A Systematic Literature Review: The Impact Of The Fourth Industrial Revolution On The Development Of The Soft Skills Of Students In Higher Education Institutions Of South Africa

***Hester Vorster[1], Annmarie Botha[2]**

[1]Faculty of Economic Sciences, School of Accounting, North-West University, South Africa.

[2]Faculty of Humanities, School of Languages, North-West University, South Africa.

***Corresponding Author**

Received: Nov 25, 2024; Revised: Feb 18; Accepted: Feb 22; Published (unedited first): Feb 25, 2025

CITATION: Vorster H, Botha A, 2025. A Systematic Literature Review: The Impact Of The Fourth Industrial Revolution On The Development Of The Soft Skills Of Students In Higher Education Institutions Of South Africa. *Management and Economics Research Journal,* 11(1): 9900106. https://doi.org/10.18639/MERJ.2025.9900106

ABSTRACT

The 4IR has brought about progress that has had a major impact on industries and educational institutions worldwide. The HE sector in SA has to deal with many challenges to adapt to 4IR and also to ensure that students master the necessary soft skills required for success in an increasingly digital and automated world. This SLR examined the impact of the 4IR on developing soft skills among students in HEIs in SA. A comprehensive search of articles and literature published between 2019 and 2024 was conducted and was conducted across multiple databases. The literature review confirmed how integrating advanced digital technologies into higher education has impacted the development of soft skills such as critical thinking, adaptability, communication, and problem-solving. The findings confirmed that despite the many benefits of 4IR, HEIs still face significant challenges, including inadequate technological infrastructure, limited digital literacy, and a lack of strategic approaches to incorporate soft skills into traditional curricula. The study concluded that successfully addressing the challenges of 4IR requires much more investment in technology and the implementation of innovative pedagogical practices and curriculum reforms that emphasize holistic skill development. Therefore, based on these insights, recommendations were made for educational leaders and industry stakeholders to develop comprehensive frameworks, including curriculum design, more collaboration between HEIs and industries, and greater emphasis on lifelong learning initiatives to impact the holistic development of students' soft skills. The gaps in existing research have been identified and focused on the challenges faced by South African HEIs. Challenges include increased investment in educational resources, curriculum development, and technology adoption to ensure the country remains competitive within the global 4IR context. These conclusions have laid a foundation for future research, particularly aimed at adapting strategies to improve soft skills development in HEIs in SA to prepare students for the future demands of the workforce.

KEYWORDS: Fourth Industrial Revolution (4IR); Higher Education; Students; Soft Skills; South Africa.

ABBREVIATIONS: 4IR: Fourth Industrial Revolution; HEIs: Higher Education Institutions; SA: South Africa; HE: Higher Education; IoT: Internet of Things; SLR: Systematic Literature Review; TVET: Technical and Vocational Education and Training.

1. INTRODUCTION

Klaus Schwab conceptualised the 4IR [1]. Schwab believes that while the 4IR builds on the Third Revolution, there was a significant shift in technical advancement and its impact on society [2]. The 4IR involves merging physical, digital, and biological technologies, including artificial intelligence (AI), robotics, the IoT, big data, and blockchain [3-5].

1.1 THE NATURE OF 4IR

While earlier industrial revolutions were primarily focused on mechanization, mass manufacturing, and automation, the 4IR expanded automation and digitalization, and the demand for skills other than technical abilities is growing [6]. This focuses on improving soft skills such as critical thinking, adaptability, emotional intelligence, cooperation, and ethical decision-making [6-8]. Ilori and Ajagunna [9] and Scepanović [1] underline the necessity of these skills in navigating the ever-changing 4IR landscape, where technological innovations exceed traditional education and employment practices.

According to Mhlanga [10], the global impact of the 4IR is causing potential challenges in many sectors, including manufacturing, healthcare, transportation, and education. Although the possibility of growth of innovation is improving productivity and economics, the rapid technological advancements of the 4IR are causing disruptions, especially in the labour market [11]. AI-driven processes and automation are causing traditional jobs to become obsolete, as well as an

emphasis shift in employment skills, which changes the focus from hard technical skills to more flexible and transferable soft skills [2, 10, 12, 13].

1.2 THE ROLE OF 4IR IN HEIs

The 4IR has brought about a major change in education and higher education [14]. Therefore, while the study of Waghid [15] suggests that HEIs are essential for providing relevant learning opportunities in the future and, therefore, need to be contextualized in terms of the 4IR criteria, there is also an obligation on HEIs to invest in relevant teaching and learning approaches to teach students the essential skills and digital skills for the future workforce [16-18]. The study by Botha and Vorser [19] suggests that HEIs adjust in terms of their curricula as well as teaching methods to prepare students for success in a rapidly changing digital environment. In a 4IR landscape, students are encouraged to prioritize developing soft skills, such as critical thinking, adaptability, problem-solving, and creativity, to solve problems and technology [1, 9, 18, 20].

1.3 4IR WITHIN THE CONTEXT OF SA

According to Ramnund-Mansingh and Reddy [21], two obstacles regarding the 4IR impact SA should enjoy priority. The 4IR landscape is of utmost importance in promoting innovation and economic progress, but has a negative impact on and exacerbates existing inequalities in employment and education [22]. It is, therefore, essential for HEIs in SA to pay attention to these issues and thereby also prepare students for the future where the labour market is changing. The skills gap between humans and machines widens [23].

Therefore, universities in SA focus on creative approaches to address issues related to the digital and soft skills needed to survive in the 4IR environment and ensure that graduates are equipped with the necessary skills [24]. As the job market increasingly changes, attention must be paid to the increasing demands and strategies that emphasize digital transformation projects and the development of new professional services [25, 26].

According to Mhlanga [27], 4IR technology may help investigate inequalities in SA. 4IR technology can benefit these issues in a conventional learning environment and contribute to the inclusive and effective delivery of education, coupled with quality and accessibility [16]. Mhlanga [10], therefore, emphasizes one of the strategies, i.e., blended learning, which blends traditional classroom teaching with digital platforms to give flexible, affordable education to a wider range of students. Notwithstanding high levels of inequality, the digital divide, and educators' lack of digital and instructional skills, continue to pose challenges in adopting these approaches [28, 29].

1.4 THE ROLE OF HEIs IN DEVELOPING SOFT SKILLS

In a 4IR environment, HEIs' contribution to developing critical soft skills becomes increasingly important [30]. This is especially essential in certain areas, such as automation and artificial intelligence [4, 31]. Therefore, with all these changes in the workplace, it is important to have the necessary skills such as emotional intelligence, teamwork, leadership, ethical awareness, communication, and flexibility. Learning these soft skills is also recommended by the World Economic Forum to be ready for any unpredictability in the future [6].

The South African higher education landscape has many challenges, and it must sort out ways to incorporate the latest technologies and deal with the country's persistent socio-economic inequality issues. Aboderin and Havenga [32] recommend that, to guarantee effective teaching and learning for future demands, HEIs should include developing these skills.

Therefore, according to Chiramba and Ndofirepi [33], special emphasis should be placed on developing soft skills. Graduates must be equipped to deal with the problems posed by the 4IR. According to Lukins [34], it is of utmost importance that graduates develop the necessary skills needed to meet the expectations of the industry and the job market. Mtshali and Ramaligela [35] emphasize the progress of fairness and inclusivity in the workplace and education.

2. LITERATURE REVIEW

2.1 INTRODUCTION

The 4IR revolutionized education by integrating digital technology into higher education, especially in SA and globally [2]. Therefore, there is a shift in the skills that graduates need. Cognitive and practical abilities are needed to thrive in a changing workforce. The introduction of the 4IR in the South African higher education system has already involved discussions about the accessibility and implementation of digital technology, especially in rural settings [36]. However, challenges remain, such as inadequate infrastructure and digital literacy in rural areas [18, 37]. Priority attention should be given to this to bridge the skills gap among South African students.

