

A systematic review on the fourth industrial revolution: African basic schools' readiness

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Abstract: *This systematic review's primary goal is to determine how prepared African basic schools are for implementing 4IR tools and how well-versed in 4IR the teachers in African basic schools are. A systematic review approach was adopted. Data base such as Johannesburg e-library, ProQuest, and Google scholar was used to search for relevant study used. It was determined that the findings were valid and rigorous through the use of PRISMA. Out 106,859 resource generated, the review included 18 studies that met the inclusion and exclusion criteria. The study highlights the necessity for African basic schools to enhance their preparedness for the Fourth Industrial Revolution (4IR). Funding is crucial to provide the necessary 4IR infrastructures, suggesting the allocation of resources by the African government for procurement and deployment of 4IR tools. Additionally, implementing a program to train teachers and school leaders in 4IR technologies is recommended to enhance their capabilities.*

Keywords: *Africa; Basic schools; Competencies; Fourth industrial revolution; Readiness of African basic schools.*

Introduction

Humans' daily interactions and behaviors have been altered by technology. Learning spaces have evolved into digital spaces with the fourth industrial revolution (4IR) (Madida et al., 2020; Uleanya & Ke, 2019). The World Economic Forum (2020) reports limited implementation of 4IR in Africa. As a result, the continent must still fully prepare for its educational potential. Based on scholarly studies, the 4IR may disturb the conventional approach to education (Madida et al., 2020; Oosthuizen, 2017; Skhephe et al., 2020; Uleanya & Ke, 2019). The COVID-19 pandemic affected the global community from 2019 to 2021. As a result of the epidemic, individuals were forced to remain at home while enterprises and educational institutions conducted their activities virtually. Thus, the reality of 4IR. In historical and societal contexts, the 4IR represents a significant period of change. Innovations and technological progress have affected globalization in a positive way (Kayembe & Nel, 2019; Madida et al., 2020; Oosthuizen, 2017; Rotatori et al., 2020). The industrial revolution began in 1784, with steam and water introduced to the industrial world. The second industrial revolution began with the advent of electricity and mass steel production in 1870. Electronic automation and computers marked the beginning of the third revolution (Rotatori et al., 2020; Eleyyan, 2021; the World Economic Forum, 2020). As companies adopt cutting-edge technologies in fields such as nanotechnology, renewable energy, genome sequencing, and quantum computing, the 4IR was introduced (Eleyyan, 2021; Rotatori et al., 2020). Through technological advancements, the 4IR transcends biological and physical boundaries (Rotatori et al., 2020; Lee et al., 2018).

The education system is also experiencing significant transformations due to global dynamic changes (Eleyyan, 2021; Rotatori et al., 2020). Schooling has evolved from its traditional form. In the past, educational institutions were exclusively brick-and-mortar. As technology advances, virtual education has become possible. Unfortunately, not all forms of education are available online in Africa. Using computers, cell phones, tablets, smartboards, and the Internet enhances teaching and learning (Rotatori et al., 2020). Therefore, educators and administrators need specialised skills to remain competitive. As a result of the 4IR, alterations in work procedures necessitate the reskilling of educators in the school system. It has been demonstrated in recent years that technological advancements like robotics, IoT, and 3D printing will require teachers to acquire new skills (Alakrash & Razak., 2022; Daud et al., 2021; World Economic Forum, 2020). Learning these relevant competencies will benefit school administrators and educators in their careers. Educating the 4IR generation requires school leaders and teachers to cultivate competencies relevant to the 4IR generation (Awodiji & Naicker, 2023). In addition to emotional, contextual, entrepreneurial, strategic, and ethical intelligence (Oosthuizen, 2017; Rotatori et al., 2020), the 4IR consists of competencies. Literature suggests developing skills such as creativity, critical thinking, problem-solving, and spiritual intelligence is critical (Alade & Windapo, 2020; Aliu & Aigbavboa, 2021; Kamaruzaman et al., 2021).

