Accelerating the Fourth Industrial Revolution in Higher Education: Realities and Lessons from Universities in Kenya, Zambia and South Africa During the Covid-19 Pandemic

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Abstract

Countries across the world advocate for the usage and benefits of the Fourth Industrial Revolution (4IR). 4IR sets the pace for artificial intelligence, increased utilisation of the internet, and digital technologies in service delivery. Society expects universities to be able to understand the key tenets of 4IR and provide guidance in its utilisation. This article adopts a qualitative research method and uses content analysis to comprehend whether the teaching mode is a significant factor to assess and define the status, including the level of readiness of 4IR in higher education institutions. The article reviewed documents to establish the status, adaptation, and gaps in the university's learning management. Thus, the review includes government decrees/statements on COVID-19 related to university learning; Universities' press releases, social media, articles and/or reports, and benchmarks against 4IR expectations. The primary findings revealed the need for a proper key stakeholder coordination (*i.e.*, government, private sector, universities, and students) to implement a successful online teaching and learning in institutions of higher learning.

Keywords: 4th Industrial Revolution, Universities, COVID-19 Pandemic, Online learning

Introduction

The COVID-19 global Pandemic has introduced multiple sudden changes in many industries. These changes relate to how various organisations function globally. Soon after the global emergency declaration, several countries imposed restrictions on movement to inhibit the spread of the infection. In March 2020, South Africa was the most affected country on the sub-Saharan region, with an exponential daily infection rate and total infection of over 1.2 million cases. This implied that the government had to impose strict lockdown measures to contain the spread of the disease. Furthermore, this shift implied that organisations, specifically institutions of higher education, had to adopt protocols to align with government regulations to mitigate the Pandemic.

This article focuses on the nexus between the application of the fourth industrial revolution tools and the effect of COVID-19 in the higher education arena. Firstly, it explores and describes the concept fourth industrial revolution, followed by reflecting on the operation of higher education institutions because of the COVID-19 Pandemic. Thirdly, the research examines higher education institutions' readiness to utilise technologies associated with the fourth industrial revolution. Subsequently, the article highlights the consequences of COVID-19 on universities. Furthermore, the institutions response is based on the outcome of government decisions in selected countries', namely: Kenya, South Africa, and Zambia. This is followed by

the identified challenges associated with the implementation of online teaching and remote learning at universities. Lastly, the article presents critical lessons towards a successful implementation of online teaching and learning at universities.

Background

The Fourth Industrial Revolution is dependent upon a massive Information and Communications Technology (ICT) infrastructure development. The development of such infrastructure is important as the quality of livelihoods of the citizens relies on it (Ayentimi & Burgess, 2019:642). Kenya, South Africa and Zambia have been chosen as case studies under investigation to provide an assessment of how the Sub-Saharan countries have been impacted by the sudden disruptions caused by the emergence of the COVID-19 global Pandemic. Furthermore, all these three countries had implemented lockdown measures between March and June 2020, which had adverse implications on the teaching and learning in universities and other educational entities, as contact sessions were immediately put to a halt. Thus, the choice of these countries is based on the ideals that indicate the commitment of these countries to initiate mechanisms that aims at improving the availability of ICT infrastructure and broader and inclusive internet access in their countries (Janse van Rensburg, 2012:95).

Research methods

This study adopted descriptive qualitative research methodology to respond to the research questions. Qualitative research methods are useful in the social sciences as they provide data that is richer in meaning and detail, than a quantitative method in which data is essentially numerical (Babbie, 2008:25). According to Kumar (2014:14), a qualitative research methodology is embedded on the philosophy of empiricism where there is an emphasis of the description and narration of experiences. Thus, rather than amplifying measurements, the qualitative method aims to explore diversity and communicate findings in a descriptive and narrative format (Kumar, 2014:14). A qualitative method is normally used to understand complex situations, where there is a need to answer questions and understand the complicated nature of a phenomena under investigation (Fouche & Delport, 2011:64). The aim of the research is to explore the relationship between higher education institutions in selected countries and the acceleration of the application of the 4th industrial revolution as triggered by the COVID-19 global Pandemic. Thus, through the usage of content analysis, documents were assessed to gather insight of the plan and institutions response to the global Pandemic. Furthermore, the following documents were reviewed: accredited academic journal articles, newspaper articles, documents issued by the various institutions of higher learning, and various official government statements. The analysis was conducted to draw a conclusion on the implications of the sudden closure of universities and how that had an effect on the application of the 4IR tools and lessons which could be learnt for the future implementation of multimodal and e-learning practices at tertiary institutions in Kenya, Zambia and South Africa.

