

The Fourth Industrial Revolution: Integrating ICT in the South African Education System

Andrew Enaifoghe

Department of Public Administration
University of Zululand, KwaDlangezwa, South Africa

Tolulope Balogun

Department of Library and Information
Science, University of Zululand,
KwaDlangezwa, South Africa

Oluwafemi Sunday Afolabi

Department of Library and Information
Science, University of Zululand,
KwaDlangezwa, South Africa

(Received June 05, 2021; Accepted July 10, 2021)

ABSTRACT

Purpose: The study look at the Fourth Industrial Revolution with the integration of ICT in the South African education system. The prospects and the latent benefits of Information and Communication Technologies (ICT) in advancing the significance of education in the Fourth Industrial Revolution (4IR) have been highlighted in several studies and reports. ICT has become the foremost tool for building knowledge societies and it could provide a way to rethink and redesign the educational systems, thus leading to quality education for all. **Motivation:** As new technologies are rapidly changing the world's economies, from cultural to social realities, the question remains how prepared is the South African education system is in positioning the current generation for the 4IR. This paper explored the role of ICT Integration for the South African education system. **Methodology:** Anchored on the qualitative research approach, this paper collected data through secondary sources, that is based on a systematic analysis of the literature of the baseline data collected of a constellation randomized controlled sample. **Findings:** Findings show that the sub-Saharan region has an overall share of high-skilled engagement as a result of the imminent disruption to employment and skills brought by the 4IR. **Recommendation:** There is a need to invest in ICT in the South African education system to equip the learners with the required skills and knowledge required to compete in the 4IR. **Originality:** No study has been conducted in this area of study that recommend the need to invest in ICT at primary education level.

Keywords: Fourth Industrial Revolution, Rethink, Social Realities, Development, Education.

INTRODUCTION:

This article explored the preparedness of the South African Government in Integrating ICT in the education system in the advent of the Fourth Industrial Revolution. The Fourth Industrial Revolution (4IR) offers countries the opportunity to advance their socio-economic development through the adoption of innovative technology. The 4IR is gradually changing how people interact with one another in society. Scholars are underlining the role of the education system in shaping future technology by becoming the testbeds for innovation and teaching future generations (Mezied, 2016; Cloete, 2017; McCrindle and Renton, 2018; Jones, 2020). The traditional education system has over the years contributed impressively to the current levels of the industrial revolution and technological development in the past decades (Mezied, 2016). For the higher education system in South Africa to deliver the right set of skills and knowledge to future

generations, the institutions of higher learning in South Africa must be transformed in their education delivery role in the 4IR.

South Africa is currently part of the transformation as the world has entered the 4IR through advancements in artificial intelligence, robotics, cloud computing, and the internet of things (GetSmarter, 2019). Even though the emergence of the 4IR has captured the mind of many Africans around the globe, providing African youths with the knowledge and skills needed for employment in the 4IR is still a major challenge. It is important to understand the various stages of the industrial revolutions. In line with such complex systemic and operational technological transformation that has innovatively demolished the previously established systems of social, political, and economic establishments is known as the fourth industrial revolution (Maharajh, 2018; Schwab, 2016). This study identifies the need to take advantage of technological advancement in education to industrialize and pursue inclusive growth capable of creating new possibilities for positive change in society. Thus, this paper aims to contribute to the literature on improving the education system in South Africa to help prepare graduates with appropriate ICT skills for future employment.

The question is how South African government can address some of the challenges facing the country like poverty, unemployment, and inequality in the fourth industrial revolution, by integrating ICT into the education system. The methodology adopted by this article is a qualitative research approach, which employs “a systematic analysis of the literature of the baseline data collected to form part of a collection” randomized controlled sample. The data was collected from secondary sources. The use of the inductive content analysis helped in the selection of documents, and focusing on particular extracts which reflect the issues on which the researcher is sought.

Conceptual Considerations for Information and Communication Technologies:

The successive replacement of administrations and technological infrastructures is the awareness and the concept of the Fourth Industrial Revolution (4IR). The 4IR promoted by the World Economic Forum appears to be weakly composed of stylized facts and popular generalisations (African Perspective, 2019). The 4IR has ushered in disruptive technologies like artificial intelligence, the Internet of Things (IoT), and big data that are transforming the way we live. Maharajh (2018) conceptualized at least five techno-economic paradigms since the mid-18th century:

“The steam engine (1780–1830); railways and steel (1830–1880); electricity and chemicals (1880–1930); automobiles and petrochemicals (1930–1970); information and communications technologies (1970–2010)”.

South Africa is a developing country with aspirations of becoming a sustainable and self-reliant economy while meeting the needs of the people in the 4IR. This includes effectively managing its limited resources to address issues of poverty and unemployment. The 4IR which is a shift in contemporary society is currently generating new possibilities for enlightening and advancing people’s daily lives. South Africa aims to harness the potential of technological innovation to grow its economy and uplift the people by 2030. This is based on the fact that accepting change is one of the proactive and positive ways to guarantee success. South Africa has been at the fore of driving and promoting innovative means to finding solutions to African developmental challenges and ensure that technological advances benefit not a selected few but for everyone.