2.2 THE ROLE OF 4IR IN HE

Therefore, integration of 4IR into the education system in SA is important, and therefore, curriculum changes at universities should be addressed to include critical soft skills such as emotional intelligence, adaptability, strategic

decision-making, and digital skills [18, 38]. Landsberg and Van den Berg [38] encourage creating a digital work environment for students in fields such as accounting, where technical and human-centred skills are considered important to meet evolving employer expectations. Skills like communication, teamwork, and leadership are still not included in university curricula. This negatively impacts graduates' readiness for future jobs [38]. Educational institutions will need to pay attention to this and, simultaneously, re-evaluate their teaching strategies to promote the holistic development of soft skills that guarantee the continued professional success of students [38]. However, there are still significant differences in engagement and access between learners from different socioeconomic backgrounds. The result, therefore, is unequal educational opportunities, as disadvantaged children have a harder time learning the soft skills needed for the 4IR. Therefore, more emphasis should be placed on a more inclusive and comprehensive approach to curriculum design to address and reduce these inequalities. This new approach should guarantee that students are adequately equipped for the modern work of the future [39].

2.3 CURRICULUM REDESIGN FOR 4IR

Higher education curricula must be redesigned to allow students to develop the skills required in a modern work environment. The incorporation of advanced technologies such as automation, AI, and robotics into large industries puts the focus on the essence of incorporating soft skills into the curriculum [40]. Skills that are important for students include critical thinking, creativity, emotional intelligence, and problem-solving skills. These skills must be developed to function in a new technological landscape brought about by 4IR. Restructuring must, therefore, take place and meet the demands of the 4IR. Kamaruzaman *et al*. [40] suggest that a balance must be found between the technical and soft skills required to succeed in a new modern work environment. Students will then succeed in the modern workplace [40].

2.4 CYBERSECURITY CHALLENGES IN 4IR

While much has been done in the 4IR landscape, SA still struggles to adapt. Jansen van Vuuren and Jansen van Vuuren [41] identify shortcomings in cybersecurity management and skill development that require urgent attention as people become increasingly dependent on data. This, in turn, leads to high risks of cyberattacks in SA. Developing a governance framework in SA is becoming essential, as these challenges are difficult to deal with without a framework [41]. There are cybersecurity policies, such as the National Policy Framework for Cybersecurity, but there is a large backlog regarding their practical implementation [41]. In SA, cybersecurity skills are particularly necessary to prepare the workforce for the 4IR. Jansen van Vuuren and Jansen van Vuuren [41] emphasize the importance of technical and soft skills such as communication, leadership, and continuous learning. This will have a positive impact on the industry, thereby preparing students for the challenges of the 4IR.

2.5 TRANSFORMATION OF HIGHER EDUCATION IN 4IR

The 4IR brings with it quite a few changes that necessitate essential transformation in education systems, especially higher education, to prepare students for the evolving demands of the workforce [1]. The rapid integration of new technologies such as robotics, biotechnology, and artificial intelligence has completely changed the structures of society, which has a negative impact and causes current job roles to disappear and be replaced with new ones. Therefore, in education curricula, transformation must occur from traditional models centered around memorization and standardized knowledge to more dynamic, interdisciplinary, and competency-oriented approaches [1]. The responsibility is to cultivate students' critical thinking, creativity, and adaptability, which is necessary to deal with the complexities of the 4IR [1]. This will ensure that students develop the necessary soft skills to succeed in an unpredictable job market and prepare them to participate in lifelong learning.

2.6 CHALLENGES IN IMPLEMENTING 4IR IN HE

Many debates surround transforming education in the 4IR. According to Oke and Fernandes [42], the education sector in SA, especially in higher education, is completely unprepared for the challenges of the 4IR. There is a growing awareness among institutions, but no definitive plan yet for dealing with these challenges. Several factors include limited infrastructure, inadequate educational training, and the slow pace of policy adjustment to integrate these technologies effectively. Investments are needed to enable reform in educational technologies and curricula. If successful, it will offer many new opportunities to enhance the students' learning experience and equip the developing workforce with better skills [42]. The education sector recognizes a great need for a learner-centered approach, leveraging digital technologies not only for digitization but also to foster interactive, personalized learning experiences that prepare students for the demands of the 4IR economy [42].

2.7 THE ROLE OF HEIs IN 4IR

HEIs should primarily focus on preparing students for the 4IR [43]. The focus should be placed on students' knowledge of 4IR technologies, and organizational support should be provided to prepare students for the 4IR workforce [43]. The design of academic programmes, curriculum development, and the availability of training have a major impact on student preparedness [43].

Smart campuses with state-of-the-art facilities are the future and need to be established to promote hands-on experiences with 4IR-related technologies. Changes will be positive in SA and lead to well-equipped graduates incorporating soft and technical skills to meet the demands of the 4IR [43]. These changes will increase students' employability in the digital age.

2.8 THE ROLE OF SOFT SKILLS

The focus should be on integrating soft skills into higher education curricula as technological advances are accelerated. Tsiligiris and Bowyer [4] argue that technical skills such as data analytics and digital literacy, and soft skills such as adaptability, communication, and critical thinking are essential for modern accountants. Therefore, future professionals must be able to handle these transitions to a more digitized and automated work environment [4].

Chaka [44] suggests that soft skills should be developed in a 4IR landscape. According to Chaka [44], developing soft skills, such as communication, creativity, and problem-solving, is equally important within the context of 4IR. Individuals must possess these skills to survive in a complex, interdisciplinary environment. Therefore, individuals must be able to adapt and cope with problem-solving along with others. Mabe and Bwalya [26] highlight the need for soft skill development in SA. Soft skills such as teamwork and emotional intelligence play a huge role in career success and are linked to organizational success in a rapidly evolving technological landscape.

Therefore, the pressure on educational institutions to pay attention to these skills is increasing to adequately prepare graduates for the workforce demands set by the 4IR [26]. Consequently, the focus must shift to developing future-oriented skills to succeed in lifelong learning and adaptation [45]. Technical proficiency, collaboration, thinking creatively, and engaging with new challenges are important.

Although soft skills are not emphasized at universities, they remain important in university education, creating a gap between the skills taught and those required by employers. This disconnect indicates a greater need for holistic educational approaches that integrate soft skills development into the core of higher education curricula and prepare students for the evolving demands of the 4IR workplace [4].

Soft skills are character traits that facilitate successful and harmonious interpersonal interactions, including problem-solving, communication, teamwork, flexibility, and emotional intelligence [26]. The 4IR landscape greatly emphasizes soft skills as they complement technical skills and help graduates navigate complex, technology-driven environments. This emphasises human-centred skills that machines cannot easily do [45, 46].

Kamaruzaman *et al*. [40, 47] also encourage the development of soft skills, including communication, teamwork, and problem-solving, for graduates to be successful in the 4IR-driven workplace. Furthermore, it improves employability and positively impacts adaptability, essential for survival in the modern work environment [44]. Therefore, students must develop hard and soft skills to meet the demands of the modern, evolving workforce [40, 44].

Magagula and Awodiji [48] argue that education curricula fall short, and curricula need to be upgraded soon. The industries all need to work with HEIs to ensure that 4IR technology is included in the learning process. Furthermore, educational institutions should encourage continuous professional development in lecturers to establish a lifelong learning attitude [48].

