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Skilling and Reskilling Students for Relevance in a 4IR Economy

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Abstract

The disruptive nature of technologies such as artificial intelligence, additive manufacturing nanomaterials and robotics has decidedly made the workplace of the future more complex, with traditional skillsets falling short in addressing the demands of the 4IR era. The authors discuss the need for current tertiary students to be skilled for futuristic, technology driven jobs in a 4IR economy. This paper examines the current school curriculum, vis-a –vis the literature on what the 4IR economy requires of its workforce. We submit that the current curriculum for Science, Technology, Engineering and Mathematics (STEM) courses at most South African universities do not align with skills requirements for a 4IR economy. A methodical, structured literature review was conducted for the purpose of this research. The PRISMA framework was employed to select the relevant literature for the study. After screening and elimination of articles, 26 sources remained and were included in the study. The study proposes four critical success factors that government can adopt in order to formulate strategic and sustainable plans to ensure that students are appropriately skilled and positioned to operate in a competitive 4IR economy once they graduate. The literature reveals a disjuncture between the current STEM curriculum and the required skillset required in a 4IR economy. The challenge leads to a state of unpreparedness of students in handling the fast approaching revolution in skills demand. The authors also found that soft skills, ideation, creativity and problem solving, which are not taught at school are critical for the workforce of the future. Probable solution to the skills gap challenges is the implementation of content knowledge, incorporated with experiential techniques. This will lead to the shift from the institutions of higher education to the individuals through investing in skilling and reskilling students in practical ways. Future research should focus on how government, Industry and academia can effectively collaborate in ensuring that students are trained to apply content knowledge in creative ways which can solve many of the continent's problems. The findings reveal that government must work closely with academia and industry towards the goal of graduating skilled, employable graduates in the 4IR economy. Future research will investigate the extent to which students are being skilled by faculty to face future challenges.

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1 Introduction

Historically, Africa is percieved as a laggard with regards to keeping up with technological advances in the world (Adendorff & Putzier, 2018). Countries such as Germany, the Netherlands, Japan and significant parts of Europe are now actively living in digitized spaces and taking full advantage of the technology affordances of the era (Shivdasani, 2019). However, the same cannot be said of their African counterparts. The development and influence of the past three industrial revolutions were not highly significant in Africa (Shivdasani, 2019). Many factors have been attributed for this slow pace, among them the dearth of infrastructure, a lack of planning, and a lack of governance (Adendorff & Putzier, 2018).

The Fourth Industrial Revolution (4IR) has been projected as an era with the capacity to deliver accelerated development to Africa (Manda & Dhaou, 2019). Several governments on the continent are scrambling to enact laws, policies and processes which will ensure their relevance, and position the country to take advantage of the opportunities presented by the technologies and capabilities of the 4IR (Kayembe & Nel, 2020). Industrialized nations, commonly referred to as the first world are far ahead of African countries in the adaptation of their economies to the technologies which enable the 4IR (National Planning Commission, 2020). Automation, occasioned by unprecedented technological innovations is the key driver of the 4IR (Baweja, Donovan, Haefele, Siddiqi, & Smiles, 2016). The integration of technologies in diverse digital, physical and biological spaces is a hallmark of the 4IR (Schwab, 2017).

The 4IR has been referenced in diverse terms. Among them are the Information Age, Industrial Internet of Things, the age of robotics, Industry +, the Fourth Economy (Kayembe & Nel, 2020). The era is touted as offering great opportunities as well as considerable threats to African economies (Allen, 2019). Opportunities are available to tap into the global economic value chain, enjoy the economies of scale that are part of a knowledge and data sharing connectedness across similar industries (Yusuf, Walters, & Sailin, 2020). African economies are also able to enjoy access to new technologies that offer affordances for solving peculiar continent problems and exploring new possibilities across the globe (Ayentimi & Burgess, 2019). In spite of the opportunities, research on how the 4IR will increase the inequality gap between Africa and the rest of the developed world abound (Mkansi & Landman, 2021). The disruptive nature of technologies such as artificial intelligence, additive manufacturing nanomaterials, robotics has decidedly made the workplace of the future more complex, with traditional skillsets falling short in addressing the demands of the 4IR era (Butt, Siddiqui, Soomro & Asad, 2020). The reality of this has brought to the fore, conversations about the role of higher education in skilling the future workforce to be relevant in the 4IR economy. In the same space, much has been written about the current university curriculum and its relevance to the skills required in an automated economy as occasioned by the 4IR (Moloi & Mhlanga, 2021). This paper contributes to the literature on the need for a relevant curriculum for universities in the country, and how to skill, and re-skill current students in order to enhance their chances of employability or entrepreneurship after leaving school. The education sector must be positioned to respond to Industry 4.0 skills need by raising technologically savvy graduates who can seamlessly translate their learnt skills and capabilities into the 4IR economic sphere. To achieve this, education as a whole in South Africa, Department of Higher Education and Training (DHET) and University faculties must take a critical look at the current curriculum, and make the necessary changes which would make future graduates employable, and relevant in a technology driven world.