“The 4IR represents a new era of innovation in technology that will enhance human-machine relationships that will unlock new market opportunities, and fuel growth across the global economy” (Mail & Guardian, 2019).

However, the education system in South Africa somewhat lacks a technology focus. The education system in several ways aggravates this problem because it is not geared to create the high-end skills in ICT at the scale that is currently needed (BusinessTech, 2019). According to a report by the Department of Higher Education and Training (DHET), only 5% of students enrolled at the technical and vocational education training colleges are enrolled in ICT and computer science programmes (Statistics South Africa, 2019). The DHET attributes these low figures to “the low levels of interest in technology among students, as well as inadequate infrastructure for education and poor teacher training” (DHET, 2019: 3). Mngxati and de Haas (2018), argued that “the future of South Africa’s education system might be the most important

consideration in its journey towards the 4IR”.

South African institute of higher learning has key roles to play, in shaping future technology to become the testbeds for technological innovation and educating future generations. It is no doubt that the traditional education system has however contributed prominently to the existing industrial revolution and technological advancement (Mezied, 2016). This shows that South Africans have a long way to go to tap into the benefits of innovation-led prosperity. There is a need for South Africans to “develop the required skills to deal with the disruptive effects of new technologies in their work environment” (Mezied, 2016: 5). For South Africa’s higher education to reach the level where it can deliver future generations with the right skills and knowledge, the institution of higher education needs to be improved to align with the employment demand in 4IR. ICT has become the foremost tool for building “knowledge societies” (UNESCO 2003, p. 1) and it could positively impact the educational systems, thus leading to quality education for all. In 2018, the World Economic Forum (WEF) reported that the future of jobs and skills in Africa (particularly the sub-Saharan Africa) has an overall share of high-skilled engagement of about 6% compared to the global average of 24% (World Economic Forum, 2018).

Schwab (2016, p.1) believes that “the pace of change is creating opportunities like never seen before, the possibilities of billions of people connected by mobile devices, with unprecedented processing power, storage capacity, and access to knowledge are unlimited”. The technological disruption of 4IR was projected to exclusively change around 39% of core skills prerequisite across jobs in South Africa by 2020 (Samans and Zahidi, 2017). The issue is how prepared the government is in positioning the current young generation for the 4IR. This issue has been debated extensively in contemporary South Africa’s institute of higher learning in recent times. The 4IR era is characterized by exponential developments, amplified human productivity, inter-connectedness, and the obscuring of the lines between mankind and machine. The ushering in of the 4IR has compelled countries to “develop new policies, strategies, and innovative plans to enable” a comprehensive society method.

The South African government also has different components of the 4IR spread across different sectors (private sector and civil society). There seems to be no plan or blueprint which brings together all key role players into a single focus currently. Though the discussion on the development of the 4IR is typically governed by the role in which the government and the private sector should play. According to Mapulane (2019: 3), “other stakeholders in a civil society like academia, women, and the youth population must have significant roles to play in ensuring an overall buy-in by all role players in the society”. In South Africa, different groups are encouraging the usage of modern technologies in the 4IR and taking various steps to realize its vision. Nevertheless, South Africans seem to have a long way to go before enjoying the fruits of innovation-led fortune. Furthermore, it is important for “people in regular jobs to develop the skills to deal with the disruptive effects of new technologies in their work environment” (GetSmarter, 2019).

South Africa’s education system could be of the utmost concern in its future journey to the 4IR. For Africa to enjoy the benefit of the fourth industrial revolution, it is imperative to introduce the use of ICT technology in all schools. South Africa as a developing middle-class nation seems is underprepared to adapt to the current industrial revolution. Studies and reports have underlined the various prospects and the latent benefits of ICT in advancing the significance of education in the 4IR (Grant, 2016). Even though the discussion on the advent of the fourth industrial revolution has been receiving attention, the social structure of our lives has been excruciatingly slow to adapt to new technological developments and their effect on social life and work as well. The various debates favour student-centred learning, with learning outcomes, and the lifelong learning process (Robins, 2016). This is coupled with the use of Information Communication Technologies (ICT) in the education system.

The current higher education system in South Africa still rely on the antiquated approaches of facilitating learning (Enaifoghe, 2018; Schwab, 2016). The current education curricula and school programmes can hardly meet the needs of industries and contemporary social life (Enaifoghe, 2019). This is a major problem that requires government action. South Africa government “is not taking sufficient advantage of Fourth Industry Revolution opportunities for establishing businesses and industries, despite its strong scientific base and innovative people” (Schwab, 2016). Nonetheless, South Africa previously had a strong and diversified manufacturing sector that contributed 13% of its GDP, and a prevailing infrastructure (Albert and Mercedes, 2010). The “sector has been losing jobs since 2010” (Chao, 2017). Its expansion is hampered by costs of production (including labour), relatively poor productivity, a shortage of high-level skills and uncertainties about government policies (OECD, 2014). Despite the skill shortage, South Africa’s local manufacturing sectors are considerably doing well.