The 4IR focuses on critical thinking, communication, creativity, and adapting successfully to new technology in a changing, evolving job market [10]. However, Mhlanga [10] asserts that a skills gap poorly prepares graduates for the demands of the modern workplace. According to the study, this gap can only be stopped by switching to blended learning methods and including digital tools that support technical and soft skills.

According to Mhlanga [10], the COVID-19 pandemic has accelerated blended learning models. However, the high levels of inequality, the digital divide, and the lack of adequate resources negatively impact the transition and contribute negatively to integrating soft skills in higher education. Kamaruzaman *et al*. [40] argue that technical skills have long been the focus of engineering education. However, this will have to change as soft skills such as leadership, teamwork, communication, and critical thinking become increasingly important to include in the curriculum. These skills are especially important in the modern workplace due to the rise of automation and robotics.

However, a balanced approach must include both technical and soft capabilities. Therefore, the approach should use a balanced strategy to ensure graduates are prepared to handle future job market demands. Therefore, creating a conceptual framework to improve and organize 4IR capabilities to be included in educational programs is good [40].

Arek-Bawa and Reddy [39] believe implementing a digital curriculum transformation can help close the digital divide and foster the growth of critical thinking, problem-solving, and teamwork, crucial soft skills. This report confirms that there has been significant progress in the curriculum's integration of digital technologies and teaching techniques.

2.9 CONCLUSION

There are several opportunities and challenges for higher education in SA when it comes to the 4IR. Quite a few issues, such as infrastructure limitations, cybersecurity risks, and gaps in curriculum design, will need to be addressed. Therefore, a strategic approach that focuses on soft skills development, cybersecurity awareness, and investments in educational technologies should be followed. These positive changes are necessary to equip students for the future workforce. SA will

need to prioritize addressing these issues and will need to ensure that its higher education system better prepares graduates for sustainable career success.

3. SIGNIFICANCE

The 4IR has the potential to cause significant upsets. It also presents opportunities for many people to improve their quality of life. Automation and technological advancements may lead to the loss of many occupations in the near future. However, new employment is likely to be created. The education of graduates must equip them with the essential skills for the work environment of the 4IR. They must recognise the importance of technological breakthroughs and understand their impact on their future careers.

SA has distinctive socio-economic circumstances; therefore, this transformation is markedly critical. While the 4IR creates new opportunities for economic growth, technical advancement, and creativity, it also risks aggravating current educational and job inequities. This twofold problem in SA highlights the critical need for South African HEIs to provide graduates with the requisite skills to thrive in an increasingly digital and rapidly changing work environment. The 4IR holds enormous promise for beneficial advancements, but all stakeholders must collaborate to ensure the most inclusive outcomes and growth for graduates.

4. RESEARCH PROBLEM AND OBJECTIVES

4.1 RESEARCH PROBLEM

The 4IR has significantly influenced every aspect of human existence, reshaped industries, and transformed workforce requirements [49]. The digital transformation of the 21st century has introduced new challenges and demands compared to the previous century, necessitating a shift in the skills required by various industries, including HEIs [18, 50]. These changes have led to an exponential increase in the importance of 21st-century skills, influenced by technological advancements, globalization, and evolving workplace dynamics [49, 51]. In SA, higher education institutions (HEIs) face significant challenges adapting to these technological advancements while ensuring that students develop the soft skills necessary for success in an evolving job market. The predominant focus on technical knowledge within higher education (HE), at the expense of soft skills development, frequently underpins this issue, raising concerns regarding graduates' preparedness to meet immediate and long-term organizational and talent management expectations [52, 53].

4.2 OBJECTIVES

In SA, there are many challenges that higher education institutions must deal with. The main one is to integrate 4IR into curricula. While improving innovation and workforce readiness is very positive, there are huge shortcomings, such as non-compliant infrastructure, limited access to digital tools, and inadequate training for educators and students. There is, therefore, a large gap between the skills required- critical thinking, problem-solving, and digital literacy – and those currently being developed in higher education. If a strategic approach is not taken that includes both technical and soft skills, graduates will have to risk being unprepared for the developing labour market, leading to increased unemployment and skills mismatches.

The main aim of this study is to conduct a broad investigation into the extent to which the 4IR affects the development of soft skills in South African students studying at higher education institutions and how these skills can be further developed so that they can be beneficial to students.

The research question for this study is: “How does the 4IR affect the development of soft skills in students within HEIs in SA?” This study focuses on HEIs in SA, a developing country. Compared to developed countries, emerging countries have a higher proportion of their future workforce unprepared for the changes technology will bring to the workplace. HEIs in SA should take proactive steps to benefit from the 4IR. Developing the necessary skills would boost job creation and support SA’s much-needed economic growth.

5. METHODOLOGY

5.1 RESEARCH APPROACH

Higgins *et al.* [54] define an SLR, often called a systematic review, as follows:

> *A systematic literature review aims to comprehensively locate and synthesize related research using organized, transparent, and replicable procedures at each step in the process.*

Dewey and Drahota [55] assert that an SLR is a transparent, replicable approach to discovering, analyzing, and integrating all published research articles to address well-defined topics. An SLR is suitable for this study as it provides a robust basis for knowledge advancement and identifies areas requiring additional investigation. This study’s SLR

comprises three primary phases: the search process, the criteria for inclusion and exclusion, and the quality assessment. The following is a concise description of each step:

- ***Search process***

The literature search uses keywords and online journal article databases, such as Google Scholar, Science Direct, Springer Link, EBSCOhost, Sabinet, and IEEE Xplore Digital Library. The subsequent keywords were extracted based on the study objectives: 4IR, influence on soft skills (and synonyms) development, students, HEIs, and SA.

- ***Inclusion and exclusion criteria***

Implementing inclusion and exclusion criteria is a crucial step in conducting an SLR.

Inclusion criteria	Exclusion criteria
Papers appear in peer-reviewed publications and conferences.	Papers not appearing in peer-reviewed publications or conferences.
The searches will cover publications issued between 2019 and 2024.	Searches will exclude documents published before 2019.
All studies must be written in English.	Studies not written in English.
	It was decided that studies not conducted at HEIs or in SA should be removed.
	Studies with inappropriate titles and abstracts.

- ***Quality evaluation***

To guarantee the quality of the chosen papers, the researcher formulated numerous criteria to streamline the selection of only the most pertinent publications for this study. This phase in the SLR process was essential to ensure the selected articles were relevant, valid, credible, and aligned with the study's aims. To be considered in the review process, an article must address soft skills within the context of the 4IR, specifically within SA and HEIs.

5.2 SEARCH OUTCOMES

Page *et al.* [56] recommend employing the preferred reporting items for systematic reviews and meta-analyses (PRISMA 2020) to improve the effectiveness of the document search process. Following the PRISMA, researchers adopt and adapt the steps, illustrating the method in Figure 1, which depicts the article searching and filtering process through a systematic approach.

6. FINDINGS

Quite a few studies have already been done on the impact that the 4IR will have on education. Critical skills and strategies are found to be extremely necessary to understand the complexities of 4IR and to address education and workforce readiness in the process. Skills that are important for surviving in this new 4IR landscape include critical thinking, creativity, problem-solving, communication, collaboration, and analytical thinking [32]. Student-centred teaching strategies that include blended and problem-based learning are essential for promoting self-directed learning and preparing students for real-world applications [32]. Many studies, especially those that emphasize TVET in SA, suggest curriculum reforms and collaboration between colleges and the labour market [48]. The focus should also be on lifelong learning for lecturers and on integrating 4IR technologies as learning tools [48].

