Scholarly discourse of the fourth industrial revolution (4IR) and education in Botswana: a scoping review

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Abstract

Implementation of the practices of the Fourth Industrial Revolution (4IR) is currently a trendy topic worldwide since various interruptions are expected. Education is considered as a major tool to equip people with the necessary kills to be prepared for the Fourth Industrial Revolution (4IR). Botswana's education system was ranked among the top ten on the African continent. Hence, this study explored the 4IR and education in Botswana, using a scoping review. The literature was analysed and presented, using themes. The findings showed that factors such as curriculum issues, lack of electricity in rural areas, amongst others are stumbling blocks in Botswana's way as it continues to prepare itself for the 4IR through education. Also, there is limited scholarly work on education and the 4IR, specifically from the perspective of Botswana. Hence, research into current practices in the education sector and institutions of learning in Botswana was recommended.

Keywords Africa · Botswana · Fourth Industrial Revolution (4IR) · Scholarly discourse · Scoping review

1 Introduction

The Fourth Industrial Revolution (4IR) is a subject of interest that affects the operations of various sectors in countries worldwide. The 4IR seems to be dominating the discourse in almost all spheres of life which resulted in many nations preparing themselves for 4IR. Power (2021) reporting on the practical ways by which the 4IR has aided some forms of progress states: "Manufacturers can use digital twins to identify changes, quantify risks, and plan improvements in a virtual setting before acting in

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the real world. Digital twin technology proved crucial when Skycatch helped Microsoft modernize its Redmond campus back in 2019." Power (2021) further alluding to the subject on the need to prepare and embrace the 4IR states that "More than just making companies more flexible, however, the cloud helps spark innovation, create economic efficiencies, and expedite service delivery. During the Fourth Industrial Revolution, the cloud will become the norm instead of the exception." The result of this is evident during the time of the COVID-19 pandemic where organizations and institutions of learning resorted to using online approach in order to remain in business (Taiwo, Uleanya & Ayandibu, 2022). Nonetheless, preparation for the 4IR still remains a challenge in the African continent (Uleanya & Yu, 2019). Like South Africa, which is considered as the country on the African continent that is best prepared for the 4IR (Nordling, 2021), Botswana is also making the necessary attempts to prepare itself for the 4IR. However, Botswana's level of preparation for the Fourth Industrial Revolution (4IR) may differ from that of South Africa and other nations on the African continent due to various factors such as population, technology, technical knowhow, the availability of skilled personnel/expatriates, the availability of funds and infrastructure, among others. However, education remains a vital tool used to prepare people for revolutions, such as the 4IR, following previous experiences (Uleanya & Yu, 2019). The role of education to ensure that countries and their citizens are well-prepared for the Fourth Industrial Revolution (4IR) can never be overemphasised. This is evident in the works and submissions of the OECD Education and Skills Today (2019) and World Economic Forum (WEF) (2016a), among others. This is the reason behind the quest and calls for the review of curricula adopted in various education systems worldwide (Setyaningsih, 2019; Menon & Castrillón, 2019; and Relocate Global, 2018). For instance, South Africa is considering the inclusion of coding, as a subject, from a low grade to introduce learners at junior level to the practices relevant for the Fourth Industrial Revolution (Government Gazette, 2020). This is to equip citizens with the necessary skills to stay relevant in the Fourth Industrial Revolution (4IR) era. However, in the 2019 report of the WEF on 'Top 10 African Countries with the best Education Systems', Botswana's education system was ranked higher than various countries; and South Africa was not even mentioned among the top-ranking countries (WEF, 2019). This suggests the importance of education and the role(s) that it plays in ensuring alignment with practices of the Fourth Industrial Revolution (4IR). Thus, this study sought to explore scholarly discourse on Botswana and its education regarding issues revolving around the Fourth Industrial Revolution (4IR) and preparation. It is envisaged that from the outcome of this study which is in the specific context of Botswana lessons which may be adaptable by other developing countries, especially those in the African continent may be learnt. In other words, some practices relevant to the Botswana context enabling the country to prepare itself for the 4IR, may be helpful to other countries, notwithstanding the differences in their demographic settings. Also, it is believed that, through this review, practices hindering Botswana's effectiveness in its preparation for the 4IR may become evident and provoke a change in the country where possible. In the same vain, this research is envisaged to provoke further discussion in this regard in the context of Botswana and other specific African countries. However, this article does not insinuate that technology is the solution to all human problems, yet it plays pivotal

roles. The remaining sections of the study are divided into: important briefs about Botswana specifically in the context of this study, a short discussion on the subject – the fourth industrial revolution, formal education in the fourth industrial revolution, research methodology, discussion, Conclusion and recommendations.

1.1 Important briefs about Botswana

According to Sibanda (2020), Botswana ranks among the fastest developing nations on the African continent together with Mauritius. The country is recognised for succeeding in ensuring development and is making extraordinary progress in different sectors, such as political and economic. (Sibanda, 2020; and Mizero, 2018). Following the report of the World Economic Forum (2019) Botswana is ranked in the sixth place ahead of Kenya, Cape Verde, Egypt, and Namibia. The ranking was done with factors such as digital literacy development, interpersonal skills, and critical thinking and creativity taken into consideration. Additionally, internet facilities are available to schools, in Botswana. For instance, following the report of the findings of the work of Langthaler (2020, 69), "… internet connection in schools is reported to cover 78% of primary and 100% of secondary schools in Botswana. According to Letsholathebe (2021) reporting for the United Nations Commission on Science and Technology for Development (CSTD), twenty-fourth session, 'Botswana ranked at 111th place on the frontier technology readiness index – the second highest for a landlocked developing country in Africa and 9th place for a Sub-Saharan Africa (Letsholathebe, 2021, 5).'" The findings indicate the extent to which internet facilities are considered and treated as important. However, following the submissions of Fomunyam (2020), WEF (2016b), WEF (2015a & 2015b), and Akokuwebe & Okunola (2015), there is a major gap in the levels of education of younger and older generations in Botswana, compared to other African coutries like Benin Republic, Malawi, Mozambique, Nigeria and Uganda.