The COVID-19 pandemic forced African schools to implement 4IR technologies to deliver instructional content virtually (Mhlanga & Moloi, 2020; Mhlanga, 2021). Based on the researchers' experience and observations, a few educators possess comprehensive knowledge and expertise in e-learning. Amid disruption in work and education, 4IR competencies can benefit school leaders and teachers. Teachers and school leaders must be trained for digital technologies to be integrated into schools (Daud et al., 2021; Awodiji & Naicker, 2023).

Also, urban and rural schools need more technical resources. The absence of essential equipment and insufficient technological training for educators and administrators in rural schools has resulted in a lack of technology integration (Madida et al., 2020). Schools must consider their unique requirements to implement 4IR technologies and enhance pedagogical settings effectively. Thus, an e-classroom facilitated by proficient educators is the optimal solution for transforming education across African basic schools (eLearning Africa & Hub, 2020; Kamal & Illiyan, 2021; Mhlanga & Moloi, 2022; Rashid & Yadav, 2020; Varol, 2013). Governments in Africa must include funding for 4IR technologies in schools through fiscal expansion mechanisms. It is expected that this measure will facilitate the integration of 4IR technologies. Africa must, however, prepare adequately for the fourth industrial revolution. To ensure comprehensive readiness, it is imperative that all basic schools in Africa be furnished with 4IR technologies. In addition, both educators and school administrators receive adequate training to operate the technologies in a proficient manner. Significant investments are required to equip schools with the necessary technologies. This systematic review evaluates the readiness of African basic schools to use 4IR tools and their proficiency in 4IR competencies. So this research aims to describe African basic schools equipped to

integrate 4IR technologies and to what extent basic school teachers in Africa are proficient in the skills required for the 4IR.

The 4IR and Sustainable Development Goals (SDGs) are inherently interconnected. According to Ying et al. (2022), the utilisation of Artificial intelligence (AI), learning analytics, and the Internet of Things (IoT) in the context of the 4IR has the potential to foster education that is inclusive, equitable, and of high quality. In order to adequately equip educators for the demands of educating 21st-century students amidst the 4IR, it may be advisable to transition from an instructional paradigm to a learning paradigm (Atibuni et al., 2022). Technology integration in educational institutions during the 4IR is a recent development (Mhlanga & Moloji, 2020; Skhephe et al., 2020). The definition of the 4IR serves to obscure the boundaries that traditionally separate the domains of information technology and biotechnology within the given context. Mhlanga and Moloji, as well as Skhephe et al. (2020), posit that the 4IR is characterised by advanced technologies that blur the lines between the physical, digital, and biological domains (Olaitan et al., 2021). The integration of e-classroom presents a distinct and resolute instructional approach in the contemporary era, marked by the ubiquitous impact of technology in various domains, particularly in developed nations, where it is rapidly supplanting conventional pedagogical practices as the principal mode of education in academic establishments.

In the context of the 4IR, the pervasive influence of technology has led to the widespread adoption of e-learning as an unwavering substitute for conventional modes of pedagogy on a global scale (Albrahim, 2020; Glukhov & Vasetskaya, 2017; Rashid & Yadav, 2020; Xing & Marwala, 2017). E-learning is a modern method for delivering high-quality education within the classroom. It facilitates active learning by utilising communication, collaboration, multimedia, and knowledge transfer, while overcoming time and geography constraints (Mhlanga & Moloji, 2020; Oke & Fernandes, 2020; Skhephe et al., 2020). The integration of technology has enhanced the methods of acquiring up-to-date knowledge. E-learning tools have enabled teachers and students to access all necessary information (Skhephe et al., 2020).

Adopting Artificial Intelligence (AI) solutions is becoming increasingly prevalent in the global economy. According to Atibuni and Manyiroha (2022), there is expected to be a need for individuals possessing AI skills, which encompasses the capacity to proficiently implement, collaborate with, and oversee the utilisation of emerging technology. Educational institutions must cultivate students with advanced proficiencies in science, technology, engineering, and mathematics (STEM), digital literacy, and enhanced social and collaborative skills to effectively navigate the complex machinery of the 4IR (Abdulraheem-Mustapha, 2021; Atibuni et al., 2022). For learners to acquire these skills, teachers must be equipped with 4IR skills to impart knowledge to them effectively. To effectively impart skills pertinent to the automated workplace, educators must undertake a process of refocusing, restructuring, reimagining, and reinventing themselves (Butler-Adam, 2018; Atibuni & Manyiroba, 2022). Thus, the need for educators to acquire 4IR pedagogical competencies, which will enable them to facilitate the construction of knowledge among their students. The integration of 4IR