There is also an emphasis on entrepreneurship education in preparing graduates to be job creators in a 4IR-driven economy. Collaboration between government, industry, and universities is important and is encouraged by the triple helix model [68]. Critically important skills required are soft, social, methodological, and hard skills. Soft skills such as adaptability and creativity are especially recommended for success in the 4IR [58]. However, there are quite a few shortcomings in students' understanding of 4IR technologies, which include AI and big data [59].

HEIs must face many challenges, including conflicting global views on 4IR and significant digital skills gaps. Therefore, comprehensive skills plans and infrastructure investments are crucial to succeed in the 4IR landscape [14]. Educational splendours are already experiencing the disruption AI and the IoT are causing in education. Educational practices will soon need to transform to adapt curricula to focus more on pedagogical approaches and support learning [60]. The inequality in digital curricula has a negative impact and limits the effectiveness of learning, especially for disadvantaged students [39]. Many studies suggest that cybersecurity management needs to be addressed by implementing management models and encouraging cybersecurity education to address the skills gap and adapt to the 4IR challenges [26, 41].

The 4IR and the COVID-19 pandemic have caused a turnaround in education and have accelerated the adoption of blended learning. This leads to many opportunities and challenges regarding access to digital resources and curriculum flexibility [10]. There are quite a few obstacles, such as limited digital infrastructure, that rural institutions must deal with to

thrive in a 4IR landscape. However, there is potential to bridge gaps between rural and urban education [36]. Fomunyam [45] suggests that integrating soft skills such as teamwork, emotional intelligence, and technical skills is essential for engineering education and, therefore, ensures that graduates are ready for the modern work environment.

Sociopolitical education is significant within the 4IR context, emphasizing the need for ethical, inclusive, and socially responsible teaching practices. Democratic citizens must be cultivated to deal with global and local challenges [67]. While Wessels [65] offers suggestions on how universities should transform to better prepare graduates for the 4IR workplace, Karsten *et al*. [64] find a gap in the comprehensive programmes that combine academic and soft skills development. Finally, Kayembe and Nel [66] highlight the many challenges that exist in infrastructure and skills gaps. Government investment is, therefore, essential to ensure SA can thrive in a 4IR landscape.

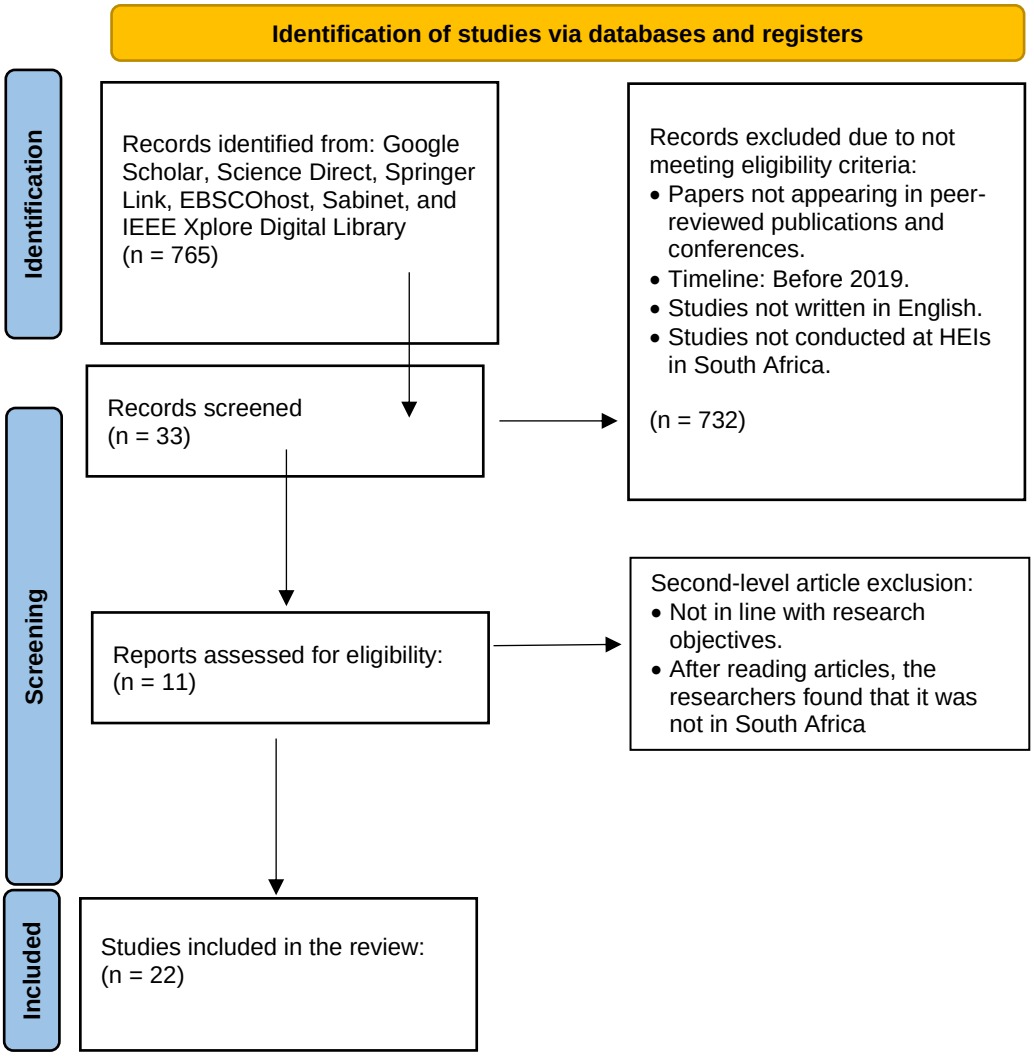

Figure 1: PRISMA flow diagram for article searching and filtering process [56].

These steps offer a structured approach to identifying pertinent literature for the review process. In total, 33 articles were selected to thoroughly read and synthesise their key findings to address the research questions. The summary of the research articles is presented in Table 1.

Table 1

Authors	Impact of 4IR	Soft skills mentioned by the authors	Gaps identified by authors
1. [32]	Higher education institutions will urgently need to re-evaluate their teaching methods and curricula to thrive in the 4th Industrial Revolution and thus deal with the rapidly changing skills demands in the workforce. This once again highlights the need for higher education institutions to focus on developing both technical and soft skills that are positive for their students, enabling them to adapt effectively to real-world challenges. Skills such as complex problem-solving, collaboration, and innovative thinking are some of the skills that are extremely important in a 4IR environment.	Emotional intelligence Creativity Communication Collaboration Analytical thinking Teamwork Critical thinking Innovation Management skills Active learning Troubleshooting Flexibility	This study points to the large gap in existing literature regarding the specific strategies for skills development within the context of the 4IR. Although the importance of soft skills is recognized, little research still focuses on effective teaching methods to promote these skills in higher education settings.
2. [48]	The 4IR highlights the critical importance of adapting TVET programs to the changing environment by updating curricula, promoting collaboration across industries, and integrating new technologies. The focus is to equip graduates with the essential soft skills in a modern work environment.	Creativity Communication Problem-solving Project management skills Critical thinking	The gap in the current curriculum in terms of practical skills and soft skills that are important in the modern work environment is pointed out in this study. The need to integrate the hands-on experience into the education system is also emphasized. .
3. [57]	In a 4IR landscape, graduates with technical and soft skills such as creativity, higher-order thinking, problem-solving, innovation, and analytical abilities are needed. In SA, HEIs' curricula are not aligned with the 4IR landscape. Graduates can develop entrepreneurial skills in an evolving economic landscape. This can have a positive impact on unemployment in SA.	High-order thinking Problem-solving Analytical skills Creativity Innovation Adaptability Digital literacy Critical thinking	HEIs in SA need to align their curricula to meet the changing demands of the labour market within the context of the 4IR. Incorporating technical knowledge and soft skills into the curriculum is essential. This approach will equip graduates to fulfill their fundamental needs and help address unemployment.
4. [58]	HEIs must revise their curricula to prioritize not only hard skills but also soft skills development in graduates, thereby equipping them for the demands of the 4IR workplace. Innovative pedagogical approaches can be utilized to enhance these skills.	Flexibility Adaptability Organisational skills Social responsibility Self-development Personal efficiency Ability to work under pressure Lifelong learning Critical thinking Collaboration Leadership Emotional intelligence Communication	This study indicates a deficiency in integrating soft skills within HEIs' curricula. The insufficient focus on the essential skills employers require in the 4IR has resulted in a disparity between the skills taught and those needed in the workforce. A holistic educational approach should encompass hard and soft skills instruction.