2 Methodology

A methodical, structured literature review known as PRISMA was conducted for the purpose of this research. The PRISMA framework is utilised when authors want to contextualize and provide a detailed approach on the selection of the contents that were relevant for a study and how these were employed in order to reach a scientific conclusion. It is vital that there are set processes and procedures that a researcher follows when undergoing a systematic review of literature in a way that can be validated and verified scientifically (Moher, Liberati, Tetzalaff, Altman, & Prisma Group, 2009). The scope and quality of the literature incorporated in a study is as a result of a well-executed systematic review. In this study, the PRISMA framework formed the basis of the recommended steps followed to review literature on key skills required in the 4IR era. This approach was deemed beneficial in order to explicate solid and scientific grounds for the study (Moher et al., 2009).

An iterative method of identifying critical, relevant, and recent literature on the topic of skilling, upskilling, and right-skilling university students for the 4IR workplace was conducted. The iterative approach is useful when a researcher seeks to understand, in-depth, a certain phenomenon and dig deeper into factors responsible for the phenomenon under investigation.

The iterative approach searches relevant literature which, may assist in the interpretation and appropriation of factors that are important to the successful transition of students from the classroom to the 4IR workplace. The search string with keywords such as upskilling, student re-skilling, 4IR workplace were used to search for relevant literature on the topic. The search parameters were further refined to include 4IR skilling, upskilling and reskilling, university graduates, employability, and 4IR. When the search strategy was defined, strings were used interchangeably to query. The paper's title, abstract and keywords, were searched using various key terms together with Boolean operator "OR", "AND" and wildcard *. "upskilling" AND "student", OR "upskilling AND university student", "Student re-skilling" +*re-skilling* student* AND 4IR, "skills in 4IR". Due to the diversity of search strings, the search result generated numerous inapplicable results. For instance, when sources such as Google Scholar was searched for "upskilling", it included a lot of managerial and workplace related studies without mention of upskilling for a student. Therefore, modifications were done in terms of keywords, "student upskilling" + "fourth industrial revolution". The inclusion of the "student" keyword significantly refined the search results, thus making the exclusion of articles to be more manageable. The selected parameters also contributed to a more refined systematic review.

The search iteration was repeated until the authors reached a saturation point i.e. could not generate new information. Five databases were used to source literature for this study; these include: Emerald, EBSCOhost, Google Scholar, Sage and Science Direct. The databases were selected mainly due to accessibility from the institutional library of subscribed databases; and contains a majority of reputable and high impact factor journals.

The search maintained the same keywords across the various databases initially, however, after seeing the yielded results, adjustments were made on the search strings. Peer reviewed articles from conference proceedings and journals were utilized. Section below details the PRISMA framework process for the study.