However, if the manufacturing sector is not organised or ready for the new industrial revolution, jobs would be lost and industrial markets will be lost to foreign competitors (Graham, 2017, p.3). This is because a country will not be able to harness new manufacturing technology unless its human capital is sufficiently equipped (Chao, 2017, p.2). There will be obstacles regarding all adaptive qualities of individuals, governments, economic sectors, and societies at large under the current 4IR exponential change as opposed to a constant linear pace (Chao, 2017). Mathomo (2006) noted that these changes will have a drastic impact on the labour market leading to loss of jobs across the globe. There are debates concerning the benefits and risks AI poses (Xing and Marwala, 2017; Schwab, 2016; Resnick, 2013). Artificial intelligence (AI) is also anticipated to pose a major risk in the new industrial revolution. While Schwab (2016) argues that the presence of robotics tends to cause loss of jobs, Resnick (2013) believes that innovations like self-driving vehicles will advance safety on public roads thereby saving millions of lives that could be lost to road accidents daily.

Assessing South Africa's National Policy on e-Strategy in the 4IR:

The emergence of 4IR created a need for countries to “develop new policies, strategies, and innovation plans to enable an inclusive whole of society approach, with the government playing leadership roles” (Government Gazette, 2018). Assessing the readiness of the South African government towards the global 4IR, Schwab (2016) notes that professionals believe that South Africa is currently lagging. There are numerous potential to change the industrial sector and move it into a more globally competitive position. Collaboration across all sectors and industries, both public and private, as well as civil society, is deemed critical to the progress of 4IR in this regard (Creamer Media, 2019). Manufacturing production volume has increased little since 2004, owing to de-industrialization in South Africa, but retail volume has surged by more than 60% in the same period. As a result, there are more imports and less revenue (Creamer Media, 2019: 2).

As a continent that is “obstructed by historically low levels of development, Africa can and must take advantage of the technological advances to industrialize, pursue inclusive growth, and attract investment” (Ramaphosa, 2020, p.1). Embracing innovation has the prospect of attracting investors to the education system, and this helps to equip the country's youths with the right skills. South Africa has developed innovative platforms like the launch of the African Centre for 4IR, to be launched later this year and hosted at CSIR, as well as new learning factories. For us to achieve and reap the benefits that await in the future, collaboration remains key. The South African national policy calls for a collaborative approach to the 4IR programme, both locally and in collaborating with international organizations (Gastrow, 2020; NDP, 2020). South Africa needs to take advantage of the 4IR by paying attention to local economic development in the rural areas. This includes full and equal participation of both women and the youth population in the decision-making process in all the value chains of the 4IR. The 4IR establishes itself through the technological innovations whose impact cuts across all levels of society, hence the need for a broader perspective and approach (Government Gazette, 2018, p. 2). For South Africa to achieve inclusive growth and harness the benefits of the 4IR, it needs to advance in digital systems at all levels of education. The current rapid growth and convergence are driving the fourth industrial revolution in the world with the emerging technologies, as well as the physical and biological (Schwab, 2016).

The fourth industrial revolution is regarded as a collective term for technologies and conceptions of a value chain body that enable to connect cyber-physical systems, including the Internet of Things (IoT) and other new technologies” (DHET, 2018). Cloud computing, big data, predictive analytics, artificial intelligence, augmented reality, agile and collaborative robotics, and additive manufacturing are examples of developing technologies. As a result, as 4IR concepts and technologies are deployed, the promise of fast, flexible, high-quality, and efficient production will take on new dimensions.

Government factors in Technology Integration in 4IR in South Africa Education:

Technological advancements in the 4IR are undoubtedly increasing productivity, while there are serious concerns over job losses due to automation. Heather (2018), on the other hand, stated that school leavers with the correct abilities have limitless prospects, but the big difficulty is preparing them. According to a report by the Economist Intelligence Unit (2020), only a few countries have begun to address the impact of automation through educational policy. The relevance of STEM (science, technology, engineering, and mathematics) education as well as so-called soft skills, which allow workers to trade on their uniquely human characteristics, is predicted to rise as a result of intelligent automation (Economist Intelligence Unit, 2020). On the issue of lack of adequate training for future workers, Heather (2018) notes that:

“little has been done to prepare future workers through school curricula or, just as importantly, teacher training, at the same time, some experts warn that a focus on soft skills would be a distraction in countries where basic education is still not up to scratch” (Heather, 2018: 4)

Nevertheless, the higher education system in the 4IR is seen to be a complex one, in that there are dialectical and exhilarating opportunities that can potentially change and enhance society. The 4IR is driven by artificial intelligence (AI) and it is envisaged to transmute the workplace from a tasks-based environment to human-centred features (Ahmadi and Marwala, 2017). This is a result of the merging of man and machine. Having this in place will reduce the subject remoteness between humanities and social science environment as well as the science and technology. This promotes much more interdisciplinary training through education, research, and innovation. There are inadequacies of the needed capacity to advance ICTs in the modern industrial revolution. ICT has become a new knowledge in the South African education system. This knowledge raises some questions as well as challenges for teachers vis-à-vis their practical aptitude, knowledge, and expertise in the knowledge of it.

“Participation in the information society, influence of information technologies access, cost efficiency and quality of education, and integration of ICTs in the teaching and learning process,” according to the White Paper on e-Education (Ahmadi and Marwala, 2017, p.4). There appears to be a gap in learners' and teachers' capacity to effectively use information technology. This is not restricted to online content access, but also the creation of online content as well as the communication, collaboration, and integration of technology into the education system via teaching and learning. Besides, there is little evidence on technology integration into the South African school classroom activities which include systematic preparation and implementation of lessons. One of the major hindrances to the effective integration of technology in South African schools could be traced to the traditional South African educational system which had mainly concentrated on the educational conduit.