		skills Teamwork	
5. [59]	According to this study, the 4IR is changing the educational landscape and necessitates curriculum adjustments to better prepare students for their future careers, especially in fields such as accounting. Soft skill development is considered extremely important to keep up with changes brought about by technological advancements.	Problem-solving Digital literacy Communication Critical thinking Adaptability	This study shows a gap among students regarding in-depth knowledge about 4IR trends and technologies. According to this study, accounting curriculum students are not adequately prepared for the emerging technological landscape, which has negative consequences for students. Therefore, the educational outcomes are not compatible with labour market expectations.
6. [60]	Information technology necessitates a new skillset in the 4IR. The skills include an entrepreneurial mindset, adaptability, decision-making, critical thinking, communication, creativity, problem-solving, and interpersonal skills.	Communication Creativity Problem-solving Critical thinking Decision-making Interpersonal skills Adaptability Entrepreneurship mindset	The author identifies an inconsistency between the skills conveyed by HEIs and those demanded by employers within the context of the 4IR. Employers require graduates to possess entrepreneurial skills. This will lead to HEIs integrating these competencies.
7. [38]	Numerous industries, including accountancy, have been impacted by the 4IR. Graduates require a new skill set, encompassing data competencies and interpersonal skills. Universities face challenges aligning their courses to adequately educate graduates for employment, particularly in digital and soft skills.	Communication Leadership Collaboration Project management Teamwork Emotional intelligence Critical thinking Problem-solving Decision-making Critical analysis Strategic planning	The authors note that the module outcomes of HEIs do not adequately foster the development of digital and soft skills.
8. [61]	According to this study, the 4IR necessitated a shift to the skills needed for the quantity surveying profession. Graduates are unprepared and lack the necessary soft skills for the evolving workforce requirements in a 4IR work environment.	Emotional intelligence Teamwork Leadership Problem-solving Critical thinking Creativity Communication skills	This study indicates a large gap between the skills taught in current curricula and those required by the industry within the 4IR context. According to this study, more research needs to be done to examine soft skills education at various institutions and then specifically see if it aligns with the needs required by the industry.
9. [14]	This study emphasizes equipping the 4IR students with skills such as creativity, problem-solving, critical analysis, independent thinking, and analytical skills to exploit digital technology opportunities. According to the study, there is a perception that the 4IR can ruin these skills.	Critical thinking Communication Interpersonal skills Adaptability Problem-solving Digital literacy	According to this study, there is a major gap in understanding barriers to accelerating the adoption of 4IR technologies in South African HEIs. Knowledge is lacking about the drivers of adoption and the many obstacles institutions must face, especially in integrating 4IR skills into teaching and learning processes.
10. [62]	The 4IR requires HEIs to reform their curricula to prepare graduates for the workforce adequately. HEIs must implement flexible curricula to accommodate diverse skills, including digital literacy, critical	Critical thinking Creativity Adaptability Problem-solving Communication Digital literacy	A gap exists between effective teaching methods and the integration of technologies necessary to prepare graduates for the 4IR at HEIs. Further research is necessary to identify the skills required by the 4IR, particularly

	thinking, creativity, and adaptability, while integrating interdisciplinary knowledge.		to align the curricula of HEIs with industry needs to prepare graduates for employment.
11. [39]	Authors argue that HEIs must incorporate digital technologies into curricula due to the 4IR. This will assist in equipping graduates for their employment opportunities. Digital technologies should focus on helping graduates develop their soft skills. However, a digital divide in SA can impede graduates' access to essential learning practices.	Critical thinking Analytical thinking Collaboration Creativity Problem-solving Communication skills Digital competence	The authors note that insufficient efforts have been made to integrate digital technologies and soft skills into the curricula of HEIs. Graduates lack equal access to digital technologies, which can hinder their qualifications for employment.
12. [41]	The 4IR has transformed cybersecurity education in SA. Graduates are required to possess both technical and soft skills. Organizations need skilled individuals due to the demand for cybersecurity professionals. Graduates must collaborate, communicate, and lead. HEIs should incorporate soft skills into their curricula to prepare graduates for the job markets in the era of the 4IR.	Communication Leadership Writing skills Analytical skills Collaboration Lifelong learning Problem-solving Determination	The education system in SA lacks formal qualifications and comprehensive curricula incorporating soft skills relevant to cybersecurity. This results in graduates who are unprepared for the 4IR job market.
13. [26]	This study highlights a shift in educational practices, which focuses on the importance of soft and technical skills. Hard and soft skills are critically essential for effective participation in the modern job market, which is becoming increasingly competitive and dependent on technology. In the 4IR, the essence and demand for soft skills have increased.	Lifelong learning Innovation Adaptability Emotional intelligence Collaboration Leadership Data analysis Ethical awareness Critical thinking	A gap in the existing literature regarding the management and nurturing of soft skills is highlighted in this study. Although the importance of soft skills has been recognized, only a few empirical studies still focus on effective strategies for developing these soft skills within the educational framework.
14. [63]	HEIs must adapt curricula to include technical and soft skills relevant to the 4IR, ensuring that graduates possess the competencies demanded by the job market.	Communication Collaboration Critical thinking Creativity Emotional intelligence Problem-solving Flexibility Judgment Decision-making	The authors indicate that HEIs in SA are unprepared to provide students with the essential skills required for the 4IR. They argue that the curricula of HEIs are outdated, resulting in a deficiency of soft skills that leaves graduates unprepared for the workplace environment. Another issue is the disparity in technology access among students.
15. [10]	According to this study, the 4IR should address the integration of blended learning approaches in education, which will, therefore, impact the development of soft skills among students. The transition to blended learning can help students foster critical soft skills such as adaptability and digital literacy, which are critical to surviving the complexities of the modern workforce shaped by technological	Communication Critical thinking Problem-solving Digital literacy Adaptability Collaboration	This study points to a gap in the educational infrastructure and preparedness to implement blended learning effectively. There is a need to develop strategies that specifically address the digital divide, thereby equipping educators with the necessary skills to facilitate blended learning effectively.