Furthermore, from the report of Technopolis and Research ICT Africa and Tambourine Innovation Ventures (2019), Botswana ranks as one of the best five performers for Human Capital in Africa. Other countries that also received high rankings are Ghana, Mauritius, South Africa and Tunisia (Technopolis & Research ICT Africa & Tambourine Innovation Ventures). However, in contrast, the report of Technopolis and Research ICT Africa and Tambourine Innovation Ventures (2019), states that the youth unemployment rate is high in Botswana. This suggests a disconnect with the country's high ranking education system and human capital performance.

Botswana strives to be on par with the rest of the world. According to Honourable Olopeng (Minister of Tertiary Education, Research, Science and Technology) education and training should not to be domesticated but globalised and institutions of higher learning should develop futuristic learning programmes that can position Botswana as a country that is globally competitive (Olopeng, 2019). This corroborates earlier submission of Williams (2018) who states that Botswana has negotiated with organisations overseas and have gone ahead to acquire equipment and arrange for training opportunities for students. Williams (2018) further states that computing clusters are being established for use by students and students have been able to attend training courses and conferences abroad. Maramwidze (2021), quoting Botswana's Minister

of Basic Education, Fidelis Molao, that Botswana has announced plans to get senior secondary schools ready for e-learning during the 2021/22 financial year. Meanwhile, the Ministry of Basic Education has started with a long-term capacity building plan where Trainers of Trainers (TOTs) are positioned countrywide to provide rigorous online training. This is in collaboration with various stakeholders, including the Botswana Open University (BOU) (Maramwidze, 2021). At tertiary level, Botswana International University of Science and Technology (BIUST), Gwangwava (2019) states that "The BIUST engineering workshop houses more than twenty laboratories. Also, the Minister of Tertiary Education, Research, Science and Technology, Dr Douglas Letsholathebe, has called on young citizens aged between 18 and 21 to participate in the mobile Gov-App hackathon challenge to ensure citizen participation in the 4IR space (The Mid-Week Sun, 2021). This is in congruence with the works of Lee et al., (2018), Gwangwava (2019), Jaiyeoba & Iloanya (2019), Makaloba (2020), Mogomotsi et al., (2020), as well as Mokeresete & Esiefarienrhe (2020) which shows that the role(s) of institutions of learning in ensuring that Botswana gets prepared for the Fourth Industrial Revolution (4IR) is crucial. Mokeresete & Esiefarienrhe (2020) and Muchuchuti et al., (2021) further explain that Botswana needs to align itself with skills needed for the 4IR through training to ensure employee alignment with jobs relevant for the era. According to Dr Letsholathebe, as reported by The Mid-Week Sun (2021), Botswana stands to gain a strong position in Africa and the world as a 'Smart Society,' with broader use of technology to grow, work and transact. Also, according to EdTech Hub (2020), following the statement of an ICT specialist in Botswana, the government has announced schooling on the national TV station and has partnered with local cell phone providers to provide free service to customers to access educational content. Meanwhile, despite efforts made by the nation, challenges hinder the country from achieving its goal in being technology savvy and prepared for the 4IR (Letsholathebe, 2021). Among the identified challenges are: curriculum issues (Mogomotsi et al., 2020; Phatsima, 2021), lack of fund (Muchuchuti et al., 2021), and lack of ICT skills and experts (Seeletso, 2021). The foregoing shows that efforts are made by the nation to prepare and align itself with the 4IR practices though challenged by different factors. However, for the purpose of this study, scholarly articles were reviewed to identify the discourse of Botswana's education system and practices preparing for the Fourth Industrial Revolution. In order to achieve the focus, the researcher attempted to answer the identified research questions guiding the study: What is the scholarly discourse about Botswana, its education system and practices with regards to the Fourth Industrial Revolution (4IR)? The next section presents a brief overview of the subject: 4IR.

1.2 The fourth industrial revolution

The founder and executive chairman of the WEF by name Schwab in (2016) states "We stand on the *brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another*. In its scale, scope, and complexity, *the transformation will be unlike anything humankind has experienced before*. We do not yet know just how it will unfold, but one thing is clear: *the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the*

public and private sectors to academia and civil society (WEF, 2022 italics added).”
A fusion of technologies which blurs the existing lines between the physical, digital,
and biological spheres is a major feature of the era (Schwab, 2016). This suggests
the massive disruption pre-empted to be experienced during the 4IR era as alluded by
Ab Rahman, Abdul Hamid and Ai Chin (2017). In the words of Smith (2021), “4IR
can be defined as the revolutionary change when information technology proliferates
in all industries and is the connection between technology and the market (p. 1).” In
furtherance, Ab Rahman, Abdul Hamid and Ai Chin (2017) as well as Uleanya and
Yu (2019) cited in Uleanya (2022) hold the view that disruptive technologies, Inter-
net of Things (IoT), artificial intelligence (AI), virtual reality (VR) and robotics, are
examples of experiences to be expected during such era. Meanwhile, according to
Schwab (2016) integrated and comprehensive efforts which involves all stakeholders
of the global community, in both private and public, civil society and academia is
needed (Schwab, 2016). This implies that collective efforts are needed for survival
and positive response to the disruption of the 4IR. This accounts for reasons behind
various conferences on the subject of the fourth industrial revolution across the world
in different sectors.