Conceptual understanding of the fourth industrial revolution

According to Yang and Cheng (2018:39), the fourth industrial revolution (4IR) concept

generates excitement and advances ambiguity in undertaking certain procedures. Thus, the concept is probably understood to refer to various phenomenon by different people. Klaus Schwab[1], argues that the terminology's current epoch characterises a unique digital revolution founded on the successes of the previous (third) industrial revolution, which has been occurring for approximately 50 years (Yang & Cheng, 2018:39). Klaus Schwab describes the fourth industrial revolution as a turnaround period where individuals interface with the digital domains and offline reality, which is supported by the connected technology to manage and enhance their living conditions (Xu, David & Kim, 2018:90). According to Nhede (2018:204), the fourth industrial revolution is an epoch characterised by an abrupt adaptation of artificial intelligence usage and the *robotisation* of the economies and everyday life among a plethora of technological advancements. Thus, the concept of the fourth industrial revolution can be applied in different contexts. This article's vantage point relates to the conceptualisation of the fourth industrial revolution within an abrupt and radical transformation in Africa's higher education landscape. This implies changes associated with high-end technological advancements to manage the daily operations initiated by higher learning institutions amid the COVID-19 global Pandemic.

Reflection of the effects of COVID-19 global Pandemic

The transformation that COVID-19 brings about, in the end, suggests significant changes in several industries, particularly in the higher education landscape. Universities exist in environments which embrace changes to allow for the cultivation of knowledge and cutting-edge research. Thus, this introduces a new world order of how to manage situations and processes. For example, before the COVID-19 global Pandemic, contact universities usage of technology to achieve better outcomes in their teaching and learning, research and development, and community engagement was minimal. Following the harsh lockdown measures, institutions adopted "*work from home*" policies to limit the spread of new infections.

Similarly, the students were expected to continue with their tuition/lessons from home through the technology provided by the universities. The universities were successful in salvaging the academic year through the utilisation of technology, which was vailed to the students. Hence, the universities were able to complete the modules as initially planned. For example, of the 26 universities in South Africa, 10 were able to complete the academic year by December 2020 (Macupe, 2020), whereas 16 could finalise the examinations for the 2020 academic year by March 2021 (Universities South Africa 2021).

Assess the readiness of 4IR in Higher Education Institutions

Africa faces a myriad of challenges resulting from a legacy which emanated from colonisation and oppression in most of its countries (Madumo, 2016:82). Thus, the governments' structure and attitude in the provision of services to communities in most countries still resembles the former oppressors' archaic establishment. For example, Kenya, South Africa, and Zambia are Anglophone countries. Although slightly tweaked, the governance structures resemble a Westminster governance system, which is associated with the former British empire (their colonial masters).

Among the various challenges, Kenya, South Africa, and Zambia are faced with the limitation of the widening digital divide (Janse van Rensburg, 2012:100). This gap is attributed to illiteracy rates and the reluctance to utilise technological advancements by the respective countries senior citizens. Xing and Marwala (2017:10) argue that higher education institutions' position is complex, dialectical, and provides exciting opportunities to potentially transform society for the better.

Universities are at the center of societal development through teaching, research, and community engagement programs. Thus, propelling the 4IR agenda in its academic enterprise operations, universities affect their communities. Assessment of higher education and its implementation of the 4IR is rather a complex process. Firstly, there is no standard measure of what constitutes 4IR in the university context. Secondly, universities have different agendas, and focus on research intensity while others concentrate on teaching and community engagement. However, similar factors are at play in determining the productive usage of the 4IR essentials. The sections below will reflect on the pre-COVID-19 arrangements and further describe the critical stages to assess 4IR readiness among higher education institutions in South Africa, Kenya, and Zambia.