To date, the South African educational system still reflects the “appendages of the colonial era, where it had fundamentally been a platform to produce and re-produce white-collar graduate job seekers as opposed to covering all facets of an education system”. Nomalungelo (2018) posits that this has led to several factors like the high rate of failures in the country and a high number of drop-out and repetition rates as many unqualified learners with unsatisfactory results had been pushed to go to universities to further their studies. The South African Department of Education believed that the Three Stream Model is expected to provide distinguished assistances to learners that would respond explicitly to the various “needs of South Africa and the country's young population” (Basic Education, 2018). It also perceived that it would respond to the skills that are needed for the current ever-changing world with the industrial revolution. According to Nomalungelo (2018), the South African “Three Stream Model was outlined into three pathways: academic, technical-vocational, and technical occupational”.

The South African Department of Education had envisioned that these three streams could subject the learners to public assessments at the end of Grade 9, and this is expected to be helpful to stream learners into the advanced education and training (FET) field while improving education and training system in South Africa (Nomalungelo, 2018). The South African government acknowledges the fact that improving education, training, and innovation is key. This is evident in the South African 2030 VISION which aims for South Africans to have access to the highest quality of education and training by 2030 to significantly improve learning outcomes, increase the employment rate and reduce poverty. Affirming this, the Parliamentary Monitoring Group (PMG) (2018: 1) noted that “South Africa has set itself with the goals to eradicate poverty, reduce inequality, grow the economy by an average of 5.4 percent, and thereby cutting the rate of unemployment up to 6 percent by 2030”. Nonetheless, quality “education, training, and innovation are key tools to achieving these set goals”.

The Department of Basic Education’s intention with “the technical vocational stream is to improve in producing artisans” as part of responding to the National Development Plan (NDP) (Vision, 2020) (PMG, 2018: 1). The PMG (2018) further argued that:

“Technical and Vocational Education and Training (TVET) colleges had made an effort to produce artisans, but the foundation started with schooling, the Department had now heightened its relationship with industry”.

“The industry had assisted in developing the curriculum and was now on board in terms of sponsoring and funding the activities of the subjects related to preparing learners for the world of work”.

Nomalungelo, (2018, p.2), articulated that the DBE had shown its keenness to “prepare learners to function in the Fourth Industrial Revolution (4IR), and therefore it would be preparing the youth for jobs that existed and jobs that were yet to exist -- jobs of the future”. Despite the fact that the department had started with developing disruptive technologies, only the Eastern Cape, Gauteng, and the Free State had begun to deploy them. When the remaining provinces signal their willingness to begin, they will be included. “Information and data literacy, communication and collaboration, digital content creation, safety, and problem solving” are the key components of the digital proficiencies that will be necessary in the future (Nomalungelo, 2018). However, according to PMG (2018), the number of teachers who have been educated thus far does not meet DBE's goals, but “the digital content could be accessed by teachers and learners using their own devices and receiving service, provided to zero-rate access to the use of such content”. According to Rosenstock (n.d. p.6), education is currently “in the middle of a fundamental transition, where academic institutions are being allowed to work for the advantage of the student through breakthroughs in technology and teaching methodology.”

The World Bank (2017) suggested that for organizations to be able to compete in a global economy, “quality management within the organisational environment is of paramount importance to strategic pursuits, competitive advantage and corporate survival”. Improved school administration and management can help to increase educational quality. The growing complexity of educational leadership, as well as the necessity for innovative, divergent, and unexpected responses to school settings and challenges, necessitates a demanding approach to educational management. The issue of educational management in the information era cannot be disregarded in dealing with this complexity. To improve school leadership, “it is essential in the view of the current global revolution, education in the changing nature of work, the realities of the information age, new global partnerships and awareness of technological changes” (World Bank, 2017: 1).

Principals must integrate the three parts of administrative practise, which include administration, management, and leadership, to achieve or fulfil a school's mission, goals, and objectives. The ubiquitous process of efficiently planning, organising, directing, and controlling people and resources is known as administration (World Bank 2017, p.1). Principals with strong leadership qualities are needed in schools to manage resources and maintain a safe and orderly learning environment. According to Resnick (2013), the primary role of the secondary school principle in enhancing school performance is to provide effective leadership. Fry and O'Neill claim that (2002, p.1);

“We know that if we can have a dramatic impact on raising the quality of school leadership, we will have a dramatic improvement in student achievement across the board”.

In preparation for the education sector to educate the younger generation for the fourth and future industrial revolutions, there is a need for the South African government to embrace the technologies that are associated with them. The South African education systems, alongside its programmes and curricula, need to be flexible in allowing students' interests and needs (Chao, 2017). The education framework with school learners' subjects in correlation with the industrial revolution can be re-designed to be relevant to the unforeseen revolution in the job environments with modern technologies and social issues (Albert and Mercedes, 2010). It is also important for the teachers to continuously stay updated with relevant skills and adapt the use of new technologies in the continuously changing environment. The use of ICT in South African education is important in meeting the requirements of evolving technologies. This involves an outcomes-based system that would ensure continuous improvement to teaching and learning practices in the South African education system.