1.3 Formal education in the fourth industrial revolution

Prior to exploring formal education in the 4IR in the specific context of Botswana
which is the focus of the study, a general search was done on the subject in the con-
text of specific countries and regions. Below is a brief report of formal education in
the 4IR as reported in the specific contexts of few countries and regions across the
globe. Lee et al., (2018) conducted a study on new curriculum of software education,
using a specific context of Korea. The study showed the importance and the need
for proper design and implementation of school curriculum. However, the study was
focused on specifically software education curriculum for children who are five years
of age in Korea. Similarly, Uleanya and Yu (2019) conducted a conceptual study on
the preparedness of rural African communities for the fourth industrial revolution, the
finding of the study showed that African countries are unprepared for the revolution,
rather focus is on subjects of decolonization, decoloniality, among others. The study
conducted in Portugal by Morgado et al., (2021) on smart education as a tool for
empowerment suggests the need for training in preparing teachers for the 4IR. The
study indicates that there is need for veteran teachers to be well equipped through
training for teaching in the time of the fourth industrial revolution. According to
Plawgo & Ertman (2021) using Poland as case study, one of the factors which deter-
mines the successful implementation of the 4IR is the competencies of managers and
staff members. Such competences can be enhanced through formal education (Plawgo
& Ertman, 2021), thus, the need for formal education is crucial in the fourth industrial
revolution. Smith (2021) conducted a study on how 4IR can be beneficial to least
developed asean countries. Sequel to the finding of the study, it can be deduced that
for 4IR to be beneficial to developing countries and territories, the need to develop
critical thinking skills and communications as well as being able to make enquiries
through questioning is critical. The foregoing on previously conducted studies show
that there is emphasis on the need to use the curriculum of formal education system

to prepare people for the 4IR. This indicates the need for formal education through its curriculum to be aligned with current trends of needs in order to enable people and societies adequately prepare for the 4IR.

2 Research methodology

Scoping review methodology, as presented by Arksey & O'Malley (2005) and used by Sucharew & Macaluso (2019), was employed for this study. Historically, two of the recognised earliest proponents of the scoping review methodological framework are Arksey and O'Malley. There are six steps involved in a scoping review methodical framework (Arksey & O'Malley, 2005; Sucharew & Macaluso, 2019). These steps are identification of the research question; identification of relevant studies, study selection; charting the data; collation; summary and reporting of results and the sixth the consultation exercise, which is optional. The six steps identified by Arksey & O'Malley (2005) and Sucharew & Macaluso (2019) were used in the context of this study. The application of these steps are explained below.

Step 1: Identification of the research question: The researcher identified the research question which served as a guideline for the study while applying each of the identified steps. The purpose of identifying the research question was to ensure that the focus was achieved. The research question which guided the study is: What is the scholarly discourse about Botswana, its education system and practices with regards to the Fourth Industrial Revolution (4IR)?

Step 2: **Identification of relevant studies**: Having identified the research question as a guideline for the study, the researcher proceeded to identify previous studies considered relevant for the research. According to Sucharew & Macaluso (2019), relevant studies are to be identified from electronic databases, hand searches and reference lists. In the context of this study, the following databases were searched: Sabinet, Scopus, ScienceDirect, Web of Science (WoS), Google, as well as Google Scholar. These databases were used due to their wide coverage.

Step 3: Study selection: Sucharew & Macaluso (2019) state that the study selection process can comprise, but should not be limited to, the generation of hypotheses of already observed data; criteria adopted for including, excluding or modifying search terms while following the procedure of identifying literatures for data collection. For the purpose of this study, the search terms were "4IR" And "Education" And "Botswana" The search was first done on 21 October 2021 and repeated on 22 October 2021 on Scopus and Web of Science (WoS) databases. However, no item was found on any of the databases, in order to ascertain the result of zero items, following the search terms on each of the databases, the researcher asked a colleague to assist with the same search and the result remained the same. Using the same search terms ("4IR" And "Education" And "Botswana"), a further search was done on the ScienceDirect and Sabinet databases, the results were one (1) and eight (8) articles respectively; however, none of the articles was exclusively on Botswana. The researcher proceeded to search on Google and Google scholar where more articles with the search terms were retrieved. The articles were then sorted and categorised into three groups: 1 article focused on Southern African Development Community (SADC) or
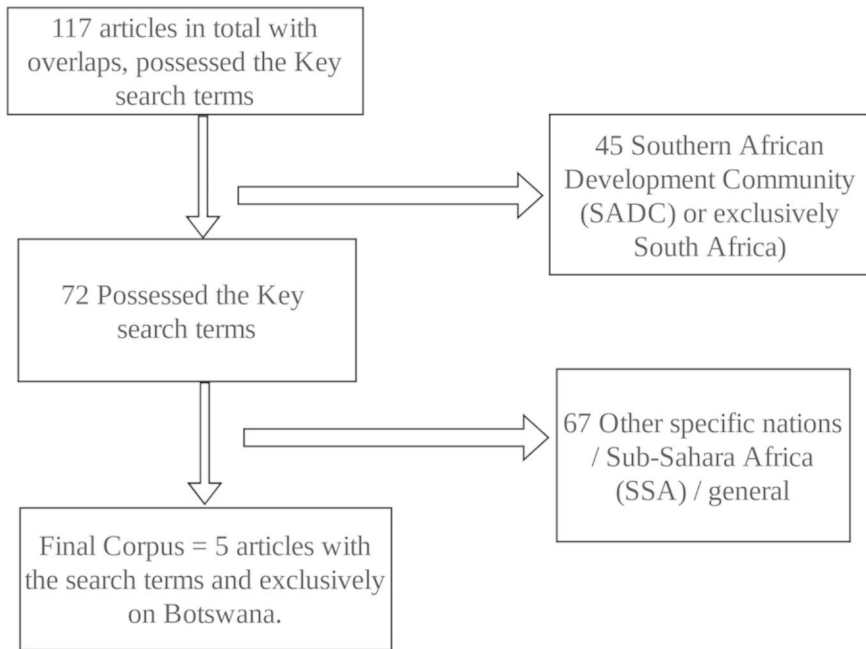
Fig. 1 Flowchart of number of searched articles and final corpus

exclusively South Africa); 2. articles on other Sub-Sahara African nations (SSA) or the world at large; and 3. articles exclusively on Botswana. A total of 117 articles were retrieved. Hence, following the categories, the researcher sorted the articles to identify the final corpus for analysis. After sorting, all the articles in the first category (45) were removed because they were not exclusively on Botswana The next to be removed were the 67 articles in the second category because they focused on other nations or the world at large. The third and final category comprising five articles was analysed and used for this study These articles formed the final corpus which was used for the study because they were exclusively on Botswana. Additionally, it is important to note that White Papers, policy documents, magazines, dissertations and theses were not included in the counts, since the focus was on scholarly articles in journals and books. Figure 1 shows the flowchart of the of scholarly literature retrieved and those excluded from the analysis before arriving at the final corpus of five articles which were analysed for the study.