Key stages for general assessment and readiness for the 4IR

The fourth industrial revolution is embedded in the previous industrial revolutions' successes, particularly the third, which brought an increased utilisation of electronics, telecommunications, and computers (Oke & Fernandes, 2020:2). This implies that the future of the 4IR can be influenced by certain components which serve as the necessity for the previous revolutions, for example, electricity and access to computers and the internet. Like other developing countries in South America and Asia, African countries are perceived as those with the broadest digital divide. Africa lacks the availability of adequate and affordable technological infrastructure for inhabitants such as in the developed European and North American countries. Antonio and Tuffley (2014:674) define the digital divide as a gap between those who access vital information and communications technology (ICT) resources and those who do not have access to the internet, limited infrastructure, and electronic devices.

Certain universities in Africa have been at the helm to promote the utilisation of technology, although it has proven to be a serious challenge. For example, when the Kenyan government imposed a lockdown in response to the COVID-19 as a containment measure, universities utilised e-learning to continue with the academic calendar year. According to Wachira and Ombati (2020), selected universities in Kenya negotiated with internet service providers to ensure affordable access to the service, specifically for e-learning. Furthermore, there was a large-scale production of user manuals in certain universities to capacitate lecturers and students in the quest to ensure a seamless transition from traditional face-to-face teaching to an online platform (Wachira & Ombati, 2020).

Meanwhile, in South Africa, most of the universities have physical infrastructure, such as learning management systems. What proved to be a challenge was user access, particularly by the students from disadvantaged backgrounds. However, the sudden changes necessitated by the need to restrain the disease meant that universities had to

be responsive to address certain underlying issues, such as the provision of resources to the students to participate in teaching and learning (Asma, 2020). According to Kupe (2020), COVID-19 Pandemic has highlighted the need for universities to evolve. This implies that universities need to take advantage of the technology available to advance collaboration with international partners and stakeholders in the quest to promote transdisciplinary and trans-institutional research.

In Zambia, the government encouraged universities to implement a policy that would promote online learning as an integral part of students' learning process (Tonga, 2020). Furthermore, the disruption because of COVID-19 ensured that universities hold virtual graduations and a refund policy to reimburse the students who had already paid tuition fees for the courses which required them to present themselves at the university.

Consequences of COVID-19 on Universities

Due to complications posed by COVID-19, institutions of higher learning face additional significant short-, medium- and long term consequences (Altbach & De Wit, 2020:28; Marinoni, vant Land & Jensen, 2020:6; Ouma & Kupe, 2020:1; UNDP, 2020:17) which result in disruptions to learning. The effect of COVID-19 escalates with the country's national or partial lockdowns and other health-related measures which restricts human interaction. Globally, governments and institutions failed to generalize the effect of COVID-19. Altbach and De Wit (2020:28) argue that 20,000 universities and 200 million students faced varying challenges as universities differ per type (public or private), resources, underlying vision, and served population, all of which determines the magnitude of the impact of learning. The critical factor which will determine the survival of universities during and post-COVID-19 remains the resources which support enhanced e-learning, student admission, and research.

The recovery of global national economies - post-COVID-19, may take a long time and is estimated to be deeper than those estimated by the Great Recession (Altbach & De Wit, 2020:28). The recovery of institutions of learning depends on various factors such as broader policies and realities which emerge from the crisis (World Bank, 2020a:19). Universities across the board face varied deep routed challenges orchestrated by history, economic, social, and cultural factors which affects the quantitative and qualitative aspects of learning. Altbach and De Wit (2020:29-30); Ouma and Kupe (2020:3-5); World Bank (2020a:22): project the impact of COVID-19 for universities is as follows:

The fittest will survive: Globally and nationally established top quality higher institutions of learning with financial resources will either be strengthened, survive, or recover quickly post-pandemic by maintaining academic programs, attracting new students, and overcoming admissions (Altbach & De Wit, 2020:4). Universities which depend solely on tuition fees, particularly from the private sector will be affected severely. With regard to students, the loss of jobs and the impact of the economy will determine the ability to join and/or continue with higher learning (Ouma & Kupe, 2020:5).