South Africa in the Global Fourth Industrial Revolution and the Future Job:

The Fourth Industrial Revolution (4IR) has been viewed as a fundamental shift in the way people live, work, and interact with one another around the world. The 4IR, like any revolution, will have an impact on both positive and negative developments in society. Changes brought on by the 4IR may already be seen in how civilizations produce, distribute, and consume commodities and services that fuel human

development. On the other hand, there are significant differences in the rate of transformation within and between socio-technical systems and countries. The pervasive “mobile supercomputing, the intelligent robots with the Self-driving cars, the neuro-technological brain enhancements, the genetic editing, and Artificial intelligence” (Schwab, 2016, p.1). Schwab (2016) affirms that:

“The evidence of dramatic change is all around us and it’s happening at exponential speed, while technology is widely considered the main source of economic progress, it has also generated cultural anxiety throughout history”

According to Brown-Martin (2017, p.9), a shift in technology has put pressure on employment and wages, raising concerns about growing inequality and the risk of greater job insecurity. When viewed through the lens of finance and economics, “history suggests that major innovations like the steam engine, electricity, and the assembly line can be disruptive” (Brown-Martin, 2017). Human history shows that people have held an ambivalent opinion to technological advancement which raises concerns like the replacement of “workers with machines to improve productivity and reduce cost” (Kitur and Rotich, 2014). The moral consequences of the development and the slowing down of development are the result of the stagnation. The OECD (2015) discussed some of the concerns raised above. They conclude that, while short-term disruptions to particular labour groups may occur, technological advancement benefits society in the long run by offering a “historical appraisal of each of these 4 categories” (Mezied, 2016, p.12).

In the industrial revolution, “the bigger fear today is a world where the elimination of work itself is the source of dehumanisation as a result of income insecurity and declining social agency” (Brown-Martin, 2017, p.3). Gordon (2016) expressed concern about the end of a period of significant technical advancement. According to Gordon (2016), “the headwinds of rising inequality, stagnated education, an ageing population, and the rising debt of college students and government will hold back the productivity development of Western economies.” “Artificial Intelligence (AI), automation, and digitalisation confront high-routine jobs,” according to the OECD (2013) in its policy brief on the future of employment. Automation has resulted in the automation of a large portion of everyday jobs, regardless of skill level (OECD, 2013). According to the OECD (2016), “the rapid progress in AI raises the prospect that a much broader range of tasks than previously thought could be carried out by machines”.

Manyika et al. (2017) in a McKinsey Global Institute report “found that about 30% of tasks in 60% of occupations could be computerized”. In 2016, the Bank of England’s chief economist also said that 80m US and 15m UK jobs might be taken over by robots (Haldane, 2015). In 2013, a study on *The Future of Employment* by the Oxford University academics surveyed 702 common occupations and established that telemarketers, tax preparers, and sports referees were at a greater risk of losing their jobs to automation (Frey and Osborne, 2017). Other jobs like recreational psychologists, dentists, and physicians can be at risk. Acemoglu and Restrepo (2016) observed that there is minimal increase in employment in other occupations, with a large number of people out of work and with no clear pathway forward, especially those regarded as blue-collar men without college degrees. This led to the conclusion that robots are winning the race for jobs in America (Acemoglu and Restrepo, 2017). However, Acemoglu and Restrepo (2016), showed that increased automation would likely create new, better jobs, so employment and wages would eventually return to their previous levels.

The future of communication systems and networks, which may spread over technologies like artificial intelligence to distribute and automate network administration, will be at the epicentre of the fourth industrial revolution. Because most governments are now striving to understand the changes and come up with effective actions that limit the hazards while maximising the opportunities, this includes data analytics and collective knowledge. In the case of South Africa, it will necessitate “an inclusive approach to guide the response with a thorough knowledge of the tripartite issue of high-level poverty, inequality gap, and high unemployment rate” that are at the root of the country's problems. The vision, according to the NDP (2020), should serve as the foundation for South Africa's 4IR strategy, which includes national development plans, policies, and strategies that attempt to build and advance the goals of inclusive and shared growth.

Education System Upgrade amid COVID-19 and the Government factor:

Although the South African government has come up with several policies and strategies, these are considered inadequate in their approach to reach the school learners before being admitted into the university. Many first-year university students especially those from rural schools have never seen or used

a computer, and this is particularly common in previously black disadvantaged South African universities have never seen or use a computer (Oyedemi and Mogano, 2018; Du Plessis and Mestry, 2019; Ajani and Gamede 2020). The question is how prepared are South African graduates in positioning themselves for opportunities in the 4IR? In anticipation that the 4IR will influence government, business and society, the government has the responsibility to provide digitally-enabled services to the citizens in contemporary society. The 4IR is a model user of information and communication technologies (ICTs).

The South African president acknowledged that the prosperity of the “nation depends on its ability to leverage the advantage of rapid technological change, and this involves an urgent need to develop capabilities in science, technology, and innovation” (Government Gazette, 2018). In the 2018 State of the Nations address, President Cyril Ramaphosa stated that:

“We will soon establish a Digital Industrial Revolution Commission, which will include the private sector and civil society to ensure that our country is in a position to seize the opportunities and manage the challenges of rapid advances in information and communication technology”.