After analysing the final corpus, main themes and sub-themes were then identified and discussed, using other supporting literature, where necessary. This is as presented in the step following. Considering the final corpus, only XYZ published articles were analysed. However, following the submission of Saldana (2016) as well as Major & Savin-Baden (2010), the final corpus though succinct, is useful for analysis. For instance, while Saldana (2016) , p. 205) states that "the number of different yet related studies needed for such ventures varies among methodologists, ranging from as few as 2 to as many as 20," Major & Savin-Baden (2010) recommend that "between 6 and

	Authors	Year of Publication	Key findings
Table 1 Data charting form used to extract information from reviewed literature	Muchuchuti et al.	2021	Many but not all urban-based Botswana workers/employees are quite aware and preparing for the Fourth Industrial Revolution (4IR)
	Makaloba	2020	The education sector has a crucial role to play in preparing the nation and its people for the Fourth Industrial Revolution (4IR).
	Mogomotsi, et al.	2020	The need to position tertiary institutions of learning for achieving the Sustainable Development Goals (SDGs).
	Mokeresete and Esiefarienrhe	2020	Role(s) of universities
	Gwangwava	2019	The role of the Botswana International University of Science and Technology (BIUST) in creating enabling environment to promote 4IR.

10 studies is optimal to provide sufficient yet manageable data (p. 54)." On this basis, the researcher proceeded in analysing the final corpus of the study.

Step 4: **Charting the data**: According to Sucharew & Macaluso (2019), the process of data extraction in a scoping review is known as data charting. It consists of the use of a data charting form which is employed to extract the needed information considered as pertinent and significant to the study of focus from the reviewed literature. In the context of this study, the data charting form was used for the five articles which formed the final corpus of literature used for the study. Table 1 below presents a sample of some excerpts from each of the reviewed and analysed literature.

Additionally, an inductive content analysis was employed for the study (Hsieh & Shannon, 2005; Saldana, 2016). The reviewed literature were coded, categorised, thereafter themes were generated. This was done in alignment with the submission of Saldana (2016). The themes are reported in the discussion section of this study.

Step 5: Collating, summarising and reporting results: Arksey & O'Malley (2005) explain that thematic construction is needed in the step to present a narrative account of existing literature. Thus, for the purpose of this study, themes were created and consequently used as guide to provide answers the research question of the study: What is the scholarly discourse about Botswana, its education system and practices with regards to the Fourth Industrial Revolution (4IR)? In discussing the identified themes from the reviewed literature, extracts were used in support of the discussion points. The themes are presented in the discussion section.

3 Discussion

This section presents relevant themes identified from the reviewed and analysed literature. The themes deduced from the analysed literature are as presented and discussed below:

3.1 Theme 1: Inevitable role(s) of the Botswana education sector

The findings from the reviewed literature on scholarly discourse on Botswana, education and the 4IR showed that tertiary institutions of learning, especially universities, have expedited roles to play if Botswana is to align itself with implementation practices of the4IR in its attempt to be on par with the rest of the world. For instance, some scholars from the reviewed literature are reported stating that: "With the onset of the Fourth Industrial Revolution (4IR), economies around the world are becoming increasingly knowledge-based. 'The education sector in Botswana is one of the few in the world that is wholly government funded and has the potential to become a key driver of the country's economy. Investments into the education sector and the information sector can therefore be improved, enabling the country to move towards a knowledge-based economy, as opposed to its current reliance on natural resources' (Makaloba, 2020, 64)." This suggests that the role of the education sector of Botswana is crucial. Other discourses on theme 1 include: "Essentially, 'the pursuit of the knowledge-based economy is a direct and deliberate response to prepare for 4IR'" (Mogomotsi et al., 2020, 282) This is supported by Lee et al., (2018) who state that the need to strategically design a workable plan with universities is crucial. According to Lee et al., (2018), though it is necessary to strategically plan with firms based on the roles to be performed in the Fourth Industrial Revolution (4IR) era, the place of universities is inestimable. Thus, universities and other tertiary institutions of learning are to be engaged to help Botswana prepare itself and its people for the 4IR. For example, according, according to Gwangwava (2019, 37) "Botswana International University of Science and Technology (BIUST) uses the winter school model for enrolled engineering students. The program allows second year students to undergo various engineering workshop practices, gaining essential hands-on skills. The BIUST engineering workshop houses more than twenty laboratories. In order to promote 4IR, the laboratories are equipped with state-of-the-arts machinery for thermal processes, advanced manufacturing, meteorology, and many other disciplines. Other initiatives being mooted to promote 4IR are targeted infrastructure, skills development, financing models, and promoting partnerships between public and private sector (3Ps) through MOUs." This shows the attempt made by a specific University in Botswana to align students and help to position Botswana for relevance in the 4IR. Mogomotsi, Mogomotsi and Norris (2020) , 281) state that "…the University of Botswana should leverage the competitive edge it has to effectively contribute towards meeting SDGs." Additionally, Mokeresete & Esiefarienrhe (2020), in support of the need for education as crucial for sustainable development in Botswana and alignment with the practices of the 4IR, states that "Colleges, Universities in Botswana are supposed to produce trained human capital to provide online education; their state of preparedness indicates they are not (Mokeresete & Esiefarien-

rhe, 2020, 3).” This corresponds with the finding of the earlier work of Jaiyeoba & Iloanya (2019) stating that policy-makers, the youth who make up 60% of Botswana' population, are assisted to acquire knowledge to achieve set goals and aspirations. However, in the Fourth Industrial Revolution (4IR) era, one way of achieving the goal is capable trained online education providers who can help in this regard.

The scholarly discourse on the first theme shows that the roles to be played by the Botswana education sector are very crucial. In fact, “Higher education in Botswana is believed to transform life through the provision of job opportunities for those with the privilege to access it (Makwinja, 2020, 85).” though some relevant practices seem to be ongoing, as identified in the case of BIUST, more work is needed.