Limited research funds and areas: Events determine sources, volume, and research priorities. Focus during post COVID-19 may comprise of managing and solving crises,

and focus more on life sciences. Research funds in the aftermath of the COVID-19 crisis may be channelled to solve the crisis by inventing human life remedies to address the pandemic and its related challenges (Altbach & De Wit, 2020:29).

Deep financial crisis: Universities face immediate financial problems during the COVID-19 crisis, and the effects thereof is expected to continue afterward due to the probable decline in support by both private and public sources including a plummeting economy (Marinoni *et al.* 2020:38; Ouma & Kupe, 2020:5). Challenges exist and will continue in the short and medium-term related to admissions, student retention, and a decrease in scholarships because of the massive expenditure which was aimed to stabilize economies during the crisis. Shifts in subsidy levels and other government funding hurt the vulnerable poor and working-class families, as well as affect third-stream income (Ouma & Kupe, 2020:3).

Increased inequality: The COVID-19 crisis is likely to deepen the already existing inequities and inequalities within society (Marinoni *et al.* 2020:38) across and within institutions of higher learning (Ouma & Kupe, 2020:1; World Bank, 2020a:23). Diminishing government resources and affected economies pose a deepened threat of inequality which stem from the failure to retain students, pay for tuition, and affected learning programs. The universities capacity to provide learning material, and electronic devices limits access to resources and learning.

Implementation of online learning: Challenges

Universities responded to COVID-19 restrictions by closing all campuses and contact learning. Marinoni *et al.* (2020:6 & 11) presented a report on the closure of schools and universities in 185 countries. A total of 109 countries indicated total closure of all campus activities. Tamrat and Teffera (2020:28) estimate that approximately 9.8 million African students learning was disrupted by this desperate measure. A survey conducted to establish the universities preparedness in response to the COVID-19 disruptions revealed the following findings[2]:

- 21 of 78 universities expect to continue teaching during the lockdowns;
- 41 universities expect to teach partially, while 16 universities are not expected to deliver any training;
- The majority of academic staff expects to teach and supervise research activities partially during lockdowns;
- Reported top challenges include limited preparedness for online courses; digital divide which affects students who reside in unconnected areas; broad infrastructure challenges; lack of e-learning platforms; managing a large number of students online.

The abovementioned findings do not state how readiness is clustered amongst undergraduate and graduate learning, where the latter requires less face-to-face interaction than the former. The findings illustrated readiness and technicalities to respond to the crisis. The above study findings revealed that approximately

[2] https://aau.org/wp-content/uploads/2020/04/AAU-eLearnAfrica-Wiley-Partnership-.pdf downloaded on 8th January 2020 1828hrs

25% of the universities in Africa expected to continue learning activities, which is significantly lower than expected from an adaptation of information technology that paves the way for the 4IR. Successful university online learning programs depend on internal and external operating environments - the pull and push factors for higher learning institutions' consideration, embarking, as well as operating online learning. Universities operate in an interconnected and mutually dependent triangle.

Globally, universities opted to shift to online teaching for continuity, avoid repeating an academic year and fail to admit new students or cause a backlog in annual student admissions. Governments, regional and international bodies championed online learning in support of universities. For example, on 9 April 2020, the Association of African Universities (AAU) issued a statement in response to COVID-19. The statement revealed that a partnership with eLearnAfrica and WILEY Education Services in support of continuous learning in African universities by migrating teaching to online platforms.