technologies in educational institutions necessitates the acquisition of specialised skills by educators (Atibuni & Manyiroba, 2022; Penprase, 2018). The acquisition of skills that are essential for teaching in the context of the 4IR includes creativity, ingenuity, innovation, problem-solving, metacognition, digital and technological literacy, global awareness, higher-order thinking, values and ethics, civil engagement, communication, and critical thinking (Jwair & Al-Dosari, 2023; Shafe et al., 2019).

In the context of the 4IR, pedagogy involves incorporating technology into the instructional process. It involves interactions between technology pedagogy and content which are separate from each other (Koehler et al., 2014; Naido & Singh-Pillay, 2020). Teachers must possess Technological Pedagogical Content Knowledge (TRACK) skills (Koehler et al., 2014; Naido & Singh-Pillay, 2020). According to Aprianti and Sahid (2020), incorporating technology-based learning in the context of the 4IR necessitates educators' acquisition of pedagogical competencies. Additionally, the authors suggest that teachers should also possess social, personality, and professional competencies.

Numerous scholarly investigations have explored educators' comprehension, expertise, preparedness, and disposition concerning 4IR technologies. The first indicator of basic school readiness is 4IR infrastructure, which includes computers, stable internet connection, and mobile networks. A school's access to all these infrastructures will determine its readiness (Olaitan et al., 2021; Mncube et al., 2019) despite the significant technological advancements and the substantial investment in the 4IR in Africa. It has been observed that the utilisation of technology in African schools was sporadic and needed a more significant impact. The statement suggests that the skills being imparted are not commensurate with the level of education, leading to learners needing to be more adequately equipped for the demands of the 4IR world of work (Sikhakhane et al., 2021). Therefore, African basic schools' preparedness level to incorporate 4IR technologies into their instructional methodologies is inadequate.

Student-teachers need to improve in advanced knowledge pertinent to the 4IR and conventional pedagogical, technological, and content knowledge. As a result, their lack of success can be attributed to insufficient education received at the university level. The study conducted by Aprianti & Sahid (2020) has revealed a significant correlation between the proficiency of teachers and their capacity to acquire knowledge about the 4IR. According to Kadira et al. (2020), it is imperative to adequately equip teachers with professional development programmes that enhance their comprehension of the 4IR to prepare them for its impact adequately. The political climate constitutes a significant determinant of the preparedness of African educational institutions. The successful integration of 4IR into educational institutions is contingent upon the presence of political determination, peaceful conditions, and stability within the respective countries. If a nation is engaged in warfare or experiencing political turmoil, its priorities are unlikely to include integrating 4IR technologies into educational institutions. It is unlikely that the 4IR will be able to occur in nations of this kind. Such technology is susceptible to destruction in a nation that has experienced conflict. The final determinant pertains to the economic milieu, whereby many African nations remain

to advance their economic status. Africa has been excluded from the preceding three industrial revolutions because its industries are still in the developmental phase and must be equipped to handle the 4IR (Olaitan et al., 2021; Mncube et al., 2019).

The 4IR yields numerous advantages. The objective of global education systems is to offer education that is both equitable and of high quality. The 4IR offers prospects for delivering equitable and high-quality education (Mncube et al., 2019; Otolcri et al., 2021; Oke & Fernandes, 2020). Educational opportunities encompass instructional sessions utilising augmented reality technology, providing students with visual access to the subject matter. In the field of life science, instructing students on the anatomy of the human heart provides them with a visual representation of its structure, as opposed to solely relying on textual descriptions found in course materials (Mncube et al., 2019; Otolcri et al., 2021; Oke & Fernandes, 2020).