Screening of Articles

A total number of 8649 results were returned from the initial search of the various databases. The yielded results still required screening in order to eliminate irrelevant articles. The first step was to remove all duplicates that existed across and within each of the databases' results. The sorting and elimination of duplicates was done through using search engine filters. For instance, filters such as the period filter which limits the results to studies published between 2011 to 2021. The selected period was to try and get the most recent publications on the selected topic. A regional filter was applied in an attempt to get studies that discuss the fourth industrial revolution in the African context. However, due to the limited studies on 4IR skills in Africa, the filter did not yield much output, hence location was

not used as a criterion in elimination of articles. The publications were required to have met the following criteria to be included: peer reviewed conference proceedings, journal articles, technical reports and thesis written in English on the Fourth Industrial Revolution in Higher Education, published between 2011 to 2021. Chain searching was used on these two publication types, hence all other peer reviewed research sources were not included. Articles published prior to 2011 were consulted in relation to any theoretical foundations or related models. Any paper whose full text was not accessible as well as a publication whose focus was not based on the specified search terms was excluded. After the screening process, a total number of 7559 articles were eliminated, resulting in 1090 sources to be put through the eligibility vetting process. Table 1 shows the number of articles per database.

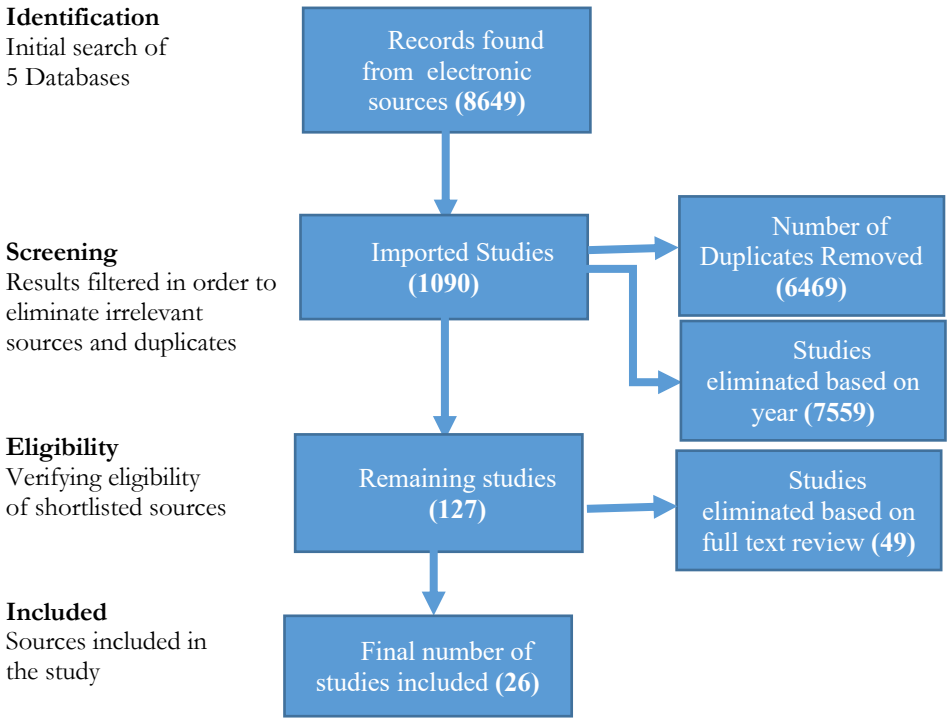

Figure 1: Adopted PRISMA Model (Olaitan & Mavuso, 2021)

Database	Initial search	1st order search	2nd order search	Final articles selected
Emerald	**994**	94	19	6
EBSCO Host	**1117**	208	24	5
Google Scholar	**3998**	482	41	7
Sage	**1100**	107	22	5
Science Direct	**1440**	199	21	3

Table 1: Number of Articles per Database

Articles included in the study

At the final stage, the remaining 43 articles were acquired in full text version. The steps included acquiring, reading, identifying and vetting of articles. All the articles in this stage were read. Full text reading was done to make sure that all content is in line with the study. The forward and backward method was utilised during the selection phase to further identify the most relevant sources. After reading the full texts, 26 sources were selected. The reduction was caused by the sources not focusing fully on re-skilling students in the Fourth Industrial Revolution. Some articles' full text was not accessible and some were not focusing on student's skilling and reskilling. Table 2 lists a summary of selected key articles deemed to be the most relevant to this study, based on the study's objectives and recommendations given. Key points include: re-skilling of students, 4IR skills shortage and solutions and university students & 4IR.