3.2 Theme 2: Employees/workers preparedness for the fourth industrial revolution (4IR)

The findings on the second identified theme – preparedness of employees show that many workers in urban Botswana, especially the capital, seem to be prepared for the 4IR. Muchuchuti et al., (2021) conducted a study exploring the preparedness of employees in Botswana. The study adopted the Unified Theory of Acceptance and Use of Technology (UTAUT) model, while quantitative method was employed. Thus, data was collected by means of a questionnaire distributed to employees in the capital of Botswana, Gaborone. However, the study failed to mention the sample size. The collected data was analysed, using SPSS version 25. The findings of the study showed that the people of Botswana are to some extent aware and prepared for the Fourth Industrial Revolution (4IR). According to the finding of the study “50% of respondents confirmed their preparedness for the adoption of 4IR technologies; 48% believed that the rest of employees in their organization were prepared for 4IR; 65% said they were prepared to embrace and take advantage of the efficiencies brought about by 4IR; job roles are likely to change significantly with some roles disappearing and new roles emerging; and critical thinking, complex problem solving, innovation and digital related skills are bound to be more in demand (Muchuchuti et al., 2021, 29).” Additionally, the study also reported that “… the attitude and self-awareness of employees to the concept of 4IR, indicates readiness for the implementation of 4IR in organisations (Muchuchuti et al., 2021, 38).” However, the study of Muchuchuti et al., (2021) only focused on the capital of Botswana – Gaborone which is an urban environment. Thus, it did not report on the state of job preparedness in rural Botswana.

Having considered that the role of the education sector in Botswana in aligning the nation and its citizens with 4IR is crucial and many employees in urban Botswana are prepared for the revolution, there is need to explore skills acquisition and training. Hence, the next identified theme to be discussed following the literature review and analysis revolves around the subject skill acquisition and training in the 4IR.

3.3 Theme 3: need for skill acquisition and training

Literature reviewed and analysed for this study shows that there is need for skills acquisition and training. For instance: “… the need to acquire some form of skill and

training and learning is exponentially growing every day in Botswana (Mokeresete & Esiefarienrhe, 2020, 3)." This shows the extent to which Botswana needs to align itself with skills needed for the 4IR, through training. This finding is in contrast with the work of Muchuchuti et al., (2021) who state that many employees in Gaborone (urban centre) are prepared for the 4IR. Perhaps, the reason for the contrast is based on the fact that the respondents of the study of Mokeresete & Esiefarienrhe (2020) were largely from outside urban and peri-urban areas of Botswana.

The findings of the work of Mokeresete & Esiefarienrhe (2020) further show the way in which skills can be acquired and training conducted. Mokeresete & Esiefarienrhe (2020, 3) state that "online education- Is the alternative provision of learning and acquisition of skills through online platforms. People use "Do It Yourself" (DIY) and other virtual systems to access both live streams and other forms to acquire qualifications in other countries (Mokeresete & Esiefarienrhe, 2020, 3)." This shows the importance of online education in assisting the people of Botswana to prepare for the 4IR through skills acquisition and training. Meanwhile, in congruence to this finding, Seeletso (2021, 122) opines that "… in developing countries like Botswana where there are ODL universities and other ODL institutions of higher learning, the transition was much easier. In some instances, such as at Botswana Open University (BOU), even before the pandemic, distance education was the mode of delivery used, and at some point, it was supported by ICTs to reduce learners' isolation." However, in contrast, following the disconnection experienced by rural areas of Botswana due to a lack of electricity, digital divide is imminent and the attempt to achieve skills acquisition and training through online platforms may become futile based on the report of Mudongo (2021). The foregoing shows that skills acquisition and training is considered important, specifically in areas outside urban and peri-urban Botswana and online platforms are required for this However, due to a lack of electricity, such an achievement may not be possible, provided that the required measures are taken by the relevant bodies. Thus, the next identified theme from the analysed literature reports on the factors militating against preparation for the 4IR in Botswana.

3.4 Theme 4: Challenges faced while adjusting to the fourth industrial revolution (4IR)

"Botswana ranked at 111th place on the frontier technology readiness index – the second highest for a landlocked developing country in Africa and 9th place for Sub-Saharan Africa. "'Although this positioning places Botswana among the stronger performers in Africa, we still face many challenges' (Letsholathebe, 2021, 5)." Muchuchuti et al., (2021, 38) state that "although technological advancement (in 4IR) plays an important role in the organisational development and growth, organisations are now faced with new challenges such as changes in production systems, design, processes and operations." The identified excerpts show that although certain achievements are made by the nation, there are still challenges obstructing it from positioning itself as desired, especially to be on par with the global world. Some of the identified challenges are as presented below, using extracts from literature.

A lack of funds for investing in the required technologies is a barrier capable of affecting organisations and the country in adjusting to and preparing for the Fourth

Industrial Revolution (4IR). For instance, according to Muchuchuti et al., (2021, 38) based on the findings of the study, "…. organisations should possess enough funds to invest in modern technologies."

Also, a lack of human capital to provide online education can be deduced as another challenge. Hence, Mokeresete & Esiefarienrhe (2020, 3) state that "colleges, universities in Botswana are supposed to produce trained human capital to provide online education …." Furthermore, in congruence with this, Seeletso (2021, 129) states that "lack ICT skills and expertise was another challenge for students and educators due to their limited experience with online teaching and learning." This implies that there is dire need for human capital in online education.