	advancements.		
16. [36]	The advent of the 4IR fundamentally transformed the educational landscape. The emphasis is particularly on the importance for higher education institutions, especially rural ones, to adapt to digital technologies. According to this study, the 4IR should improve students' teaching and learning methods and skills to meet the demands of the evolving job market. Therefore, integrating technology should help address existing skills gaps in the workforce.	Independent thinking Analytical skills Cognitive skills Communication skills Problem-solving Critical analysis Practical skills Innovation skills Collaboration skills	This study shows a gap in the lack of adequate resources and support for rural institutions within the context of the 4IR. While there are many potential benefits, quite a few of these institutions still struggle with poor infrastructure, inadequate training for lecturers, and limited access to technology, which negatively impact their ability to prepare students effectively.
17. [44]	The 4IR highlights the necessity of soft skills, particularly critical thinking, problem-solving, communication, and creativity. These skills are essential for graduates to fulfill the job market requirements.	Communication Creativity Critical thinking, Problem-solving, Collaboration, Decision-making, Innovation Adaptability Flexibility	The author highlights the under-representation of information literacy as a critical competency in the 4IR. The author supports including information literacy skills in the curricula of educational institutions. Information literacy encompasses the skills necessary to locate, assess, organize, utilize, and convey information across diverse formats, particularly within contexts that demand decision-making, problem-solving, or knowledge acquisition.
18 [45]	The 4IR has brought about a change in engineering education. It addresses the need to emphasize diverse skills, especially soft skills, which are essential to deal with complex challenges in modern workplaces. Therefore, engineering curricula must be developed to integrate soft skills training with technical knowledge, thereby preparing graduates for the demands of the 4IR.	Communication Critical thinking Creativity Emotional intelligence Complex problem-solving Teamwork Collaboration	According to the study, there is a huge gap in the existing engineering curricula, which mostly focuses on technical skills rather than soft skills. It is crucial to address this gap to ensure that graduates are well-rounded and can handle all challenges in a 4IR environment.
19. [64]	The higher education institutions in SA must deal with many challenges regarding of preparing their students to survive in a changed 4IR work environment. A more holistic approach is encouraged to integrate academic and non-academic skills, among other things. Students need self-determination skills, as well as traditional skills, to meet the demands of the 4IR.	Time management Emotional Intelligence Self-management Creativity Problem-solving Self-management Communication Critical thinking Collaboration	The study points out a lack of programmes in higher education to successfully combine the development of academic and soft skills. Although attention is paid to technical skills, it is extremely important to focus on soft skills that sometimes do not get recognition in the curricula and, therefore, hinder students' preparedness for the workforce.
20. [65]	New skills, such as digital skills, are essential within the context of the modern 4IR work environment. This requires South African universities to transform their educational practices to ensure students are equipped with the necessary soft skills and	Critical and creative thinking Lifelong learning Leadership Adaptability Social and soft skills Emotional	This study focuses on how South African universities must transform their key functions, especially teaching and learning, to prepare graduates for the modern 4IR workplace.

	knowledge for future employment.	intelligence Cooperation Communication Entrepreneurial mindset	
21. [66]	Several challenges and opportunities in the education sector are triggered by means of 4IR, which necessitates change in student preparation. The focus is on the need to integrate skills relevant to the 4IR into educational curricula. It places particular emphasis on developing hard and soft skills to ensure that graduates can navigate the complexities of the modern job market. Therefore, new skills and cross-sectoral teaching and learning are necessary to survive in the 4IR. Intercultural and interpersonal skills should be developed to thrive in a 4IR environment.	Collaboration Adaptability Digital literacy Communication Critical thinking Creativity	According to the study, there are gaps in integrating 4IR-relevant skills into current educational frameworks. Therefore, many educational institutions struggle to meet the demands of the job market to adequately prepare the students for future challenges posed by the 4IR. There is a need for more research on how to successfully implement 4IR technologies in South African education, given the challenges that have been identified.
22. [67]	The teaching methods of HEIs need to be adapted to include 4IR skills. Graduates need technical knowledge, problem-solving, social, and coping skills, among others, to effectively address complex socioeconomic issues.	Complex problem-solving Communication Emotional intelligence Critical thinking Creativity Social skills (such as persuasion and teamwork)	A shortcoming in HEIs' curricula is once again pointed out in this study. Many HEIs' curricula still reflect the requirements of the Third Industrial Revolution. This has a negative impact on graduates' development in the new 4IR environment.

7. RECOMMENDATIONS

7.1 CURRICULUM EXPANSION

HEIs should prioritize attention to motivate changes to curricula that include technical and soft skills to prepare students for the 4IR environment. Curricula should focus on real-world applications, including project-based learning, case studies, and simulations that reflect workplace challenges. Collaborative projects to promote problem-solving, teamwork, and communication are also critical for students to apply theoretical concepts in practical settings. These changes in the curriculum will positively impact students' future employment.

7.2 SOFT SKILLS DEVELOPMENT

Teaching and developing soft skills such as critical thinking, problem-solving, communication, emotional intelligence, and collaboration should receive priority attention from institutions. Workshops and interdisciplinary projects can be launched to promote these skills. Public speaking courses, negotiation simulations, and group dynamics exercises are examples of projects that can make a difference in developing skills. Soft skills included in existing courses can positively impact student education.

7.3 COLLABORATION WITH STAKEHOLDERS

Universities urgently need to address the skills gap by collaborating with industries to ensure that educational programmes align with workforce needs. Industry advisory boards can be formed to promote curriculum development, such as internships, co-op programmes, and mentorships. These development initiatives provide hands-on experience to students and help employers identify talent. Collaboration between universities and industries can positively impact the transition from education to employment.

7.4 USE OF TECHNOLOGY

Universities are responsible for exposing students to modern technologies such as learning management systems, virtual simulations, and online collaboration tools. It is, therefore, essential for the faculty to get training on how to use these tools. At the same time, digital literacy programs can positively impact students' proficiency with technology and data analysis. A tech-savvy environment also has several other benefits: it prepares students for the digital workforce.

7.5 RESEARCH AND INNOVATION

More research needs to be done to evaluate the quality of educational programmes and explore innovative methods for teaching soft and technical skills in the 4IR. Universities have an onus to encourage research into skills development, curriculum design, and technology integration. More research centres can be established, and findings from conferences and publications should be shared to contribute positively to new insights, promoting continuous improvement in higher education.

7.6 LIFELONG LEARNING DEVELOPMENT

Lifelong learning should be the focal point and should be promoted, especially by HEIs, by offering online courses, certifications, and workshops. Investments can also be made in partnerships with professional organizations that can make resources and training available, which will help graduates stay competitive in the job market and adapt easily to new technologies. People need to empower themselves to grow professionally and meet evolving industry requirements.

8. CONCLUSION

To summarise, many challenges as well as opportunities will need to be addressed by higher education institutions regarding 4IR students' preparation for this evolving landscape, and must receive priority attention. Changes are also needed in terms of HEIs' curricula. The integration of technical skills and soft skills such as critical thinking, collaboration, and emotional intelligence should be part of the new curricula. It is especially essential to enter into a collaboration agreement with industry to ensure that education matches the real needs of graduates. This need includes adaptability to thrive in complex workplace environments. There will still need to be ongoing research and innovation in curriculum development to promote higher education and positively prepare students for the workforce. Fostering lifelong learning and holistic student development can empower HEI graduates to succeed in the 4IR landscape and ensure they are equipped to handle all demands in a rapidly changing job market.

9. LIMITATIONS

The limitation of this study is the sole focus on South African HEIs, which may have a negative impact on the generalization of the findings with respect to other regions. There are unique challenges that quite a few countries must address to integrate soft skills for the 4IR. However, more research needs to be done to examine divergent strategies and outcomes in a broader international environment.

AUTHOR CONTRIBUTIONS

Both authors contributed equally.

CONFLICT OF INTEREST

None.