Despite the manifold advantages that the 4IR confers upon nations' education systems, it has its attendant difficulties. One of the challenges posed by the 4IR pertains to the provision of primary schools with 4IR technologies. Given the substantial financial and infrastructural requirements, this presents a formidable obstacle. A challenge to implementing 4IR in basic schools is transitioning from traditional to technology-equipped classrooms (Glukhov & Vasetskaya, 2017; Ilori & Ajagunna, 2020; Oke & Fernandes, 2020). According to Avelino and Ismail (2021), integrating Fourth Industrial Revolution tools in educational settings may impede learners' ability to think critically and independently, as they may rely heavily on online sources for answers. This could present obstacles to the level of education attained.

African economies are still developing, and most countries are in financial debt and cannot afford to equip schools with infrastructure. Additional challenges involve educating teachers and students on effectively using technological equipment, which may still incur expenses for governmental entities (Olaitan et al., 2021; Mncube et al., 2019). 4IR brings about change that requires Basic Education Ministries to change their curriculum, curriculum reform takes a lot of work and resources, and this comes with cost implications for the nations (Alakrash et al., 2022; Olaitan et al., 2021).

Method

The study employed a secondary research approach of a systematic review design. The approach enables the identification, evaluation, and interpretation of all available studies pertaining to a specific research inquiry (Bush et al., 2018; Hallinger et al., 2020; Page et al., 2021). The rationale behind the adoption of this methodology is to succinctly synthesise the available evidence, pinpoint the lacuna in the existing literature, and facilitate the identification of potential avenues for future research (Bush, 2022; Steele & Watts, 2022). A systematic review provides a framework for research undertakings (Hallinger et al., 2020). The utilisation of systematic literature review is employed to ascertain the extent to which available evidence corroborates a theoretical hypothesis (Kitchenham, 2004). The advantage

of using a systematic review is that it provides adequate and robust evidence of a phenomenon. One potential limitation of utilising a systematic review methodology is that its rigorous approach may lead to the identification of any potential biases present within the reviewed literature (Hallinger et al., 2020; Kitchenham, 2004; Page et al., 2021).

Different journals, reports, dissertations and conference proceedings on the themes (4IR, readiness and Basic Schools in Africa) were perused, and their findings were recorded. The inquiry and subject matter of the study will be evaluated and analysed (analysis) of all existing research. The articles under consideration must have been composed exclusively in English and made available for public consumption within the timeframe spanning from January 2017 to 2022. Keywords such as 4IR, basic schools, Africa, and readiness of African Basic schools on Google Scholar and ProQuest Library eJournals were used for searching. The search yielded a total of 106,592 results. Furthermore, a manual exploration of pertinent articles' bibliographies was carried out.

The screening criteria utilised in the study was PRISMA (Hallinger et al., 2020; Page et al., 2021). The sampling did not encompass investigations conducted prior to 2017. The primary area of interest in the investigation was the domain of basic education in Africa. At this juncture, a total of 6,569 queries were deemed invalid and subsequently disregarded. The remaining 1,318 records were subjected to scrutiny of the review's significance and any instances of redundancy.