Curriculum is another challenge experienced by the nation in preparing people for the 4IR following the literature review. For instance, according to Mogomotsi et al., (2020, 282), "While traditional education has contributed positively to the current levels of the industrial evolution and technological advancement, the 4IR era requires a transformation in the design and delivery of the curriculum. In recognition of these changes, many of which are currently being experienced in many aspects of ordinary lives, the government of Botswana has committed to pursuing a 'knowledge-based economy." This is in congruence with the inaugural statement of the President on 31March 2018. In his speech President Masisi (2018) stressed the need to build the nation towards being sustainably developed up to modern standard, while ensuring the country's ability to openly compete with the rest of the world. In support of this finding on curriculum, Phatsima (2021) reports: "After going around the country and doing work in 40 schools, I realized that the teachers themselves don't know about 4IR, coding or robotics. Coding isn't part of our curriculum at the moment; only a few schools have robotics kits, but they don't know how to use them cited by (Phatsima, 2021, 1)." Furthermore, comparing the curriculum of schools in Botswana with what is obtainable in other African nations, Phatsima (2021, 1) states that "In other African countries such as Rwanda, you'll find that coding and robotics are taught in schools and they are part of the curriculum … Recently, President Cyril Ramaphosa of South Africa stated that coding will be taught in schools. We in Botswana are a little slower in catching on to these developments." This implies that while there is recognition of the deliverables that are obtainable in the curricula of other countries, Botswana seems to be lagging in the area of alignment through the curriculum.

The findings of this study show a lack of funds, a lack of human capital in online education, curriculum issues challenges encountered by the nation in aligning itself and its citizens with the practices of the Fourth Industrial Revolution (4IR).

3.5 Theme 5: way forward

Sequel to the analysed literature which comprised the final corpus of articles that were adopted for this study, various submissions of scholars were classified under the way forward. This means ways in which Botswana can position itself to align itself with the implementation of Fourth Industrial Revolution (4IR) practices. Muchuchuti et al., (2021), following the findings of the study conducted on Botswana employees' preparedness for the Fourth Industrial Revolution (4IR), show that there is need for Botswana employees "…to equip themselves and future generations with requisite

skills, for the changing roles (Muchuchuti et al., 2021, 29)." Also, "… organisations ought to ensure that adequate long-term resources are available for upskilling (training & development) of their employees as well as acquisition of the necessary fourth industrial revolution technologies. Constant training of employees could help create increased awareness and familiarity with the 4IR dynamics, inspire more openness for acceptance, and increase their morals to become actively engaged with the 4IR dynamics (Muchuchuti et al., 2021, 38–39)." This finding, corresponds with the submissions of WEF (2020), Harve (2019) and Omarjee (2018) who submit that reskilling is a major priority for workers in the Fourth Industrial Revolution (4IR), thus is to be treated as such. In projecting on the way forward, this finding corroborates the submission of Olopeng (2019) who pushes for education and training to go beyond being a domesticated commodity, rather be globalised, while institutions of higher learning are designed to develop futuristic learning programmes capable of positioning Botswana in globally competitive state. Similarly, following the submission of Williams (2018), Botswana has negotiated with organisations abroad to purchase relevant equipment and arrange for training opportunities for students. Also, computing clusters are being established for use by students and students have been able to attend training courses and conferences abroad (Williams, 2018)). Meanwhile, plans are underway in preparing Botswana senior secondary school learners for e-learning during the 2021/2022 financial year (Maramwidze, 2021).

Additionally, the practice of the Botswana International University of Science and Technology (BIUST), as presented by Gwangwava (2019), is to be commended and upheld. Gwangwava (2019) states that "The BIUST engineering workshop houses more than twenty laboratories. 'In order to promote 4IR, the laboratories are equipped with state-of-the-arts machinery for thermal processes, advanced manufacturing, meteorology, and many other disciplines'. Other initiatives being mooted to promote 4IR are targeted infrastructure, skills development, financing models and promoting partnerships between public and private sector (3Ps) through MOUs" (Gwangwava, 2019, 37). This suggests the need to make infrastructure available to promote teaching and learning in the Fourth Industrial Revolution (4IR) era.

Step 6 (Optional): **Consultation exercise**: This stage is considered an optional step by Sucharew & Macaluso (2019). In other words, it can be omitted. At this stage, stakeholders other than the researcher(s) conducting the study review team are requested to provide insights that can inform and validate findings from the scoping review. For the purpose of this study, a researcher was contacted to give insights which helped to validate the search and its findings.

4 Conclusion and recommendations

The study explored discourse on the Fourth Industrial Revolution (4IR) and education in Botswana from a scholarly point of view, using a scoping review method. The idea was to find opinions of scholars of published works based on research conducted on Botswana and its positioning on the Fourth Industrial Revolution (4IR), from an educational point of view. Education is considered as a fundamental factor to help promote the drive for the Fourth Industrial Revolution (4IR) in Botswana and its

institutions of higher learning, like Botswana International University of Science and Technology (BIUST) which is already positioning itself to ensure that graduates are relevant for the Fourth Industrial Revolution (4IR) are produced. However, part of the quest for education aligned with the practices of the Fourth Industrial Revolution (4IR) is the need for human capital, for knowledge economy, skills acquisition and training in Botswana. Several factors are reported to be militating against the positioning of the education system of Botswana in ensuring the smooth implementations of the practices of the Fourth Industrial Revolution (4IR). Among these factors are a shortage of qualified personnel, a lack of funds, limited equipment, and non-alignment of the curricula of schools with the demand for the Fourth Industrial Revolution (4IR).

5 Limitation and suggestion for further study

The study was limited in that it reviewed only five published articles which formed the final corpus adopted for this study. The study showed that not much had been done exclusively on the Fourth Industrial Revolution (4IR) on the part of 'Botswana and education'. Hence, it is suggested that studies be conducted on the preparations of Botswana for the Fourth Industrial Revolution (4IR). Such studies can be conducted, taking cognisance of actual practices on how institutions of learning and/ or the education sector in Botswana is preparing its citizens in this regard. Also, the positioning of rural and urban based institutions of learning can be considered with regard to preparation for the Fourth Industrial Revolution (4IR).

Data availability Data sharing for this study is not applicable as no datasets were generated.

Conflict of Interest None.