ORCID

HV – https://orcid.org/0000-0001-8535-0672
AB – https://orcid.org/0000-0001-6567-3757

REFERENCES

1. Scepanović S, 2019. The fourth industrial revolution and education. In: 2019 8th Mediterranean Conference on Embedded Computing (MECO), 10-14 June 2019, Budva, Montenegro. IEEE: Budva; 1-4. https://doi.org/10.1109/MECO.2019.8760114
2. Schwab K, 2016. The Fourth Industrial Revolution. Penguin Random House: New York, NY. ISBN: 9781524758868
3. George AS, 2024. The fourth industrial revolution: a primer on industry 4.0 and its transformative impact. Partners Universal Innovative Research Publication; 2(1), 16-40. https://doi.org/10.5281/zenodo.10671872
4. Tsiligiris V, Bowyer D, 2021. Exploring the impact of 4IR on skills and personal qualities for future accountants: a proposed conceptual framework for university accounting education. Accounting Education; 30(6), 621-649. https://doi.org/10.1080/09639284.2021.1938616
5. Ukwandu EA, *et al*., 2021. Cybersecurity in the emerging world of smart everything. arXiv preprint arXiv:2109.05821. https://doi.org/10.48550/arXiv.2109.05821
6. World Economic Forum, 2020. The future of jobs report - 2020. https://www.weforum.org/docs/WEF_Future_of_Jobs_2020
7. Gray A, 2016. The 10 skills you need to thrive in the fourth industrial revolution, World Economic Forum. https://www.weforum.org/agenda/2016/01/the-10-skills-you-need-to-thrive-in-the-fourth-industrial-revolution/
8. Philbeck T, Davis N, 2018. The fourth industrial revolution. Journal of International Affairs; 72(1), 17-22. https://www.jstor.org/stable/26588339

9. Ilori MO, Ajagunna I, 2020. Re-imagining the future of education in the era of the fourth industrial revolution. Worldwide Hospitality and Tourism Themes; 12(1), 3-12. https://doi.org/10.1108/WHATT-10-2019-0066
10. Mhlanga D, 2021. The fourth industrial revolution and COVID-19 pandemic in South Africa: the opportunities and challenges of introducing blended learning in education. Journal of African Education; 2(2), 15-42. https://doi.org/10.31920/2633-2930/2021/v2n2a1
11. Nyagadza B, *et al*., 2022. Digital technologies, fourth industrial revolution (4IR) & global value chains (GVCs) nexus with emerging economies' future industrial innovation dynamics. Cogent Economics & Finance; 10(1), 2014654. https://doi.org/10.1080/23322039.2021.2014654
12. Anshari M, *et al*., 2021. Developing talents vis-à-vis the fourth industrial revolution. International Journal of Asian Business and Information Management; 12(4), 20-32. https://doi.org/10.4018/IJABIM.20211001.oa2
13. Zincume PN, 2024. The key 4IR soft skills for the rail sector. South African Journal of Industrial Engineering; 35(1), 57-71. https://doi.org/10.7166/35-1-2918
14. Lubinga SN, *et al*., 2023. Adoption of the fourth industrial revolution: challenges in South African higher education institutions. http://hdl.handle.net/2263/94027
15. Waghid Z, 2019. The need for South African (higher) education institutions to be attuned to education 4.0. South African Journal of Higher Education; 33(5), 1-6. https://doi.org/10.20853/33-5-3670
16. Adhikari R, 2020. Harnessing the potential of the fourth industrial revolution in South Asia. Book chapter in "Trade and Regional Integration in South Asia. South Asia Economic and Policy Studies"; Raihan S, De P (eds). Springer: Singapore. https://doi.org/10.1007/978-981-15-3932-9_16
17. Kupe T, 2019. Universities are Key to 4IR Employment. The People Space: London. https://www.thepeoplespace.com/ideas/articles/we-need-revolution-education-and-skills-if-humans-are-thrive-future-economy-says
18. Nwosu LI, *et al*., 2023. Fourth industrial revolution tools to enhance the growth and development of teaching and learning in higher education institutions: a systematic literature review in South Africa. Research in Social Sciences and Technology; 8(1), 51-62. https://doi.org/10.46303/ressat.2023.4
19. Botha A, Vorster H, 2022. Primary obstacles preventing students from the Faculty of Economics and Management Sciences (FEMS) from acquiring skills and competencies required by the fourth industrial revolution. Ensovoort; 43(4), 1-28.
20. Foerster-Metz US, Golowko N, 2018. The need for digital and soft skills in the Romanian business service industry. Management and Marketing: Challenges for the Knowledge Society; 13(1), 831-847. https://doi.org/10.2478/mmcks-2018-0008
21. Ramnund-Mansingh A, Reddy N, 2021. South African-specific complexities in aligning graduate attributes to employability. Journal of Teaching and Learning for Graduate Employability; 12(2), 206-221. https://doi.org/10.21153/jtlge2021vol12no2art1025
22. Levy B, *et al*. 2021. South Africa: When Strong Institutions and Massive Inequalities Collide. Carnegie Endowment for International Peace: Cape Town. https://carnegieendowment.org/2021/03/18/south-africa-when-strong-institutions-and-massive-inequalities-collide-pub-84063
23. Okolie UC, *et al*., 2019. Graduate employability: how higher education institutions can meet the demand of the labour market. Higher Education, Skills and Work-based Learning; 9(4), 620-636. https://doi.org/10.1108/HESWBL-09-2018-0089
24. Olaitan O, Mavuso N, 2022. Skilling and reskilling students for relevance in a 4IR economy. In: Proceedings of NEMISA Summit and Colloquium; 4, 88-101. https://easychair.org/publications/paper/t1rM
25. Hattingh S, 2017. How South African Universities Can Contribute to Preparing the Future Workforce for the Fourth Industrial Revolution. Stellenbosch University: Stellenbosch. Retrieved from https://scholar.sun.ac.za
26. Mabe K, Bwalya KJ, 2022. Critical soft skills for information and knowledge management practitioners in the fourth industrial revolution. South African Journal of Information Management; 24(1), a1519. https://doi.org/10.4102/sajim.v24i1.1519
27. Mhlanga D, 2020. Industry 4.0: The challenges associated with the digital transformation of education in South Africa. Book chapter in "The Impacts of Digital Transformation"; Efe Academy, İstanbul; 12-25.
28. Chalmers D, *et al*., 2021. Artificial intelligence and entrepreneurship: implications for venture creation in the fourth industrial revolution. Entrepreneurship Theory and Practice; 45(5), 1028-1053. https://doi.org/10.1177/1042258720934581
29. Henukh D, Astra IM, 2021. Bridging the digital divide in rural education through blended learning approaches. Journal of Educational Technology Systems; 49(2), 145-162.
30. South African Qualifications Authority (SAQA), 2012. Level descriptors for the South African National Qualifications Framework. SAQA: Pretoria. https://www.saqa.org.za/level-descriptors-for-the-south-african-national-qualifications-framework/
31. Lok B, *et al*., 2021. The relationship between soft skills training and development, human resource outcome and firm performance. International Journal of Business and Society; 22(1), 382-402. https://doi.org/10.33736/ijbs.3184.2021
32. Aboderin OS, Havenga M, 2024. Essential skills and strategies in higher education for the fourth industrial revolution: a systematic literature review. South African Journal of Higher Education; 38(2), 24-43. https://doi.org/10.20853/38-2-5430
33. Chiramba O, Ndofirepi ES, 2023. Access and success in higher education: disadvantaged students' lived experiences beyond funding hurdles at a Metropolitan South African university. South African Journal of Higher Education; 37(6), 56-75. https://doi.org/10.20853/37-6-6021
34. Lukins S, 2021. Why are soft skills so important in the graduate job market? https://www.topuniversities.com/student-info/careers-advice/why-are-soft-skills-so-important-graduate-job-market
35. Mtshali TI, Ramaligela SM, 2020. Contemporary employability skills needed for learners to succeed in the civil technology field in the 4IR era. Journal of Technical Education and Training; 12(3), 29-40. https://doi.org/10.30880/jtet.2020.12.03.003
36. Yende SJ, 2021. A transition towards the fourth industrial revolution (4IR) in the South African education sector: a perspective from rural-based higher education. African Journal of Development Studies; 11(2), 55-75. https://doi.org/10.31920/2634-3649/2021/v11n2a3
37. Sam S, 2019. Bridging the Digital Gap in Sub-Saharan Africa. A Critical Analysis of Illiteracy and Language Divide. Book chapter in "Mapping the Digital Divide in Africa: A Mediated Analysis". 215. https://doi.org/10.1515/9789048538225-013
38. Landsberg E, van den Berg L, 2023. 4th industrial revolution skills in the current South African accountancy curricula: a systematic literature review. South African Journal of Accounting Research; 37(3), 177-201. https://doi.org/10.1080/10291954.2023.2172833