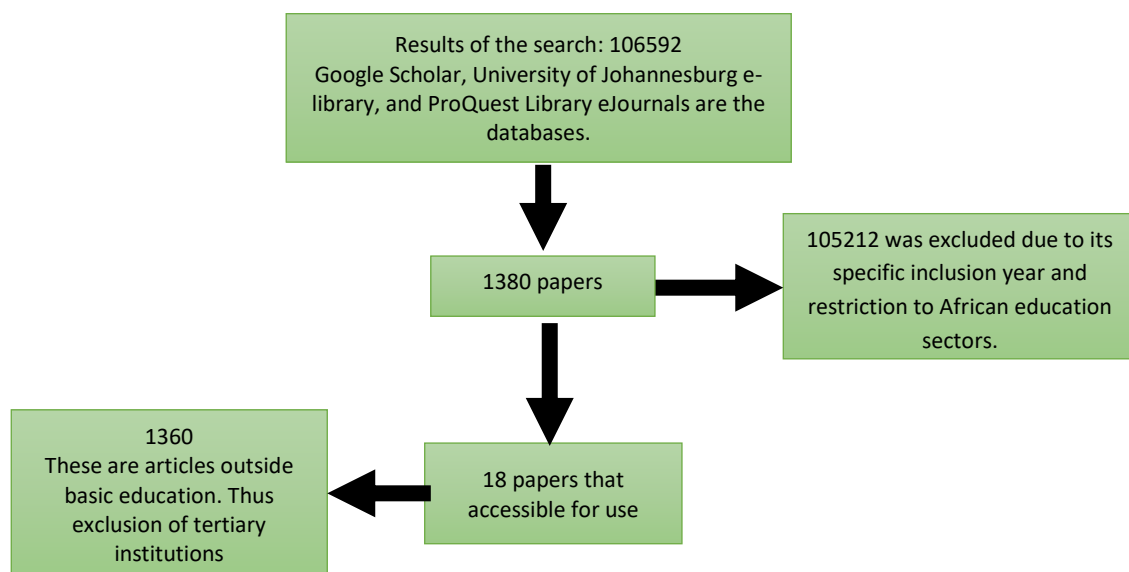


Figure 1: Prisma

During the data extraction phase, the subsequent protocols were adhered to for article selection:

1. The articles must consist of research that is original in nature.
2. The exclusive use of the English language is recommended for the entirety of the articles.

3. The temporal parameter for the publication year is restricted to the interval between 2017 and 2022.
4. The article must be Africa based research.

A total of eighteen articles on African basic schools' preparedness for 4IR were double-coded by the researchers according to the extent to which 4IR tools were provided at basic schools and how proficient the teachers were in 4IR skills (see Tables 1 and 2 for a complete list of articles included in the review). The measures coded included the title of the article, the duration of the study, the study type/design, and the country of the study, as well as the results. A quantitative article, eight qualitative articles, four mixed methods articles, and five literature reviews were used. Two academics from South Africa and Namibia evaluated the studies gathered. Assessors assessed and critiqued all identified studies.

The abstracts of articles were assessed for their quality and relevance. After conducting a thorough analysis of the articles, a total of 1364 articles were excluded. Eighteen articles from the e-library were utilised for the investigation. As the research was secondary, it did not involve any participants and solely relied on the analysis of scholarly journals. The utilised articles were properly cited and accompanied by in-text citations.

Table 1. To what extent are basic schools in Africa equipped to integrate 4IR technologies?

Authors	Title	Method of research	Findings
Uleanya and Ke (2019)	"Review of Preparedness of Rural African Communities Nexus Formal Education in the Fourth Industrial Revolution"	Literature Reviews	A significant proportion of African primary and secondary educational institutions need to improve in 4IR technologies.
Oke and Fernandes (2020)	"Innovations in teaching and learning: Exploring the perceptions of the education sector on the fourth industrial revolution (4IR)"	Qualitative	Many African countries need to be more earnest towards the 4IR, failing to undertake the requisite measures to integrate 4IR technologies into primary educational institutions. The readiness of the African education sector for the 4IR needs to be improved. The 4IR presents a promising prospect for leveraging its advantages in education. However, substantial curriculum investments and enhancements are required to fully realise threalisential fully.
Moloi and Mhlanga (2021)	"Key Features of the Fourth Industrial Revolution in the Basic Education System of South Africa"	Qualitative	Several basic schools have acknowledged the utilisatioo of technology and provided testimony to the advantages they have derived from its implementation. Due to the lack of 4IR technology in most rural schools, integrating 4IR in teaching and learning was not perceived as advantageous.