References

Ab Rahman, A., Hamid, A., U.Z., & Ai Chin, T. (2017). Emerging Technologies with Disruptive Effects: A Review. *Perintis eJournal*, *7*(2), 111–128

Akokuwebe, M. E., & Okunola, R. A. (2015). Demographic transition and rural development in Nigeria. *Journal of Developing Country Studies (USA)*, *5*(6), 1–13

Arksey, H., & O'Malley, L. (2005). Scoping Studies: towards a methodological framework. *International Journal Of Social Research Methodology*, *8*(1), 19–32. doi: https://doi.org/10.1080/1364557032000119616

EdTech Hub (2020). *The Effect of Covid-19 on Education in Africa and its Implications for the Use of Technology: A Survey of the Experience and Opinions of Educators and Technology Specialists*. UKaid. DOI https://doi.org/10.5281/zenodo.4018774. http://www.guninetwork.org/files/the_effect_of_covid-19_on_education_in_africa.pdf

Fomunyam, K. G. (2020). Engineering Education and soft skills in the Era of the Fourth Industrial Revolution in Africa. *International Journal of Recent Technology and Engineering (IJRTE)*, *9*(3), 339–345. doi:https://doi.org/10.35940/ijrte.B3972.099320

Gwangwava, N. (2019). Active role of learning institutions in promoting Fourth Industrial Revolution (4IR) In Jamisola, Rodrigo S. Jr (ed.) BIUST Research and Innovation Symposium 2019 (RDAIS 2019); 1 (1) 37–41. http://repository.biust.ac.bw/handle/123456789/159

Harve, A. (2019). *Reskilling the Workforce for the Fourth Industrial Revolution*. Available at: https://training-industry.com/articles/workforce-development/reskilling-the-workforce-for-the-fourth-industrial-revolution/. Accessed 25 October 2021

Hsieh, H., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, *15*, 1277–1288

Jaiyeoba, O. O., & Iloanya, J. (2019). E-learning in tertiary institutions in Botswana: apathy to adoption. *The International Journal of Information and Learning Technology*, *36*(2), 157–168. DOI: https://doi.org/10.1108/IJILT-05-2018-0058

Langthaler, M. (2020). *Digital skills for whom? Reflections on the impact of digitalization on education in the global south*. pp. 63–72. Available at: https://www.oefse.at/fileadmin/content/Downloads/Publikationen/Oepol/Artikel2020/OEPOL2020-Margarita-Langthaler.pdf. Accessed 22 October 2021

Lee, K. H., Koh, E., Hong, C., Lee, Y., Moon, E., & Cho, J. (2018). New curriculum of software education for 5-years-old children. *Journal of Advanced Research in Dynamical and Control Systems*, *10*(14), 374–381

Lee, M., Yun, J. J., Pyka, A., Won, D., Kodama, F., & Schiuma, G. (2018). How to respond to the fourth industrial revolution, or the second information technology revolution? Dynamic new combinations between technology, market, and society through open innovation. *Journal of Open Innovation*, *4*(3), 21. https://doi.org/10.3390/joitmc4030021

Letsholathebe, D. (2021). *The role of science, technology and innovation in a sustainable and resilient recovery from the COVID-19 pandemic*. Geneva: United Nations Commission on Science and Technology for Development (CSTD)

Major, C. H., & Savin-Baden, M. (2010). *An introduction to qualitative research synthesis: Managing the information explosion in social science research*. London: Routledge

Makaloba, K. (2020). The Reverberations of the Covid-19-Hit International on Botswana Diamond Market. *The Thinker*, *84*, 61–64

Makwinja, V. M. (2020). "Inclusive and Multicultural Education: The Dynamics of Higher Education Institutions in Botswana – Inequality and Exclusion of Students." In *Developing and Supporting Multiculturalism and Leadership Development: International Perspectives on Humanizing Higher Education Innovations in Higher Education Teaching and Learning*, Volume 30, 85–99. doi:https://doi.org/10.1108/S2055-364120200000030007

Maramwidze, A. (2021). *Botswana looks to fast-track e-Learning strategy*. Available at: https://itweb.africa/content/JN1gP7OYOrxqjL6m. Accessed 21 October 2021

Masisi, M. E. K. (2018). *Inauguration address by Mokgweetsi Masisi, the fifth president of Botswana on Sunday April 1, 2018*. Gaborone: Office of the President, Republic of Botswana

Menon, K., & Castrillón, G. (2019). Reimagining curricula for the Fourth Industrial Revolution. *The Independent Journal of Teaching and Learning*, *14*(2), 6–19

Mogomotsi, G. E. J., Mogomotsi, P. K., & Norris, D. (2020). "Positioning the University of Botswana Towards Achieving the Sustainable Development Goals (SDGs)." In *Sustainability in Developing Countries*, by S. O. Keitumetse et al. (eds.), pp. 281–293. Springer Nature: Switzerland AG. https://doi.org/10.1007/978-3-030-48351-7_1

Mokeresete, M., & Esiefarienrhe, B. M. (2020). "Users' perspective on the assessment of Botswana Fibre Backbone Network Infrastructure." *2020 2nd International Multidisciplinary Information Technology and Engineering Conference (IMITEC)*, pp. 1–8. DOI: https://doi.org/10.1109/IMITEC50163.2020.9334128

Morgado, J. C., Lencastre, J. A., Freires, T., & Bento, M. (2021). Smart Education as Empowerment: Outlining Veteran Teachers' Training to Promote Digital Migration. *Technology Knowledge and Learning*, *26*(4), 897–916. https://doi.org/10.1007/s10758-021-09494-6

Muchuchuti, S., Ebewo, P., JR, Muchuchuti, K. C., & Mutoko, W. R. (2021). Jobs 4.0: Are Botswana Workers Ready? *Developing Country Studies*, *11*(2), 29–40

Mudongo, O. (2021). *LONDA: Botswana Digital Rights and Inclusion 2020 Report*. Yaba, Lagos: Paradigm Initiative Publication

Nordling, L. (2021). *Africa least ready to surf fourth industrial wave*. Available at: https://www.research-professionalnews.com/rr-news-africa-pan-african-2021-3-sub-saharan-africa-least-prepared-to-surf-fourth-industrial-wave/. Accessed 18 October 2021

OECD Education and Skills Today (2019). *What the fourth industrial revolution could mean for education and jobs.* Available at: https://oecdedutoday.com/what-the-fourth-industrial-revolution-could-mean-for-education-and-jobs/. Accessed 24 October 2021