Author Details	Article's Objectives	Publication Type	Keywords & key search string
Kayembe, C., & Nel, D. (2020). Challenges and Opportunities for Marketing Scholars in Times of the Fourth Industrial Revolution	The article focused on the South African education sector. The findings of the study stated that the education sector in South Africa is facing a number of challenges. The challenges include insufficient funding, infrastructure, and skills to prepare graduates to participate in the 4IR.	African Journal of Public Affairs	Artificial intelligence (AI); Big data; *Fourth Industrial Revolution (4IR);* Internet of Things (IoT); Robotics.
Manda, M. I., & Dhaou, S. Ben. (2019). Responding to the challenges and opportunities in the 4th industrial revolution in developing countries.	The purpose of the study was to understand the challenges faced by developing countries in the adoption of digital transformation agendas in order to influence the social and economic benefits of the digital-driven industrial revolution 4.0.	ACM International Conference Proceeding Series	Socio-technical, *4th industrial revolution*, smart society, digital transformation.
Adendorff, C., & Putzier, M. (2018). A Causal Layered Analysis of South Africa's Readiness for the Fourth Industrial Revolution Towards 2035.	The paper addressed global trends and drivers for change through environmental scanning efforts within the 4IR, and how this directly impacts on the creative economy in general.	IMESA Conference	*Fourth Industrial Revolution* (4IR) Future workforce, digital transformation.

Bennett, D. (2018). Graduate employability and higher education: past, present and future.	The article focused on answering the question: how might higher education students be prepared in order to navigate an increasingly complex world and labour market in which they will need to think for a living? The labour market environment into which graduates transition was closely analysed .	HERDS A Review of Higher Education	Graduate outcomes, graduate attributes, graduate labour market, *university*, graduate work, career development learning, work integrated learning, *higher education* policy.
Mkansi, M., & Landman, N. (2021). The future of work in Africa in the era of 4IR-The South African Perspective.	The paper explored South African universities' 4IR readiness alongside the backdrop of general industry 4IR adoption. Interpretive interviews with three leading 4IR education training and industrial automation company directors were conducted in order to determine the available skills sets and/or labor force readiness.	Africa Journal of Management	*Fourth industrial revolution (4IR,)* automation, labor market, *curriculum redesign.*
Yusuf, B., Walters, M., & Sailin, S. N. (2020). Restructuring Educational Institutions for growth in the 4th Industrial Revolution(4IR): A Systemic Review.	The study's focus was on how the delivery of education will be undertaken and how educational institutions will be restructured by the 4IR in order to prepare students for challenges in the future.	Internati onal Journal of Emerging Technologie s in Learning (iJET)	*Fourth Industrial Revolution, Educational Institution*, technology, student and workforce.
Waghid, Y., Waghid, Z., & Waghid, F. (2019). The Fourth Industrial Revolution Reconsidered: On Advancing Cosmopolitan Education.	The article's main objective was on the investigation of the impact of prioritising the cosmopolitan human condition in reference to university teaching and learning, and how the fusion of 4IR fits in.	South African Journal of Higher Education	*Fourth industrial revolution, higher education*, cosmopolitanism.

Sikhakhanea, M., Govender, S., & Maphalalaba, C. (2021). The extent of South Africa's preparedness to counteract 4IR challenges: learners' perspectives.	The aim of the paper was to explore learners' perspectives on how their schools are preparing them to prosper in the Fourth Industrial Revolution (4IR) era which is powered by Artificial Intelligence (AI).	Journal of e-Learning and Knowledge Society	Artificial Intelligence, *Fourth Industrial Revolution,* Level of Preparedness, Technology Acceptance Model.

Table 2: List of Key Articles

3 Literature Review

3.1 The 4IR and African Reality in Context

The 4IR has been described as the era in which technology enables the integration of physical, digital and biological worlds; a blend with the capacity to impact businesses and industry in very profound, disruptive ways (Schwab, 2017). Addendorf et al. (2018) are of the opinion that the 4IR brings critical but necessary disruptions to personal, interpersonal and intrapersonal relationships and affordances in both public and private spaces. The Covid-19 pandemic has evidenced this position as convergence and congruence in the workspace were mostly online for over a year. The nature of jobs, and the required skills to perform them is rapidly changing. It is projected that as many as 40% of current jobs would have become obsolete by 2050, and 65% of youths will have jobs that do not yet exist at this present time (Lewis, 2020).