Response by Universities: Kenya, South Africa and Zambia

In Kenya, the number of COVID-19 infected cases rose to over 400, with approximately 20 fatalities by the end of April 2020. Consequently, the country decided to close all schools and institutions of higher learning (UNDP 2020). Mitigating strategies for Kenya included using platforms such as radio and television, learning through live stream and on-demand content via EduTV Kenya YouTube channel, government avail electronic copies of textbooks free on the Kenya Education Cloud for all students (World Bank 2020b). Furthermore, the government with partners deployed Google's Loon Balloons with 4G base stations. A single balloon provided internet connectivity in an 80km diameter area. Atieno Ndede-Amadi collated Kenya Universities' response to online learning after a directive of its closure by 20 April 2020. His writing describes students' limited reach due to limited university capacity to manage online learning, limited access to electronic devices, and high-speed internet connectivity. UNDP (2020:17) raised an inequality concern amongst students in Kenya, which affects most of the disadvantaged. UNDP (2015), cited in UNDP (2020:17) reported that the effect of the Ebola 2014-2016 epidemic's failure to retain students, persistent socio-economic and gender disparities. The same effects are predicted post-COVID-19 in Kenya.

According to Rawford *et al.* (2020:17), the South African universities responded in various ways to the government's declaration of the COVID-19 Pandemic. Suspension of all face-to-face classes and impending graduation ceremonies were some of the measures taken. The immediate measures taken by the government and universities included the following (Ouma & Kupe, 2020; Rawford *et al.* 2020:17; Tamrat & Teferra, 2020:29):

- extended leave breaks;
- travel restrictions on students or staff unless there is a critical reason after consulting the relevant authorities;
- continuing research work;
- self-isolating requirements for members who had returned from recent

international travel;
- symposia and conferences should be restricted and replaced with alternative formats;
- plans to evacuate 12,000 South African students studying abroad and explore the digital and online methods of delivery for teaching and learning.

The South African government announced a national state of disaster due to the increasing number of daily infections and fatalities due to COVID-19. The government's measures included well-defined five levels of lockdown restrictions, to promote social distancing, restricted interactions, thus limiting face-to-face learning. During the first month of lockdown restrictions, universities continued to explore the possibilities of full online teaching and learning. Ouma and Kupe (2020:10) describe the state of online learning in universities as follows *"…some universities have been developing model whereby contact sessions….are supplemented with online learning platforms….., in which additional activities, notes, and other learning resources are provided online"*. This explains the precarious state of online learning, especially during the COVID-19 lockdown. The shift from face-to-face to online learning was not automatic but undertaken within the first month after the universities closed.

The Zambian government responded to increased COVID-19 infections by closing universities and all campus activities. Within one month after the restricted lockdown, universities could not offer online learning in place of face-to-face programs. Exceptions remain for universities offering degrees through online learning. The government announced the premature closure of schools and universities to inhibit the spread of COVID-19 amongst students and teaching staff[3]. The government further restricted people's movement, and limit students' access to campus learning facilities. The government later announced a phased approach to resume learning by re-opening postgraduate face-to-face teaching in June 2020.

Interestingly, certain institutions such as the University of Zambia (UNZA) offer online/distance learning for various undergraduate and postgraduate programs. The program started in 1966 and has progressed to online platforms with a developed and approved Open and Distance Learning (ODL) Policy. The ODL at UNZA introduced postgraduate programs in 2014. UNZA offers approximately 28 under and postgraduate programs to a student population of 8,000. However, the degree programs are separate from those admitted for face-to-face programs. Their learning was affected by the closure of both schools and universities. Notwithstanding, UNZA provides a suitable platform and foundation to offer online learning programs under normal or COVID-19 Pandemic circumstances.

Table 1: Summary of university responses within one month after COVID-19

S/n	Action	Kenya	South Africa	Zambia
1	Closure of universities	Yes	Yes	Yes
2	Suspension of face-to-face studies	Yes	Yes	Yes

3 President Edgar Lungu's speech on COVID-19. (https://www.moh.gov.zm/?p=6395).

3	Combining face-to-face to online learning	No	No	No
4	Student movement	Limited	No	Limited
5	Library services	Limited	Limited	Limited
6	Postgraduate research work	Limited	Limited	Limited

Source: Authors summarised from: UNDP (2020); Ouma & Kupe (2020); World Bank (2020b); UNDP (2020); University of Zambia (2020).