Authors	Title	Method of research	Findings
			The research discovered that diverse digital platforms, such as WhatsApp/Google Apps, YouTube licencing, Office 365 licencing/ MS Teams, and Zoom, were employed to enable pedagogy and scholarship, primarily in metropolitan educational institutions. ICT is not commonly utilised in schools.
Mhlanga (2021)	"The Fourth Industrial Revolution and COVID-19 Pandemic in South Africa: The Opportunities and Challenges of Introducing Blended Learning in Education"	Desk research	African basic schools need more information and communication technology (ICT) tools. High inequalities among schools; schools in rural areas lack resources compared to schools in towns.
Mtshali and Ramaligela (2020)	"Contemporary Employability Skills Needed for Learners to Succeed in the Civil Technology Field in the 4IR era."	Quantitative & Qualitative	More resources are needed to ensure the complete adoption of the Fourth Industrial Revolution (4IR).
Mhlanga and Moloi (2020)	"COVID-19 and the digital transformation of education: What are we learning on 4IR in South Africa?"	Qualitative desktop research	More information and communication technology (ICT) tools and resources are needed.
Sithomola (2021)	"The Manifestation of Dual Socio-Economic Strata Within the South African Schooling System A Setback for Congruous Prospects of 4IR."	Qualitative Desk research	Socio-economic disparities and a digital divide challenge the widespread adoption of 4IR technologies in schools. The 4IR has yet to be optimally implemented in African schools due to the presence of economically disadvantaged learners and schools situated in impoverished communities. Educational institutions must prepare to fully capitalise benefits presented by the Fourth Industrial Revolution. Africa is slowly embracing the 4IR, but more investment needs to be made to equip schools and train teachers.
Uleanya (2022)	"Scholarly discourse of the 4IR and education in Botswana: a scoping review."	Scope review	The continent of Africa currently needs to be prepared. Insufficient infrastructure and inadequate access to electricity are prevalent issues. Furthermore, there needs to be more literature on the subject matter.
Madida et al. (2020).	"Barriers to effective digital teaching in rural schools."	Qualitative	There needs to be more ICT resources. ICT still needs to be fully integrated with most African Basic Schools. Integrating Information and Communication

Authors	Title	Method of research	Findings
			<p>Technology (ICT) in educational institutions is imperative to cater to their unique requirements. Infrastructure and other fundamental requirements should be taken care of first to facilitate effective ICT use for improving learning environments.</p> <p>The available resources need to be improved to facilitate knowledge acquisition, considering the particular quantity of students in a particular instructional period. In order to improve the quality of education, the government could encourage other industries to contribute to the future of our nation by giving needy schools computers. In the interim, schools can establish rules permitting students to use their mobile devices (smartphones) for educational purposes on school grounds.</p>
Mduduzi and Saurabh (2022)	"Learning curve: Harnessing the Fourth Industrial Revolution begins with education."	Newspaper	<p>Public schools in Africa are less equipped with ICT tools compared to private schools. Typically, students from privileged socio-economic backgrounds tend to enroll in private schools, affording them greater ease in accessing 4IR technology and adapting to evolving curricular demands.</p> <p>The challenges associated with integrating 4IR technologies into African educational institutions include the need for such technologies within the schools themselves and the requisite training needed to equip educators and students with the skills necessary to effectively utilise 4IR.</p>
Tshabalala and Mavuru (2023)	"Utilising ICT to address language challenges in life sciences classrooms"	Mixed method research design	<p>The unavailability of suitable 4IR tools has acted as a deterrent for educators to utilise ICT within educational institutions.</p>
Sikhakhane et al. (2021)	"South African teachers' perspectives on using the computer as a tool for teaching and learning"	Qualitative	<p>The inadequate availability of suitable 4IR technologies has resulted in a demotivating effect on educators, thereby hindering their utilisation within educational institutions.</p>
Koopman (2023)	"The Fourth Industrial Revolution: Teachers' Views on Integrating Digital Technologies As a 21-Century Teaching Strategy"	Husserlian phenomenological approach (qualitative)	<p>The results indicate that educators possess a rudimentary and erroneous comprehension of the 4IR. The participants' perspectives on the incorporation of technology in their science instruction were influenced by their evaluations of the perceived</p>

Authors	Title	Method of research	Findings
			usefulness (PU) and effort expectancy (EE) associated with technology implementation. The impact of PU and EE on the participants' behavioural intentions was found to have a subsequent effect on their attitude towards the transition to 4IR pedagogy.
Naidoo and Singh-Pillay (2020)	"Exploring Mathematics Teachers' Professional Development: Embracing the Fourth Industrial Revolution"	Qualitative	Lack of facilities and resources at schools.
Kayembe and Nell (2019)	Challenges and Opportunities for Education in the Fourth Industrial Revolution	Desk Research	Lack of 4IR infrastructures and funding.