Additionally, the global youth unemployment rate is three times higher than the adult unemployment rate (Committee for Economic Development of Australia, 2015). Youth unemployment remains high in spite of significant rise in the number of young people who have earned a tertiary degree. The same trend is observable in South Africa, where only a reported 7% of university graduates find it easy to get jobs in the formal economic sector (National Planning Commission, 2020). In this challenging landscape, it is conjectured that one of the major reasons for the high level of unemployment is the fact that current curriculum does not align to the requisite skills required by employers (Lewis, 2020). Graduate employability is contingent, not only on the understanding of content knowledge, but proficiency in the use of modern technological artefacts, soft skills and an ability to solve real life problems with creative thinking (Waghid, Waghid, & Waghid, 2019). If the current gap between theory (course content) and practice (skills required in the workplace) is not addressed and closed, graduate unemployment could reach endemic proportions, and this would have significant socio-economic implications for the unemployed youths and society at large (Modiba & Ntshangase, 2021).

McNully (2018) argues that reliance on digital technologies in the workplace will be a major part of futuristic jobs hence current learners must be trained and equipped with the necessary technological skills to fit into these digital roles. Addendorf & Collier (2015) believe that the 4IR will encourage human-machine partnerships and open up new frontiers, thereby stimulating economic growth. The rise and prevalence of these human-machine relationships in the workplace underpins the argument for curriculum change or revamp, especially in universities of technology. Yusuf, Walters, & Sailin, (2020) project that 80% of businesses will establish global networks with linear, streamlined and connected workstations in diverse geographical locations, all under a central leadership or management team. Consequently, the future of work demands new competencies, offering a huge opportunity for students

to upskill, re-skill and multi-skill in preparation for the disruption caused as a result of the 4IR (Schwab, 2017). African businesses are far behind in the race for economies to become 4IR compliant in most spheres, hence the continent is at great risk of being left out of the innovative and digital growth on the global stage. This reality also impacts negatively on the ability of African firms to position themselves as global players (Moloi & Mhlanga, 2021).

Poverty and inequality are some of the greatest challenges on the African continent (Olaitan, Issah , & Wayi, 2021). Seery, Okanda, & Lawson (2019) contend that an estimated one percent of Africans owns forty percent of the wealth of the entire continent. Also, three billionaires on the continent have more wealth than the bottom fifty percent of the African population (about 650 million people) (Seery et al, 2019). Many futurists and economists are predicting massive disruptions in many industries because of the evolution of the various technologies, which came with the 4IR. Although the 4IR is not fully operational in the global South, including South Africa, some challenges of disruption do exist. There has been a marked increase in contract work, multiskilling and gig work (working independently on a task-by-task basis for various employers). It is estimated that up to thirty-five percent of jobs could be replaced in South Africa if the 4IR revolution takes off (Adendorff & Collier 2015). It is also projected that more than two billion jobs will disappear by 2030 (Adendorff et al. 2018). These statistics are sobering for a country like South Africa, which already has a staggeringly high rate of youth unemployment and under-employment. To put the argument in context, nearly more than half of the world's population (most of whom are on the African continent,) are yet to experience the third Industrial revolution (Baweja, Donovan, Haefele, Siddiqi, & Smiles, 2016). The delivery of basic services, such a clean water and electricity, are still the source of violent protests in South Africa. The cost of data is also prohibitive and out of reach for the average citizen. In light of all these challenges, it is reasonable to argue that the reference to the 4IR readiness by both industry and government, is at best, an idealistic one whose intention is to sensitize the country about developments around the globe (Olaitan, Issah, & Wayi, 2021). In spite of this, and the reality of low rates of enrolment into the STEM fields at tertiary level in South Africa, it is important for universities, and other higher institutions to prepare the coming generation for careers in the 4IR, and this can only be done if a deliberate and systematic agenda for this purpose is put in place across institutions of higher learning.