For this article, an exploration into the events which transpired one month after the announcement of the lockdown restrictions in three countries is explored and summarised in Table 1 above. The government directives on institutions of higher learning affected all the universities. All activities on campus ceased from immediate effect including face-to-face learning. Within one month after the announcement of the COVID-19 lockdown measures, the universities could not start online learning programs *in lieu of* face-to-face programs because of limited human and institutional capacity (financial resources, staff and students, limited access to electronic devices, and limited access to the internet). The University of Zambia and the University of South Africa offer online and distance learning programs. However, these are selected institutional exceptions which cover a small percentage of the university student population in respective countries. Moreover, online and distance learning infrastructure remains on university campuses, that is, technical, content support and access to study material may have been compromised due to closure of campuses. Due to foreseen student admission and completion of academic year challenges, governments in Zambia and Kenya introduced a phased approach to ease the universities' learning restrictions and university closures which permit tightly controlled and well-managed face-to-face learning.

Tenets for successful university online training: key lessons

Figure 1 below illustrates actors and interrelated factors, which shape an ideal status of online university programs. Online learning is supported by an enabling environment and capacity sitting in universities, such as commitment to implementing reasonable policies and setting an environment that promotes, facilitates, and manages online learning effectively. The governments set a conducive regulatory framework which supports investment, infrastructure development and facilitates the private sector in the provision of services related to online learning. Ouma and Kupe (2020:1) argue that digital transformation, commonly referred to as the Fourth Industrial Revolution (4IR), carries profound advancement in science and technology and significant implications for higher education institutions and learning.

Figure 1: Tenets for successful university online learning

Source: Own illustration (2021)

Across the board, countries, and institutions higher learning need a digital-savvy workforce, and students who break cultural and social barriers to adapt to a

universities' online learning requirements. In 40 of 84 countries with access to the internet for which data is available, less than 50% of the population possess the required computer skills, for example, copying a file or sending an email with an attachment (ITU, 2019:10). The more complex activities referred to as standard skills, *e.g.,* using basic arithmetic formulae or installing new software, the extents stand at 50% (ITU 2019:10).

Various factors impinge on online learning in Africa. Access to the internet is a critical factor in determining successful online learning in institutions of higher learning. Mohamedbhai (2020:30) postulates that the digital divide in Africa is a limiting factor why students have limited or no access to electronic devices and internet data. Approximately 87% of the population in developed countries can present themselves virtually, while in the least developed countries (LDCs), approximately 19% have access to the internet. Thus, Europe has the highest internet usage rate and Africa the lowest (ITU, 2019:2). The World Bank released data relating to access to the internet in Sub-Saharan Africa (SSA)[4]. The 2018 data revealed the country with the highest internet connection per population as Gabon (62%), while Eritrea was the lowest (1%). Such disparities exist across the 46 SSA countries, thus leading to a skewed pattern towards limited connectivity. Only 6 countries have more than 50% access to the internet, while 13 have less than 10% connectivity per population.

COVID-19 lockdown restrictions led to university students having to return home, while many were grounded on university campuses due to disrupted and restricted travel regulations. This further exacerbated the digital divide as many of these students depend on the internet and information and communication infrastructure at university campuses. Xu and Ki (2018:91) propose an opportunity from the 4IR as a connected life through the internet. Disparities to access the internet in both rural and urban areas is prevalent. There are inexpressible inequalities in the availability and capacity to purchase mobile data or access high-speed internet. Internet access depends on a household's purchasing power which contributes towards purchasing electronic devices to connect to the internet. ITU (2019:7-8) reports that in Africa, approximately 17.8% of the households have an internet connection; 10.7% to computers, while 79.5% to mobile phones which may facilitate online learning across all levels of education.