Table 2. Teachers' proficiency in 4IR skills in African basic schools

Authors and Year	Title	Method of research	Findings
Skhephe et al. (2020)	"Accounting teachers' readiness for E-learning in the fourth industrial revolution: A case of selected high schools in the Eastern Cape, South Africa."	Qualitative	Teachers need training on how to use ICT tools.
Mhlanga and Moloji (2020)	"COVID-19 and the digital transformation of education: What are we learning on 4ir in South Africa?"	Qualitative	There needs to be a greater level of ICT training between teachers in rural schools and their urban counterparts. Specifically, educators in rural areas tend to need more exposure to and familiarity with ICT tools. Most teachers in rural areas still use traditional teaching methods like chalkboard and chalk. Many educational institutions have yet to adopt the 4IR technologies and require adequate provisions.
Mpungose (2020)	"Student Teachers' Knowledge in the Era of the Fourth Industrial Revolution"	Qualitative	Many educators in rural schools need more information and communication technology (ICT) competencies.
Ayanwale (2023)	"Can Experience Determine the Adoption of Industrial Revolution 4.0 Skills in 21st Century Mathematics Education?"	Cross-sectional quantitative approach	Educators demonstrate a willingness to incorporate novel techniques into their pedagogical practices.

Authors and Year	Title	Method of research	Findings
Tshabalala and Mavuru (2023)	“Utilising Utilisingdress language challenges in life sciences classrooms”	Mixed method research design	The need for technological pedagogical content knowledge is observed among educators.
Sikhakhane et al. (2021)	“South African teachers’ perspectives on using the computer as a tool for teaching and learning”	Qualitative	Educators were found to need to improve in integrating Technological Pedagogical, Educational Psychology and Content domains.
Koopman (2023)	“The Fourth Industrial Revolution: Teachers' Views on Integrating Digital Technologies As a 21-Century Teaching Strategy”	Husserlian phenomenological approach (qualitative)	Research shows that teachers' understanding of 4IR is very basic and contrary to reality. It is imperative that educators receive adequate training on ICT within their instructional practises.
Naidoo and Singh-Pillay (2020)	“Exploring Mathematics Teachers' Professional Development: Embracing the Fourth Industrial Revolution”	Qualitative	The instructor needed to gain adequate expertise in the area of TRACK. Educators require competencies in utilising 4IR technologies.
Kayembe and Nell (2019)	Challenges and Opportunities for Education in the Fourth Industrial Revolution	Desk Research	Need for more proficiency in integrating 4IR technologies within educational institutions.
Moloi and Mhlanga (2021)	Key Features of The Fourth Industrial Revolution In South Africa’s Basic Education System	Qualitative	The findings indicated a disparity in the technological proficiency of rural teachers compared to their urban counterparts when it comes to utilising them for instructional purposes. Educators heavily depended on conventional instructional approaches like blackboard and chalk.
Atibuni et al. (2022)	A Fourth Industrial Revolution Paradigm Shift in Teacher Education?	Qualitative	Teachers need to gain technological pedagogy knowledge.

Results and Discussion

Two research questions were investigated; the first was the extent that African basic schools are equipped to integrate 4IR technology. The second examined the extent to which basic school teachers in Africa are proficient in the skills required for 4IR classrooms. Based on the studies analysed, it was indicated that a considerable number of primary and secondary schools across Africa exhibit inadequacies in the adoption and integration of 4IR

technologies (Kayembe & Nell, 2019; Mhlanga, 2021; Mtshali & Ramaligela, 2020; Naidoo & Singh-Pillay, 2020; Tshabalala & Mayuru, 2023; Uleanya & Ke, 2019; Sikhakhane et al., 2021). According to Oke and Fernandes (2020), a considerable proportion of African nations demonstrate a need for more commitment towards the 4IR, resulting in their inability to implement necessary measures to assimilate 4IR technologies in basic schools. Thus, the preparedness level of the African basic schools for the 4IR needs to be improved. It was found out that 4IR tools are not available within educational institutions, thus deterring educators from utilising them. In addition, lack of infrastructure and funding was found to hindered 4IR tool integration in African basic schools.

