countries are yet to be included in the development of AI tools, which has hampered the continent's contribution to these technologies. AI tools are developed by multinational organisations based in the Western countries with no participation from Africa, whereas Africa forms

a larger part of those multination's customer base. Anshari, Hamdan, Ahmad, Ali, and Haidi (2023) advise that organisations should apply the stakeholder theory which involves the relations between a business, individuals, and groups of people who can affect or are affected by the decisions. All stakeholders must be treated fairly. Hence, this theory would address challenges such as understanding the potential harms and benefits for groups or individuals, the effective management of stakeholder relationships that helps the survival or thriving of the business, as well as to create value and prevent moral failures in the case of AI tools in HE.

Development of AI in Curricula

Perhaps, this could be another factor worth considering that African governments should look at. First and foremost, HE curricula must incorporate AI-tools skills to implement the essential adjustments to educate students and educators for the future, guaranteeing their relevance to changing labour markets, economies, and societies across a range of disciplines and competencies (UNESCO 2021a). The African education sector must create programmes, courses, and credentials that offer knowledge and proficiency in the areas of AI creation, ethics, and technology operation.

However, African participation in both the design and development phases of technologies at international level has not been realised given that the multi-national companies who happen to own the technologies are home-based in the Global North (Western countries). Despite these obstacles, Africa should encourage the creation of educational resources based on good techniques and pedagogical research on AI (UNESCO 2021a). Due care though is needed when Africa develops such tools, first for the context for which such technologies will be developed, and second, their cultural and religious beliefs should form part of the development to avoid a possible backlash. Africa is home to millions of ethnicities with distinct characteristics and practices, a myriad of religions and cultures, which should not be ignored in the design and development phase of the AI technologies that can work for the continent's needs.

To develop local AI potential, HE and research institutions should receive support. A gender-based pool of experts with the know-how to design AI systems from a variety of socioeconomic backgrounds must be established, policies must be put in place to support HE and research institutions, and programmes to cultivate AI talent must be developed or improved (UNESCO 2021a). To encourage engineering firms to invest in retraining their employees in AI technology, the continent should think about creating executive master programmes. With potential protection against regional disparities in pay and benefits, AI companies should be encouraged to locate locally. By offering engaging intellectual challenges and a healthy work-life balance, as well as by 'incorporating fundamental concepts of data science and the ethics of data acquisition; using real-world data sets that require students to address privacy, fairness, and legal issues while developing AI solutions,' AI professionals can be retained. delivering ethics-related instruction in a variety of formats and at various times; 'ethics across the curriculum' serves as a model for doing this, but the idea is to consistently emphasise the importance of ethics, even in 'technical' courses (Borenstein & Howard 2021:64).

Developing Expertise and ICT Skills Levels

People should improve AI literacy in all spheres of society by implementing institutional measures; giving all Africans access to basic AI education will be necessary to prepare the continent's educational system. This education will teach people to think critically and responsibly about their rights, privileges, and choices considering AI and how it affects their daily lives (UNESCO 2021a). They ought to be educated on how to safeguard their privacy and manage their own information and choices. The continent may need to educate the populace about AI's limitations and the distinctions between it and human intellect to debunk the myths and hype surrounding the technology. Furthermore, new AI literacy abilities must be carefully incorporated with already-established fundamental abilities like media and information literacy. To avoid overburdening the curricula, it is also necessary to determine how the many necessary literacies can emerge.

Educators should experiment with and expand evidence-based approaches to using AI in the classroom. The first step in implementing AI in education is to support pilot testing and evidence-based informed adoption of technologies, such as chatbots, augmented and virtual reality tools, learning network orchestrators, dialogue-based tutoring systems, exploratory learning systems, automatic writing evaluation systems, language learning tools, AI-based artwork, music generators, and AI-based learning models (UNESCO 2021a). Adoption of AI tools that support diverse and open-ended exploratory learning settings must also be encouraged. As opposed to short-term or *ad hoc* plans, the use of AI in education must be integrated into long-term pedagogical plans to foster broad, transferrable abilities such as socio-emotional skills, meta-cognition, collaboration, problem-solving, and creativity (Gwagwa, Kraemer-Mbula, Rizk, Rutenberg, & De Beer 2020; UNESCO 2021a).