39. Arek-Bawa O, Reddy S, 2022. Digital curricular transformation and fourth industrial revolution 4.0 (4IR): deepening divides or building bridges. E-Journal of Humanities, Arts and Social Sciences; 3(11), 308-326. https://doi.org/10.38159/ehass.2022sp31124
40. Kamaruzaman FM, *et al*., 2019. Conceptual framework for the development of 4IR skills for engineering graduates. Global Journal of Engineering Education; 21(1), 54-61.
41. Jansen van Vuuren JC, Jansen van Vuuren A, 2022. Preparing for the fourth industrial revolution: Recommendations to adapt cybersecurity governance and skills in South Africa. Journal of Information Warfare; 21(1), 71-90. https://doi.org/10.2307/27199957
42. Oke A, Fernandes FAP, 2020. Innovations in teaching and learning: exploring the perceptions of the education sector on the 4th industrial revolution (4IR). Journal of Open Innovation: Technology, Market, and Complexity; 6(2), 31. https://doi.org/10.3390/joitmc6020031
43. Al-Maskari A, *et al*., 2022. Factors affecting students' preparedness for the fourth industrial revolution in higher education institutions. Journal of Applied Research in Higher Education; 16(1), 264. https://doi.org/10.1108/JARHE-05-2022-0169
44. Chaka C, 2020. Skills, competencies and literacies attributed to 4IR/Industry 4.0: scoping review. International Federation of Library Associations and Institutions; 46(4), 369-399. https://doi.org/10.1177/0340035219896376
45. Fomunyam KG, 2020. Engineering education and soft skills in the era of the fourth industrial revolution in Africa. International Journal of Recent Technology and Engineering; 9(3), 339-344. https://doi.org/10.35940/ijrte.b3972.099320
46. Kissi E, *et al*., 2023. Skills development in the 4th industrial revolution: the construction industry. Book chapter in "Emerging Debates in the Construction Industry"; Kissi E (ed). Routledge: Milton Park; 149-173. https://doi.org/10.1201/9781003340348-10
47. Razali N, *et al*., 2024. Assessing the skillset impacting the readiness of HVAC bachelor's final year students for industrial revolution 4.0 (IR 4.0). Online Journal for TVET Practitioners; 9(1), 73-83. https://doi.org/10.30880/ojtp.2024.09.01.007
48. Magagula MM, Awodiji OA, 2024. The implications of the fourth industrial revolution on technical and vocational education and training in South Africa. Social Sciences & Humanities Open; 10, 100896. https://doi.org/10.1016/j.ssaho.2024.100896
49. Safitri D, Ibrahim N, 2022. Developing 21st century skills. Edukasi IPS; 6(2), 14-23. https://doi.org/10.21009/EIPS.006.02.02
50. Van Laar E, *et al*., 2020. Determinants of 21st-century skills and 21st-century digital skills for workers: a systematic literature review. Sage Open; 10(1), 1-14. https://doi.org/10.1177/2158244019900176
51. Marin-Zapata SI, *et al*., 2022. Soft skills, do we know what we are talking about? Review of Managerial Science; 16(4), 969-1000. https://doi.org/10.1007/s11846-021-00474-9
52. Ahmed I, 2019. Bridging the gap between governmental accounting education and practice. Accounting; 5(1), 21-30. https://doi.org/10.5267/j.ac.2018.6.003
53. Lawson RA, *et al*., 2014. Focusing accounting curricula on students' long-run careers: recommendations for an integrated competency-based framework for accounting education. Accounting Education; 29(2), 295-317. https://doi.org/10.2308/iace-50673
54. Higgins JPT, *et al*., 2011. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. BMJ; 343(7829), d5928. https://doi.org/10.1136/bmj.d5928
55. Dewey A, Drahota A, 2016. Introduction to systematic reviews: online learning module, Cochrane Training.
56. Page MJ, *et al*., 2020. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ; 372:n71. https://doi.org/10.1136/bmj.n71
57. Baadjie TP, 2023. Industry 4.0 as a catalyst for developing entrepreneurial graduates in South Africa. In: Proceedings of the 10th Focus Conference (TFC 2023). Book Series: Advances in Social Science, Education and Humanities Research; 788, 27-40. Atlantis Press. https://doi.org/10.2991/978-2-38476-134-0_23
58. Borrageiro K, Mennega N, 2023. Essential skills needed in the fourth industrial revolution (4IR): a systematic literature review. In: IST-Africa 2023 Conference Proceedings. IST-Africa Institute and IIMC. ISBN: 978-1-905824-71-7
59. Cele S, *et al*., 2023. Exploring undergraduate students' perception of 4IR digital era at a higher education institution in South Africa. Journal of Accounting Research, Organization, and Economics; 6(1), 49-62. https://doi.org/10.24815/jaroe.v6i1.32046
60. France NS, The effect of 4th industrial revolution on entrepreneurial education: a case study on education, new skills and knowledge, South Africa.
61. Liebenberg G, Els MM, 2022. The impact of the 4th industrial revolution on quantity surveying education in South Africa: a qualitative overview on soft skill requirements. Book chapter in "Building Smart, Resilient and Sustainable Infrastructure in Developing Countries"; CRC Press: London: 79- 88. ISBN: 9781003325321
62. Smith L, 2023. Implications of the fourth industrial revolution on higher education. In: Proceedings of the 10th Focus Conference (TFC 2023). Book Series: Advances in Social Science, Education and Humanities Research; 788, 355-365. Atlantis Press. https://doi.org/10.2991/978-2-38476-134-0_23
63. Coetzee J, *et al*., 2021. South African universities in a time of increasing disruption. South African Journal of Economic and Management Sciences; 24(1), a3739. https://doi.org/10.4102/sajems.v24i1.3739
64. Karsten I, *et al*., 2020. Empowering accounting students to enhance the self-determination skills demanded by the fourth industrial revolution. South African Journal of Higher Education; 34(2), 36-58. https://doi.org/10.20853/34-2-3487
65. Wessels L, 2020. How South African Universities Can Contribute to Preparing the Future Workforce for the Fourth Industrial Revolution. Stellenbosch University: Stellenbosch. http://hdl.handle.net/10019.1/108143
66. Kayembe C, Ne l D, 2019. Challenges and opportunities for education in the fourth industrial revolution. African Journal of Public Affairs; 11(3), 79-90. https://doi.org/10.10520/ejc-19605d342e
67. Waghid Y, *et al*, 2019. The fourth industrial revolution reconsidered: on advancing cosmopolitan education. South African Journal of Higher Education; 33(6), 1-9. https://doi.org/10.20853/33-6-3777
68. Leydesdorff L, 2020. Triple Helix of university-industry-government relations. Book chapter in "Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship"; Springer International Publishing: Cham; 2356-2364. https://doi.org/10.1007/978-1-4614-6616-1_452-2