This is thought to accelerate the digital industrial revolution, which will be aided by the availability of capable networks. The government is projected to become a key provider of digital content, which is a prerequisite for the digital economy, in addition to digitising content. In this regard, a national data policy must be developed and implemented as soon as possible. As a result of the 4IR's advances, governments are likely to face increased pressure to adapt their current approach to public involvement and policymaking. Policymakers, politicians, and other government officials should be able to continuously adjust to the new realities and reinvent themselves by understanding what is being regulated (Schwab, 2016). Schwab (2016, p.1) also noted that:

“We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another; in its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before”.

Governments and regulatory bodies will be expected to work closely with businesses and civil society. This is required since they would be unable to address the expansion of the digital economy in isolation, necessitating the participation of many sectors. It must, however, establish the capacity and political will to forcefully carry the process forward. New technology and platforms are projected to gradually enable citizens to engage with governments while also allowing them to express their opinions. The citizen within different communities and groups will be able to “coordinate their efforts, and even bypass the supervision of the public authorities, and minimize corruption” (Enaifoghe and Adetiba, 2020). Enaifoghe and Adetiba (2020) also recognized that smart cities are other platforms that need to be expedited with the diffusion of technologies at the municipal level.

South Africa through its advanced education system can train digital citizens, a skilled and empowered workforce, and provide youths with a competitive advantage in a new employment market. Gleason, (2018, p.3), noted that “it is exciting to live in a time of real change and transformation, and it is also scary”. Due to massive change and transformation, the higher education system is more accessible to more people more than ever in human history (Gleason, 2018). Perhaps, the very purpose and the question of what, the how, and even the why of higher education are all under interrogation. The argument regarding the 4IR readiness of South Africans readiness of its citizens and future job opportunities in the face of COVID-19. For example, the previously black disadvantaged universities in South Africa have not been able to incorporate online learning in their curriculum development.

Conversely, the COVID-19 has demonstrated that the e-Learning system has not been duly prioritized making it difficult for students to adapt to the online learning system. Again, most schools regarded as feeder high schools are not sufficiently developed, and the apparent lack of information communication technology (ICT) facilities which are a very important part of the new industrial revolution, particularly with the e-Learning system. The lack of adequate investment in e-Learning platforms in the previously black disadvantaged universities makes it difficult for learners to grasp the intricacy associated with e-Learning. For example, students in black disadvantaged universities in South Africa struggle to adapt from being away from the lecture rooms because these universities are mainly contact-based universities, where students attend classes and meet their lecturers on a one-on-one basis. The COVID-19 pandemic and the

shift towards online studies have exposed the gross inequality in South African institutions.

The uncertainties associated with the COVID-19 pandemic have forced these universities to upgrade to e-Learning systems. However, inadequate preparation and training for both staff and students explain why both the staff and students are struggling to adjust to the new reality. As many previously black disadvantaged universities are adapting to e-Learning as a contingency plan to salvage their disrupted academic calendars, it has been difficult to ensure functional systems are in place to ensure learning takes place amid the current pandemic.

CONCLUSIONS:

The impacts and role of the Fourth Industrial Revolution (4IR) in education systems operations are currently undergoing drastic transformations as a result of the disruptive effects of information and technological innovations. However, there is insufficient knowledge in terms of the acceptability and impact of the 4IR in South Africa's education sector. The paper discussed the readiness of the South African education sector for the 4IR. Analysis of literature revealed that 4IR is key to facilitating learners' experience through learning and transforming the future workplace. Nevertheless, the need to assess the learning environment is important. This is simply to understand the facilitators and the possible barriers to the 4IR debate.

This study indicated that South Africa's education sector can harness the innovation opportunity that is associated with 4IR through research and teaching to enhance learners' experience in the learning environment. This may require key improvement in education curricula, as well as preparing the citizens for future opportunities. This paper shows that the 4IR epitomizes the massive tectonic shift in contemporary society, as it is generating new possibilities for enlightening and advancing people's daily lives.

Disruptive technologies such as machine learning, artificial intelligence, and big data are shifting and transforming the way we live in our modern society. It also impacted how people work and carry out business, and how society is being governed altogether. The impact of the 4IR depends on people and their values. It is therefore recommended that we shape a future that works for everyone by primarily putting them first and by empowering them with the future required knowledge and skills.