Furthermore, some of the technologies touted as part of developments in the 3rd Industrial revolution are yet to be deployed in most parts of Africa (Waghid, Waghid, & Waghid, 2019). The response of Higher Education, in terms of curricula change, to new developments in the world of work is known to be historically slow, when compared to the fast pace at which technologies are evolving. The World Economic Forum suggests that an estimated fifty percent of the curriculum for a technical degree would have become obsolete and irrelevant by the time the student leaves university (WEF, 2020). The challenges of skilling, and reskilling potential graduates in this dispensation is complex, requiring a great deal of co-operation and collaboration between industry, universities and DHET (Moloi & Mhlanga, 2021). The next section examines the skill requirements for a technology infused, 4IR compliant economy in the global market place.

3.2 Skills Requirement for the 4IR

Twenty-first century skills do not align with the traditional standards of hierarchical workplace structures (Payton, 2017). Work has become more flexible, with knowledge skills at the center of both the experience and remuneration of work (Ayentimi & Burgess, 2019). Today, organizations are shifting and preparing for the future of work. There are now flatter structures, increased collaboration between and within organizations, with many workers choosing to work remotely and telecommuting becoming commonplace (Yusuf, Walters, & Sailin, 2020). To remain competitive in the future, organizations need to prepare for the coming changes. The World Economic Forum (2016) contends that one of the greatest challenges facing human resources practitioners in the new world order is the

need to develop a multi-skilled, versatile and nimble workforce. As stated by the International Labour Organization(ILO), "todays skills will not match the jobs of tomorrow, and newly acquired skills may quickly become obsolete" (International Labour Organization, 2019). Lifelong learning is considered as an essential ingredient for all member states to overcome the challenges of a rapidly growing, technology infused world. Ernst et al (2019) contend that the skills that are needed by 21st century workers are those that cannot be replaced by robots. These include competencies such as social skills, empathy and interpersonal skills. The World Bank Group (2018) extends this notion further by stating that advanced cognitive skills, socio-behavioural skills and adaptability are critical skills for the worker of the 21st century. Lifelong learning and continuous development are also envisaged to be sought after skills in the new era of the 4IR, as these are skills that may not be programmable for machines (Baweja, Donovan, Haefele, Siddiqi, & Smiles, 2016). The next section examines the significance of the Higher Education sector in positioning current students to become the workforce for a 4IR future.

3.3 Skilling, Reskilling, and Upskilling of Current Students

The focus of this paper is on skilling and reskilling students as a way of preparing them for a digital economy, it is therefore important to discuss the meaning of the terms in depth. Reskilling is the ability to learn job specific technical skills but also the acquisition of other fundamental, human competencies such as creativity, communication and collaborative work. Reskilling has been described as learning in service of an outcome, usually involving successful transition into a new job or equipping for the ability to successfully take on new tasks (Quintini, 2011). Reskilling may be achieved through a formalized method whereby the student or employee is taught new, additional skills to prepare them for new challenges or emerging aspects of their career spaces, or informal learning through formative or observational mentoring (Quintini, 2011; Ilori & Ajagunna, 2020).

Although the term reskilling is mostly used to refer to employees, we argue in this paper that students also need reskilling, to update their technical capabilities in response to the latest developments in the 4IR era, in cases where the curriculum has not been upgraded to cover the practical aspects of their chosen careers, such that they can be positioned for employment once they complete their degrees. In reskilling, students are able to expand, improve their current skillset in order to perform their jobs optimally in spite of new developments in the field. Reskilling is a mechanism by which a development plan to ensure that new skillsets are acquired is devised, and personnel are well positioned to get into new roles created by the demands of self, industry and new technologies (Partovi, 2018). Reskilling has become a necessity in view of the challenges of a rapidly evolving workplace (Lewis, 2020). This development makes the prospect of finding gainful and relevant employment difficult for students, if their study years have not responded to the pace of growth happening in the larger society (Wahi, Musa, Mohdali & Hassan, 2019). If reskilling is not considered as a necessary response to major developments in a field of study, students may find that they are incompetent to perform the jobs for which they obtained qualifications and are unmarketable for other employment (Gupta, 2019).