In the following section, we summarise the themes of this chapter based on the review of the related literature. As AI technologies keep on evolving, it is very difficult to precisely predict with certainty how the next new technologies will unravel educational systems on a global basis. For example, take the leap that the world is taking to I5R and E5.0, which is an improvement from I4R. Therefore, this chapter only highlights the current prospects of AI, with much speculation about its future application in the workplace, specifically education delivery and management. This is because much of the literature is based on secondary data, with just a few empirical studies available as the field of AI technologies still evolves.

Conclusion

The chapter highlights the prospects of AI tools in education, discussing the challenges and the strategies that African governments should consider implementing AI technologies in their education systems. The literature points out that AI tools can address the most complex public challenges facing society today including education, health, public infrastructure, agriculture, and security, all of which requires rigorous oversight from public officials procuring such solutions, as well as public transparency

and accountability. Africa cannot afford to be left out in the race to apply AI tools in educational systems, therefore, it is imperative for the continent to acts with caution when embracing the technologies.

In this chapter we have summarised some of the notable prospects of AI tools in education as follows: First, that African governments should tap in on natural language processing which uses AI to automatically interpret texts, including a semantic thematic analysis used in translations, and for generating texts of learning contents, and supporting the personalisation process (Tables 1 and 2). The future world is predicted to be more complex on a technological level, hence the utilisation of AI tools in education not only provides students with personal experience, but also exposes them to the reality of the workplace requirements now and in the future. For AI to support education to fully realise sustainable development, all the possible prospects of the tools need to be identified and leveraged, and the risks acknowledged and mitigated (UNESCO 2021a). These AI tools can assist the continent to deliver and manage education to its youthful population.

Second, speech recognition covers spoken words and provides AI personal assistants inside games and intelligent tutoring systems, and conversational bots in learning platforms. Third, AI tools aid the delivery and management of education; learning and assessment; empowering teachers and enhancing teaching; and promote lifelong and life-wide learning in several ways. However, it should be noted that these prospects highlighted in this chapter are exhaustive enough as AI technologies evolve every day of our lives, hence its utilities cannot be based on what the current literature provides. We still expect both prospects and challenges of its application to educational systems to unravel in Africa.

Notwithstanding the prospects of the application of AI tools in the delivery of education and management, Africa must contend with the reality that such benefits come at a cost. First, AI tools require heavy investment in ICT infrastructure for its benefits to be fully realised and utilised for education in Africa.

However, this heavy investment in AI tools in Africa's educational systems may not be one of the continent's priorities. Second, the African development agenda priority is to provide health facilities, basic education, and clean safe drinking water to the continent's growing population. Third, with a very youthful population in the world, having an average age of 19 years, the continent needs to shift its attention to the provisions of essential amenities which may not fall within ICT's infrastructure.

The challenges concerning the application of AI tools in education in Africa are identified as low literacy rate, poor infrastructure, poor internet penetration, poor electricity supply, corruption, poor governance, among others, while other impediments are insufficient funds, insufficient numbers of computers, reliance on donor funding for almost every capital expenditure, a lack of computer literacy among the educators, a lack of subject educators to integrate computers into learning areas, an absence of properly developed curricula for teaching computer skills, limited expertise and ICT skills levels, high costs of telephone and internet, and a lack of enabling policy environment.

Many of the challenges highlighted above are found in most countries on the continent and seem to be similar if not the same. The continent needs to overcome these impediments before realising the full benefits of AI tools in education. Therefore, to overcome these challenges, we propose the following as suggested in the literature: Investment in ICT infrastructure, which includes internet penetration, a constant supply of electricity or alternative use of solar power in the remote areas, an increase in the broadband lines, training and development of both educators and students on the awareness and potential of AI tools in education, a formulation of AI ethics and governance, inclusive AI policy development, and a full-time availability of funds.

Following the discussion and issues raised in this chapter concerning Africa's readiness for AI tools in education, it becomes apparent that the prospects' weightage of the issues raised outweighs its benefits, hence making it difficult to tell with certainty the continent's ability as the AI technologies are

not available in the continent of Africa. Therefore, this chapter summarises its case by cautioning educators and policymakers to pay due care before rushing to implement AI tools in education. Several claims are made by the advocates of AI tools about the potential of AI in education based on conjecture, speculation, and optimism (Nemorin 2021; Nemorin *et al.* 2022). AI is likely to create more inequities on how education will be delivered and managed, due to regional disparities within a member state country and inter-states, given that most of the countries have common challenges and a reliance on external funding for most of the continent's capital expenditure. Despite these challenges, Africa cannot sit back and watch others advancing but must strike a balance between various competing interests concerning other developments and the implementation of AI tools in their education systems.

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