The 4IR offers a potential opportunity to opportunity to utilise its benefits within the education domain. According to Oke and Fernandes (2020), significant investments and curriculum improvements are necessary to actualize this potential fully. Moloji and Mhlanga, (2021) report that numerous basic schools have recognised the incorporation of technology and have attested to the benefits they have reaped from its adoption of technology and have attested to the benefits they have reaped from its adoption. The absence of 4IR technology in many rural basic schools has resulted in a lack of perceived benefits regarding incorporating 4IR in the educational process.

Furthermore, basic schools in Africa need more ICT resources (Mhlanga, 2021). This study's findings agree with the Unified Theory of Acceptance and Use of Technology (UTAUT). The adoption of technology by educators in schools was impacted by a range of factors, including but not limited to age, gender, willingness to use, and prior experience. According to AbuShanab and Pearson (2007) and Venkatesh et al. (2003), the younger generation of educators demonstrates a higher inclination towards adopting technology than their older counterparts.

In addition, there appears to be a deficiency among educators in effectively integrating Technological Pedagogical Educational Psychology and Content Domain (Atibuni et al., 2022; Ayanwale, 2023; Naidoo & Singh-Pillay, 2020; Sikhakhane, 2021; Tshabalala & Mavuru, 2023). A discernible disparity has been observed in the degree of ICT instruction provided to educators in rural schools as compared to their urban peers. According to Mpungose (2020), educators in rural regions exhibit lower exposure to and familiarity with ICT tools. According to Mhlanga and Moloji (2020), conventional teaching techniques such as chalkboard and chalk are still prevalent among educators in rural regions. Furthermore, Ayanwale (2023) added that despite not having 4IR skills, educators are ready to integrate innovative methodologies into their teaching approaches. Koopman (2023) asserts that educators must receive adequate coaching on the integration of ICT in their pedagogical approaches.

The 4IR presents challenges that African nations need to prepare to confront. Higher education institutions should instruct inexperienced educators regarding 4IR technology and methods for proficiently integrating ICT into their pedagogical approaches. This will facilitate educators to arrive at the schools with the requisite skills and knowledge. Educators presently affiliated with school establishments should receive training programmes in integrating and

applying ICT resources in their pedagogical methodologies. The Ministry of Education could serve as the host for the seminars. Every educational institution must be equipped with the necessary resources, as determined by the governing body. The government has the ability to incentivize private enterprises to provide ICT equipment to basic schools.

The African government should allocate resources towards the procurement and deployment of ICT tools in order to provide comprehensive ICT infrastructure in basic schools. It was recommended that the Ministry of Basic Education in African countries implement a programme to provide training on 4IR technologies and skills to enhance the capabilities of educators. Training programmes can be implemented to educate students at the school level. In addition, higher education institutions and teacher training programmes should integrate 4IR competencies into their curricula for student-teachers and prepare them for the post-digital era. Furthermore, the Ministries of Basic Education should integrate 4IR concepts into their curriculum to equip students with the necessary skills for the current job market.

Moreover, private individuals and benefactors can provide backing for the development of teachers' competencies on the 4IR and offer technological assistance. The involvement of community members and parents in equipping schools and students with essential technological resources can be beneficial. International donors and organisations such as UNESCO, UNICEF, and the World Bank have the potential to collaborate with African governments to offer pertinent assistance and education. More scholarly publications need to be on the subject matter, indicating a need for further academic inquiry.

It is essential to acknowledge the limitations of the study. Specifically, more scholarly literature on the 4IR in African basic education schools needs to be published. Most of the literature focuses on higher education and entrepreneurship training in Africa. Therefore, further academic research is required. The African continent is also experiencing the impact of the 4IR, which is currently being witnessed worldwide.

Conclusion

This study examined the level of basic schools in Africa readiness to use 4IR tools. The study also examined educators' proficiency in 4IR competencies. The results of our study indicate that there is a need for African basic schools to improve their preparedness for 4IR. In basic schools especially in the rural areas, 4IR tools are not available, deterring educators from using them. Further, educators appear to have difficulty integrating technological pedagogy, educational psychology, and the content domain in basic schools in order to comprehend their proficiency in 4IR competencies. African nations must prepare for the challenges posed by the 4IR. It is necessary for higher education institutions to provide inexperienced educators with training in 4IR technology and methods for efficiently integrating ICT into their pedagogical approaches.

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