4 Current State of Technology Education in South Africa

The South African government has made great effort to position the nation as forward looking, working hard to enact laws and policies for citizens to embrace global developments as outlined in its 2030 National Development Plan (NDP, 2030). According to the NDP, all South Africans must be able to use knowledge effectively, and higher education has a responsibility to ensure that the ICT environment is well structured, and graduates are not disadvantaged by the 'digital divide' (NDP, 2011). To achieve this feat, both teachers and students must be reskilled across a broad spectrum of practical competencies to achieve the kind of revolutionary change required to stay relevant in the era of the 4IR (Waghid, Waghid, & Waghid, 2019).

In spite of the 'good intentions' expressed by government in the NDP, and other position papers, majority of academics in South Africa are not technologically competent, neither are they fully conversant with the technologies of the future, such as AI, Robotics and Machine Learning (Baweja, Donovan, Haefele, Siddiqi, & Smiles, 2016). The Covid-19 pandemic exposed the state of technological advancement, teacher capabilities and available tools at tertiary institutions across the country.

As earlier stated, the skills for the 4IR world requires a practical application of the content to the realities of the era, hence faculty have to be at the forefront of the ability to demonstrate this knowledge in a high value spectrum which machines are not capable of doing. Unfortunately, most previously disadvantaged universities have a workforce which still experience trouble with digitization and technology (Sikhakhanea, Govender, & Maphalalaba, 2021). It can thus be argued that skilling and reskilling of teachers is a precursor to the skilling of students, if Higher Education is to play a meaningful role in the reskilling of students, it stands to reason that government/ university has measures in place to ensure that lecturers themselves are in the loop about current developments and they understand the stakes for this exercise. The skills demand for a 4IR labour market is expected to be filled from colleges, traditional universities and universities of technology. Government, industry and academia must work hand in hand to ensure a symmetrical synergy for the purpose of identifying, addressing and fulfilling the country's labour needs for the 4IR (Ros ario Cabrita, Safari , & Pilar Mu noz Due nas, 2020).

In light of the current curriculum at most institutions of higher learning, it is considered that the skilling and reskilling of both students and faculty is a necessary step towards preparing the economy for a 4IR future. The education sector has to be at the forefront of preparing students for this complex landscape as education plays a major role in the transformation of society (Scepanovic, 2019). Currently, there is tension between academia and industry on the former's role in ensuring that graduates have the requisite skills to prepare students for the 4IR.

South Africa needs to have an urgent, and creative plan towards ensuring that a fundamental shift occurs in education, ensuring that students are skilled for the innovations of the future. Skills development will be fundamental to the country's ability to benefit from the gains of the 4IR. Moloi and Mhlanga (2021) argue that the Department of Basic Education(DBE) is not equipped to position both educators and pupils to prepare for the 4IR era. Research has consistently documented a mismatch between the skills of unemployed youths and the skillsets required by employers (Jackson, 2016). The convergence and intrusion of pervasive technologies such as mobile phones, automation and the inroads made into robotics will contribute to youth unemployment unless they are skilled to take advantage of the technologies which empower and power a 4IR economy. The main characteristics that employers are looking for in this industrial age include problem solving, team work and critical thinking. The concept of lifelong learning and knowledge co-construction are also considered as vital skills in the new world (Committee for Economic Development of Australia, 2015). Government, on its part, is grappling with many socio-cultural and unprecedented challenges, hence preparing for a revolution that is still to come seemed unrealistic (Allen, 2019). In view of all these, and the pace at which developments are rapidly evolving, we propose four critical success factors(CSFs) to consider in the process of skilling and reskilling current students to fit into the 4IR workplace. These CSFs are based on the literature reviewed and practical steps taken by some developing countries to right-skill their youths for relevance in a 4IR economy. Although South Africa is still behind in running a fully-fledged 4IR economy, we believe the time to position for the eventuality is now.

5 Critical Success Factors to Prepare Current Students for a 4IR Economy

Pournasir (2013) describes critical success factors(CSFs) as necessary for a particular objective to be achieved. Critical Success actors are the steps that an organisation has to take, if it were to accomplish a stated goal. We are of the opinion that government, and Higher Education, in collaboration with industry, must address the following issues if it would prepare current students to partake of the opportunities presented by the ongoing wave of the 4IR.