Olopeng, T. (2019). *1ST International Conference on Leveraging ICT's for Sustainable Development.* Gaborone: Botswana Accountancy College in Collaboration with the University of Sunderland. https://www.bac.ac.bw/sites/default/files/Abstract%28final%29.pdf

Omarjee, L. (2018). *Reskilling a priority to prepare workers for the fourth industrial revolution – report.* Available at: https://www.news24.com/fin24/economy/labour/reskilling-a-priority-to-prepare-workers-for-the-fourth-industrial-revolution-report-20181007. Accessed 25 October 2021

Paradigm Initiative News (2020). *4th Industrial Revolution: Readying Africa for the emerging AI decade.* Available at: https://paradigmhq.org/4th-industrial-revolution-readying-africa-for-the-emerging-ai-decade/. Accessed 21 October 2021

Phatsima, K. (2021). *The Tech and STEM pioneer of Botswana*. Available at: https://sheleadsafrica.org/tag/botswana-tourism/. Accessed 21 October 2021

Plawgo, B., & Ertman, A. (2021). Competency Needs of Industry 4.0 Companies. *Central European Management Journal*, *29*(4), 172–195. https://doi.org/10.7206/cemj.2658-0845.64

Power, R. (27 August 2021). 4 Examples of the Fourth Industrial Revolution in Action. *CEOWORLD Magazine*. https://ceoworld.biz/2021/08/27/4-examples-of-the-fourth-industrial-revolution-in-action/ Accessed 21/07/2022

Relocate Global (2018). *Education in the Fourth Industrial Revolution*. Available at: https://www.relocatemagazine.com/articles/education-schools-relocate-global-international-guide-education-in-the-fourth-industrial-revolution. Accessed 24 October 2021

Saldana, J. (2016). *The Coding Manual for Qualitative Researchers*. London: SAGE

Schwab, K. (14 January 2016). The Fourth Industrial Revolution: what it means, how to respond. *WEF*. https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

Seeletso, M. (2021). "Using Information Communication Technologies for Interactive Open and Distance Learning Experiences in the Era of COVID-19." In *Online Teaching and Learning in Higher Education during COVID-19: International Perspectives and Experiences*, by Roy Y. Chan, Krishna Bista, and Ryan M. Allen (eds). USA: Routledge

Setyaningsih, E. (2019). Adapting Elementary School Curriculum Innovation in Line by 4IR and Cultures. *Advances in Social Science Education and Humanities Research*, *432*, 81–91

Sibanda, O. S. (2020). AfCTA and the Trajectory of Industrialisation and Development Sustainability in Africa. *KOERS — Bulletin for Christian Scholarship*, 85(1). Available at: https://doi.org/10.19108/KOERS.85.1.2484

Smith, R. B. (2021). How can the least developed member countries of asean benefit from the 4th industrial revolution? *Walailak Journal of Science and Technology*, *18*(1), 1–12. https://doi.org/10.48048/wjst.2021.6502

Sucharew, H., & Macaluso, M. (2019). Methods for Research Evidence Synthesis: The Scoping Review Approach. *Journal Of Hospital Medicine*, *7*, 416–418. doi:https://doi.org/10.12788/jhm.3248

Technopolis & Research ICT Africa & Tambourine Innovation Ventures (2019). *Study Report: Unlocking the Potential of the Fourth Industrial Revolution in Africa. Korea-Africa Economic Cooperation*. https://4irpotential.africa/wp-content/uploads/2019/10/AFDB_4IRreport_Main.pdf

The Mid-Week Sun (2021). *Tertiary Education Minister Calls for Smart Society*. Available at: https://www.pressreader.com/. Accessed 21 October 2021

Williams, G. (2018). "Public Sector Science, Technology and Innovation in the Context of the Fourth Industrial Revolution." *Implications of the 4th Industrial Revolution for SET, industry, society and education*. Cape Town: National Science and Technology Forum (NSTF)

World Economic Forum (WEF) (2015a). *The Human Capital Report 2015. World Economic Forum Global Agenda Council White Paper*, Geneva: World Economic Forum, 2015

World Economic Forum (WEF) (2015b). *Global Agenda Council on the Future of Software and Society, Deep Shift: Technology Tipping Points and Societal Impact*, World Economic Forum Global Agenda Council White Paper, 2015

World Economic Forum (WEF) (2016a). *The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution.* Geneva: World Economic Forum, 2016. Available at: http://www3.weforum.org/dos/WEF_Future_of_Jobs.pdf. Accessed 21 October 2021

World Economic Forum (WEF) (2016b). *What role will education play in the Fourth Industrial Revolution?* Available at: https://www.weforum.org/agenda/2016/01/what-role-will-education-play-in-the-fourth-industrial-revolution/ Accessed 24 October 2021

World Economic Forum (2019). *Top 10 African Countries with the Best Education Systems*. Available at: https://www.afterschoolafrica.com/42898/top-10-african-countries-with-the-best-education-systems/. Accessed 24 October 2021

World Economic Forum (WEF) (2020). *Hundreds of millions of workers need reskilling. Where do we start?* Available at: https://www.weforum.org/agenda/2020/01/hundreds-of-millions-of-workers-need-reskilling-where-do-we-start/. Accessed 25 October 2021

World Economy Forum (2022). Fourth Industrial Revolution. *WEF*. https://www.weforum.org/focus/fourth-industrial-revolution Accessed 20 July 2022

Taiwo, S.O., Uleanya, C., & Ayandibu, O. A. (2022). Investigation of the Awareness of Rural Students on M-Learning using Smartphones. ScienceRise: Pedagogical Education, 1(46), 22-27.

Uleanya, C. (2022). Hidden curriculum versus transition from onsite to online: A review following COVID-19 pandemic outbreak. Cogent Education, 9(1), 1-10. 10.1080/2331186X.2022.2090102

Uleanya, C. & Yu, K. (2019). Review of Preparedness of Rural African Communities Nexus Formal Education in The Fourth Industrial Revolution. South African Review of Sociology, 50(3-4), 91-103. https://doi.org/10.1080/21528586.2019.1639074.