REFERENCES :

- Acemoglu, D. and Restrepo, P. (2016). The race between machines and humans: Implications for growth, factor shares and jobs, *VOX, CEPR's Policy Portal*. Retrieved from <https://www.nber.org/papers/w22252>.
- Acemoglu, D. and Restrepo, P. (2017). Robots and jobs: Evidence from the US, *National Bureau of Economic Research. Working Paper No, 23285*. Retrieved from https://irs.princeton.edu/sites/irs/files/event/uploads/robots_and_jobs_march_3.17.2017_final.pdf
- Ajani, O.A. and Gamede, B.T. (2020). Challenges of high school learners' transition into universities: a case of a South African rural university, *Gender & Behaviour*, Vol. 18 No. 2, pp. 15803-15812.
- Albert, S. and Mercedes, G.S. (2010). The role of information and communication technologies in improving teaching and learning processes in primary and secondary schools, *ALT-J*, Vol. 18 No.3), pp. 207-220.
- Brown-Martin, G. (2017). Education and the fourth industrial revolution, available at: <https://www.groupemediatfo.org/wp-content/uploads/2017/12/FINAL-Educationand-the-Fourth-Industrial-Revolution-1-1-1.pdf>.
- BusinessTech (2019). Here's how many South Africans are graduating with computer science degrees Business Tech, available at: <https://businesstech.co.za/news/it-services/340491/heres-how-many-south-africans-are-graduating-with-computer-science-degrees/>.
- Chao Jr, R. (2017). Educating for the fourth industrial revolution". *University World News*, Vol. 10, available at: <https://www.universityworldnews.com/post.php?story=20171107123728676>.
- Cloete, A.L. (2017). Technology and education: Challenges and opportunities, *HTS Teologiese Studies/Theological Studies*, 1 – 7, available at: <http://www.scielo.org.za/pdf/hts/v73n4/36.pdf>.
- Creamer Media (2019). Collaboration key to driving SA's 4IR progress, available at: https://www.engineeringnews.co.za/article/collaboration-key-to-driving-sas-4ir-progress-2019-06-05/rep_id:4136.

- Department of Higher Education and Training (DHET) (2019). Post-School Education And Training Monitor Macro-Indicator Trends, available at: https://www.dhet.gov.za/SiteAssets/Post-School%20Education%20and%20Training%20Monitor%20Report_March%202019.pdf
- Department of Higher Education and Training (DHET) (2018). Statistics on post-school education and training in South Africa. Retrieved from *Department of Higher Education and Training*. March 2018
- Du Plessis, P. and Mestry, R. (2019). Teachers for rural schools—a challenge for South Africa, *South African Journal of Education*, Vol. 39 Supplement 1, available at: <https://www.ajol.info/index.php/saje/article/view/190868/180043>.
- Economist Intelligence Unit (2020). Economic and geopolitical insight guiding the world's organisations.
- Enaifoghe, A.O. (2018). Implication of African Knowledge and Learning System for Internationalization. *African Renaissance* (AR). Vol. 15, (No. 4), December 2018. pp 227 – 251
- Enaifoghe, A.O. (2019). The Decolonization of African Education and History. *African Renaissance* (AR), Special Issue March 2019. pp 93 – 116
- Enaifoghe, Andrew. (2020). Migration, the socio-economic and political development: the South African experience. 17. 103-127. *10.31920/2516-5305/2020/17n2a5*.
- Frey, C.B. and Osborne, M.A. (2017). The future of employment: How susceptible are jobs to computerisation?, *Technological Forecasting and social change*, Vol. 114, pp. 254-280.
- Fry, B. and O'Neill, K. (2002). Redesigning Leadership Preparation for Student Achievement, In *Conference Report*, Vol. 4, 2007.
- Gastrow, M. (2020). Policy options for the Fourth Industrial Revolution in South Africa, available at: <http://ecommons.hsrc.ac.za/handle/20.500.11910/15119>.
- GetSmarter (2019). The 4th Industrial Revolution: Will South Africa Be Ready for the Jobs of the Future?, available at: <https://www.getsmarter.com/blog/career-advice/the-4th-industrial-revolution-will-south-africa-be-ready-for-the-jobs-of-the-future/>.
- Gleason, N.W. (2018). *Higher Education in the Era of the Fourth Industrial Revolution*, London: Palgrave Macmillan.
- Gordon, R. J. (2016). The end of economic growth: The extraordinary technological innovations of the past century are unlikely to be repeated. *Prospect Magazine*, available at: <https://www.prospectmagazine.co.uk/magazine/growing-pains-united-states-end-of-economic-growth-productivity>.
- Graham, B. M. (2017). *Education and the Fourth Industrial Revolution*. Prepared for Groupe Média TFO
- Grant, M. (2016). Learning in the Digital Age, Conference Board of Canada. 2016 <http://www.conferenceboard.ca/reports/briefings/learning-digital-age.aspx>.
- Haldane, A. (2015). Labour's Share - speech by the Chief Economist, Bank of England, November 2015 <http://www.bankofengland.co.uk/publications/Pages/speeches/2015/864.aspx>
- Heather, C. (2018). Education in the Fourth Industrial Revolution. *Relocate Global*. 13 August (2018). <https://dam-prod.media.mit.edu/x/files/papers/edutainment.pdf>
- Jones, K. (2020). *How Technology is Shaping the Future of Education*, available at: <https://www.visualcapitalist.com/how-technology-is-shaping-the-future-of-education/>
- Kitur, C.L. and Rotich, S.K. (2014). The impact of technology on human labour productivity in organisations in Kenya, *Global Journal of Interdisciplinary Social Sciences*, Vol. 3 No. 3, pp. 145 - 150.
- Maharajh, R. (2018). Africa and the Fourth Industrial Revolution: The Need for “Creative Destruction” Beyond Technological Change, available at: <https://za.boell.org/en/2018/12/04/africa-and-fourth-industrial-revolution-need-creative-destruction-beyond-technological>
- Mail & Guardian (2019). What does fourth industrial revolution even mean?, *Mail & Guardian*, available at: <https://mg.co.za/article/2019-09-05-what-does-fourth-industrial-revolution-even-mean/>.
- Manyika, J., Chui, M., Miremadi, M., Bughin, J., George, Katy, Willmott, P., and Martin Dewhurst (2017). Harnessing automation for a future that works, *McKinsey Global Institute*, available at: <https://www.mckinsey.com/featured-insights/digital-disruption/harnessing-automation-for-a-future-that-works>.
- Mapulane, P. (2019). *Fourth Industrial Revolution (4IR) Colloquium*, Higher Education, Science and Technology, Parliamentary Monitoring Group, available at: <https://pmg.org.za/committee-meeting/28912/>.
- Mathomo, M. Moila. (2006). *The use of educational technology in Mathematics teaching and learning: An investigation of a South African Rural secondary school*, Ph. D. Thesis, University of Pretoria.