CSF 1: An urgent curriculum revisit- In spite of the many challenges faced by the government and education sector in the current dispensation, there is no option but to skill and reskill students who are in the system to face a technology world. Current curriculum must be futuristic and reflective of what future workforce must be equipped to do (Partovi, 2018). We propose an urgent revisit of the education curriculum initiated by DHET, in collaboration with industry and academia. This will ensure that DHET's curriculum is responding to Industry needs and the academic community ensures that this is translated into the skilling, and reskilling of students for the future of work (Mkansi & Landman, 2021; Ros ario Cabrita, Safari , & Pilar Mu noz Due nas, 2020).

CSF 2: Funding, equipment and support of vocational education and training(VET)- Most technikons have been converted to universities, and enrolment in the few ones remaining are not very optimal as university education is perceived as superior. The level of vocational education and training(VET) worldwide has been described as low by several researchers (Jackson, 2016). An additional challenge is the lack of resources, making it difficult for students in STEM fields to access on-the-job training as part of their skilling. In view of the emphasis on training in practical skills in the 4IR economy, we propose a revisit of the VET kind of training for students, especially those in STEM careers. According to Payton (2017), the wide gap between the actual skills profile of recent graduates and their stated qualification is a cause for concern. We believe VETs can close this gap and provide the much needed practical and vocational training required for these sets of graduates to be work-ready in a 4IR era. Evidence from Australia, a fairly developed economy, and India, a developing economy both point to the fact that vocational training empowers students not only to envision what would be required of them in the workplace, but to have a firsthand experience and make the necessary adjustments before they leave the schooling system (Gupta, 2019; Payton, 2017). Vocational training and education must be re-imagined around the skills of the 4IR, hence students need to be trained to multi-skill, develop soft skills in highly technical environments and focus on problem solving skills.

CSF 3- Strong, global collaborations are essential to student skilling and reskilling- Technology has, and continues to play a great role in enabling collaborations between countries, institutions across several areas of human endearvours. The unprecedented rate of breakthroughs in the control and management of the Covid-19 pandemic provides great evidence of this fact. We believe that one of the critical factors to empower students by skilling, and reskilling them to fit into the workplace of the future is to create collaborative spaces between South African students and students in similar careers in countries where the 4IR has already taken root (Yusuf, Walters, & Sailin, 2020; Ayentimi & Burgess, 2019).

CSF 4- Educational safe spaces for the development of soft skills- researchers agree on the fact that soft skills such as communication, people management, critical thinking and the ability to multi task are critical for success in the 4IR (Payton, 2017). We submit that government, through the Department of Higher Education should ensure that such skills are learnt at school by graduates before they get into the workplace. These can be done through collaboration with the personnel divisions of

relevant industries, or facilitating peer-to- peer, or teacher to student learning as part of the broader process of getting the students ready for the 4IR workplace. The path to prosperity in the 4IR era will be through innovation, ideation, creativity and nimble problem solving skills (Ayentimi & Burgess, 2019). Workers who are skilled in these areas will be hugely rewarded in the era (Karr, Loh, & San Andres, 2020).

6 Conclusion

The paper examined the relevance of the curriculum being taught to current students at the institutions of Higher learning in South Africa to the skills demands and requirements in a 4IR economy. Evidence from the literature revealed that South Africa is still behind in crafting a curriculum that will keep current students relevant, employable and productive in a 4IR economy. We discuss various challenges, which may hinder these students from being able to access opportunities presented by the 4IR. We therefore propose four critical success factors that the government should address, in the quest to equip students with the right skills, and position them to take advantage of the many opportunities presented by a digitalized economy. These critical success factors are; (a). An urgent curriculum revisit, (b). Funding, equipment and support of vocational education and training (VET), (c). Strong, global collaborations are essential to student skilling and reskilling, (d). Educational safe spaces for the development of soft skills.

The paper makes a theoretical contribution to the literature on curriculum challenges within the STEM field in South Africa and how the challenges could be overcome. We noted the time lag in implementing the review of curriculum, and the fast pace of development in the workplace as a result of technological advances. The paper makes a practical contribution to the topic by proposing four critical success factors that could be addressed in order for students to be right skilled and positioned to take full advantage of the opportunities presented by a digitized economy as exemplified by the 4IR era.

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