Evidence of 4IR in higher education goes beyond the use of computers for university learning. Universities need a well-established library, learning management systems and other facilities to support online learning. The COVID-19 restrictions introduced a new norm -*working from home*, particularly in public institutions. Mehta and Wang (2020:353) present a misconception that university staff possess computers at home and a high-speed internet connection to facilitate library services from home. They further admit challenges associated with the provision of online library services to be:

a) All high demand course reserves are in print form, therefore, cannot be accessed online;
b) Limited capacity to request, process study materials from multiple platforms;
c) Discontinuation or limited access to print materials;
d) Limited access to electronic devices and internet data to both library staff and students;

e) Overwhelmed library online infrastructural facilities, staff, and faculty members.

Artificial intelligence (AI), as fundamental tenets of the 4IR, is expected to solve complex learning challenges and assumes that half of the jobs will be automated, including library services. Universities have established online access to study materials. However, there is a print form of materials which cannot be accessed electronically. Furthermore, the libraries combine online access to study materials with services which require physical contact. The university, staff, and students on limited electronic devices, internet connectivity, and capacity experience challenges associated with online access to library services.

Conclusion

The abrupt adaptations due to the COVID-19 global Pandemic dictated that universities must always be adaptable to change. As centers of innovation, research and knowledge production, universities are expected by society to become trendsetters and ingenious institutions. This article focused on exploring the nexus between the COVID-19 global Pandemic's effect and how it has coerced several industries to exploit the information and communication technologies to pursue their goals, and thereby inadvertently promote the elements of the 4IR. This was conducted in the context of the higher education landscape. The readiness of universities to implement the 4IR in selected countries was examined, and universities' response as a result of the COVID-19 Pandemic was provided. The article demystified the conceptual understanding of the term fourth industrial revolution.

Academicians and practitioners should conduct in-depth studies of institutions online learning capacity and gauge the same through the 4IR lens. Also, universities need to conduct readiness measures for 4IR and rethink necessary soft skills and capacity for university staff and students. Since online learning during COVID-19 was undertaken abruptly in many instances, universities and quality assurance regulatory institutions can examine the enhancement of qualitative aspects of online learning. Actors need to promote investment in the scale-up of online learning, facilitate its monitoring through the requirements of 4IR, and prioritise the disadvantaged segments of the communities. Moreover, national, regional, and international stakeholders need to discuss, agree and benchmark internationally accepted standards of online learning.

References

Philip, A.G. & De Wit, H. (2020). Post pandemic outlook for higher education is bleakest for the poorest. *International Higher Education*. Special Issue 120:3-4.

Antonio, A. & Tuffley, D. (2014). The gender digital divide in developing countries. *Future Internet*, 6:673-687.

Asma, A.D. (2020). 'No student will be left behind' by e-learning: Universities SA. Timeslive. Available at: https://www.timeslive.co.za/news/south-africa/2020-04-20-no-student-will-be-left-behind-by-e-learning-universities-sa/. Accessed 10 January 2021.