- McCrinkle, M. and Renton, S. (2018). The Future of Education The Future of Education, available at: <https://www.researchgate.net/publication/335159813>.
- Mezied, A. A. (2016). What role will education play in the Fourth Industrial Revolution?, *World Economic Forum*, available at: <https://www.weforum.org/agenda/2016/01/what-role-will-education-play-in-the-fourth-industrial-revolution/>.
- Mngxati, V. and de Haas, J. (2018). Unlocking digital value for business and society in South Africa, *Accenture*, available at: https://www.accenture.com/_acnmedia/PDF-93/Accenture-Unlocking-Digital-Value-Updated.pdf.
- National Development Plan (NDP) (2020). *Chapter Nine: Improving education, training and innovation*. Pretoria
- Nomalungelo, G. (2018). Three-Stream Model; Fourth Industrial Revolution: Department progress report. *Basic Education*. 08 May 2018
- OECD (2013b). *Education at a glance*. Paris: Organisation for Economic Cooperation and Development.
- OECD (2014). *Measuring Innovation in Education: A New Perspective*, OECD Publishing, Paris, available at <http://dx.doi.org/10.1787/9789264215696-en>
- OECD (2015). Policy Brief on the Future of Work, May 2016 <https://www.oecd.org/els/emp/Policy%20brief%20Automation%20and%20Independent%20Work%20in%20a%20Digital%20Economy.p>
- OECD (2016c). Education at a Glance 2016, OECD, September 2016 <http://www.oecd.org/education/education-at-a-glance-19991487.htm>
- Oyedemi, T. and Mogano, S. (2018). The digitally disadvantaged: Access to digital communication technologies among first-year students at a rural South African University, *Africa Education Review*, Vol. 15 No.1, pp. 175-191.
- Ramaphosa, C. (2020). A national strategy for harnessing the Fourth Industrial Revolution: The case of South Africa. *The Brookings Institution*, available at: <https://www.brookings.edu/blog/africa-in-focus/2020/01/10/a-national-strategy-for-harnessing-the-fourth-industrial-revolution-the-case-of-south-africa/>.
- Resnick, M. (2013). Edutainment? No Thanks. I Prefer Playful Learning, *MIT Media Laboratory*, available at: <https://llk.media.mit.edu/papers/archive/edutainment.pdf>.
- Robins, M. (2016). *Technological Innovation in Education*, Conference Board of Canada, May 2016
- Rosenstock, L. (n. d). High Tech High, Teachers as Designers <https://vimeo.com/105605942>
- Samans, R. and Zahidi, S. (2017). The Future of Jobs and Skills in Africa Preparing the Region for the Fourth Industrial Revolution, *World Economic Forum*, available at: http://www3.weforum.org/docs/WEF_EGW_FOJ_Africa.pdf.
- Schwab, K. (2016). The Fourth Industrial Revolution: what it means, how to respond, *World Economic Forum*. available at: <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>.
- UNESCO (2003). Towards Knowledge Societies, *Communiqué of the ministerial roundtable*, available at: http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/wsis_geneva_prepa_ministerial_round_table_communique.pdf.
- World Bank (2017). South Africa Economic Update: Innovation for Productivity and Inclusiveness, available at: <http://documents1.worldbank.org/curated/en/779551505322376708/pdf/119695-WP-PUBLIC-SA-EU-2017-Digital-Version-Sep-19.pdf>.
- World Economic Forum (WEF) (2018). Harnessing the Fourth Industrial Revolution for Sustainable Emerging Cities, *Fourth Industrial Revolution for the Earth Series*, available at: http://www3.weforum.org/docs/WEF_Harnessing_the_4IR_for_Sustainable_Emerging_Cities.pdf.
- Xing, B. and Marwala, T. (2017). Implications of the fourth industrial age for higher education, *The Thinker Issue 73 Third Quarter 2017*, available at: <https://arxiv.org/ftp/arxiv/papers/1703/1703.09643.pdf>.
- Ahmadi, H. and Marwala, T. (2017). Implications of the Fourth Industrial Age on Higher Education. *Tap chí Nghiên cứu dân tộc*. <http://dx.doi.org/10.25073/0866-773X/87>