Ayentimi, D.T. & Burgess, J. (2019). Is the fourth industrial revolution relevant to sub-Sahara Africa? *Technology Analysis & Strategic Management*, 31(6): 641-652.
Babbie, E. (2008). *The basics of social research.* 4th edition. California: Thomson Wadsworth.
Fouche, C.B. & Delport, C.S.L. (2011). Introduction to the research process. In De Vos, A.S., Strydom H., Fouche C.B. & Delport C.S.L. *Research at grass roots: for the social sciences and human service professions.* 4th edition. Pretoria: Van Schaik.
International Telecommunication Union (ITU). (2019). Measuring digital development facts and figures. Geneva: Switzerland.
Janse van Rensburg, A.H. (2012). Using internet for democracy: a case study of South Africa, Kenya and Zambia. *Global Media Journal (Africa Edition*), 6(1):93-117.
Kumar, R. (2014). Research Methodology: a step by step guide for beginners. 4th edition. London: SAGE Publications.
Kupe, T. (2020). COVID-19 highlights the need for universities to evolve. University World News. Available at: https://www.universityworldnews.com/post.php?story=20200902142707290. Accessed 11 January 2021.
Macupe, B. (2020). Five universities extend academic year to March 2021. Mail and Guardian. Available at: https://mg.co.za/education/2020-09-30-five-universities-extend-academic-year-to-march-2021/. Accessed 12 January 2021.
Madumo, O.S. (2016). De-politicisation of service delivery in local government: prospects for development in South Africa. *African Journal of Public Affairs*, 9(3):81-94.
Marinoni, Giorgio, vant Land, Hilligje, & Jensen, Trine. (2020). The impact of COVID-19 on higher education around the world. IAU Global Survey Report. International Association of Universities. May 2020 France: Paris.
Mehta, D. & Wang, Q. (2020). COVID-19 and digital library services – a case study of a university library. *Digital Library Perspectives,* 36(4):351-363.
Mohamedbhai, G. 2(020). COVID-19: What Consequences for Higher Learning in Africa? *International Higher Education*. Special Issue (120):30-31.
Nhede, N. (2018). The fourth industrial revolution and novel skills needed for the public sector. In M.S. de Vries, H.G. van Dijk and M. Chitiga-Mabugu (editors). Public Administration: Reflection, Relevance and Readiness. Bratislava: Nispacee Press.
Oke, A. & Fernandes, F.A.P. (2020). Innovations in Teaching and Learning: Exploring the Perceptions of the Education Sector on the 4th Industrial Revolution (4IR). *Innovations in the Teaching and Learning: Technology, Market and Complexity*, 6(31): 1-22.
Rawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., Magni, P. & Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*, 3(1): 1-20.
Tamrat, W. & Teferra, D. (2020). COVID-19 threat to higher education: Africa's challenges, responses, and apprehensions. *International Higher Education*. Special Issue (120):28-29.
Tonga, D. (2020). Universities to start phased re-opening, but is it too soon? University World News. Available at: https://www.universityworldnews.com/post.php?story=20200619142831384. Accessed 10 January 2021.
United Nations Development Programme (UNDP). (2020). Articulating the pathways of the socio-economic impact of the coronavirus (COVID-19) pandemic on the Kenyan economy. *Policy Brief*, 4. April 2020.
University of Zambia. (2020). Information – about us. University of Zambia. Available at: https://www.unza.zm/institutes/ide/aboutus. Accessed 8 January 2021.
Universities South Africa (Usaf). (2021). Notwithstanding major disruptions, COVID-19 has in its own way benefitted science and humanity. Universities South Africa. Available at: https://www.usaf.ac.za/notwithstanding-major-disruptions-covid-19-has-in-its-own-way-benefitted-science-and-humanity/. Accessed on 18 March 2021.

Wachira, K. & Ombati, R. (2020). E-Learning in public universities – the only way forwards. University World News. Available at: https://www.universityworldnews.com/post.php?story=20200511100801516. Accessed 10 January 2021.

Wangenge-Ouma, G. & Kupe, T. (2020). Uncertain times: re-imagining universities for new, sustainable futures. *HE Sustainability-Discussion Document*. August 2020, pp 1-18.

World Bank Group. (2020a). The COVID-19 Pandemic: shocks to education and policy responses. Washington DC: USA.

World Bank. (2020b). How countries are using Edtech (Including online learning, radio, television, texting) to support access to remote learning during the COVID-19 Pandemic. Online brief, accessed 29th December 2020, 1520hrs *(https://www.worldbank.org/en/topic/edutech/brief/how-countries-are-using-edtech-to-support-remote-learning-during-the-COVID-19-pandemic).*

Xing, B. & Marwala, T. (2017). Implications of the fourth industrial age for higher education. The thinker. 73:10-15.

Xu, M., David, J.M. & Kim, S.H. (2018). The fourth industrial revolution: opportunities and challenges. *International Journal of Financial Research,* 9(2): 90-95.

Yang, P. & Cheng, Y. (2018). Educational mobility and transnationalization. In N.W. Gleason (editor). Higher Education in the era of the fourth industrial revolution. Singapore: Palgrave MacMillan.