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# The Catalysed Use of Fourth Industrial Revolution Interventions in South African Higher Education Institutions, due to COVID-19, and its Influence on Efficacy

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*COVID-19 has brought about significant change in a global dispensation. One of these changes is the catalysed use of fourth industrial revolution interventions 4IRI. In South Africa, among the industries that have been influenced by the catalysed use of 4IRI is that of the Higher Education industry. Apart from the fact that South African Higher Education Institutions (HEIs) were restructured during the mid-2000s (e.g. Technikons transforming to Universities of Technology), most curricula and/or teaching practices are still outdated; do not accommodate for the development of 21st-century skills. To this end, this study was conducted to theoretically investigate whether the catalysed use of 4IRI, as brought on by COVID-19, influenced the efficacy of South African HEIs. This study was exploratory in nature and constituted online desktop research. Stemming from the research conducted, it appears that the catalysed use of 4IRI in South African HEIs may not have any influence on its efficacy, at least in a theoretical dispensation.*

***Keywords****: COVID-19, higher education institutions, higher education, South Africa, efficacy*

***JEL Classification****: I23, M10, O10, O14*

## 1. Introduction

Access to education is embedded in the South African Constitution; one of the most crucial constitutional rights of every South African citizen (South Africa, 1996). Under chapter 2, section 29, sub-section 1 of the South African Constitution, the following is stated: "*Everyone has the right – (a) to a basic education, including adult basic education; and (b) to further education, which the state, through reasonable measures, must make progressively available and accessible*" (Justice, 2020).

In layperson's terms every South African citizen has a right to both primary education and secondary education, as mandated by the Department of Basic Education (DBE), as offered by Primary Schools and High

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Schools; a right to tertiary education, as mandated by the Department of Higher Education and Training (DHET), as offered by Higher Education Institutions (HEIs) (DHET, 2018; DBE, 2019). Education in South Africa is standardised by the National Qualifications Framework; as built on Bloom's Taxonomy (Toko, 2014; Swart and Daneti, 2019). Bloom's Taxonomy is depicted in Figure 1 below.

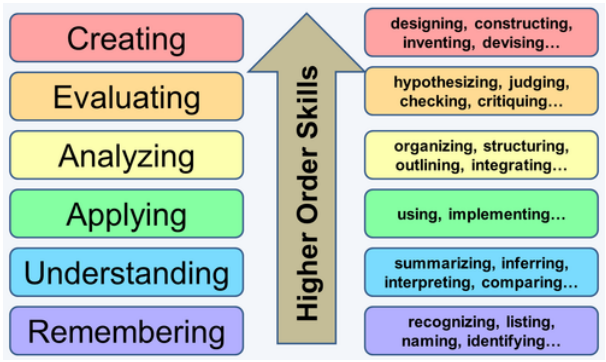


***Figure 1***. *Bloom's Taxonomy*
Source: PCubed, 2018

According to the South African Qualifications Authority (SAQA, 2020) the NQF is deemed as a strategy to respond to constant influences of external environments, to promote the development of life-long learning. Alternatively stated it is "*the set of principles and guidelines by which records of learner achievement are registered to enable national recognition of acquired skills and knowledge ... that encourages life-long learning*" (SAQA, 2020). Furthermore, the NQF consists of ten levels; demarcated in three groups (McKay, 2015; Mobida and Stewart, 2018), namely: 1) General Education and Training (Grades 1 – 9), 2) Adult Basic Education and Training (Grades 10 – 12), and 3) Higher Education and Training (Formal qualifications offered at HEIs). The ten NQF-levels are attached to the achievement of specific outcomes in order to achieve a 1) general certificate, 2) elementary certificate, 3) intermediate certificate, 4) national certificate / matric, 5) higher certificate, 6) diploma / advanced certificate, 7) bachelor's degree / advanced diploma, 8) honours degree / postgraduate diploma, 9) master's degree, and 10) doctoral degree (EduConnect, 2020).

Considering that education is synonymous intentional learning (Halliwell, 1977), it is not surprising that education, in a global dispensation, has undergone significant change. In core, education gradually moved from a teacher-centred approach to that of a learner-centred approach; catalysed by the adoption of technology (Chan et al., 2009; McKenna, 2013). This transformation entails, inter alia, moving from 1) teaching to facilitation, 2) one-dimensional assessments to multidimensional assessments, 3) passive learning to active learning, and 4) individualistic development to collaborative development (Hannafin and Land, 1997; Chen, 2010). Perhaps the most significant catalysers of this transformation is that of the Internet – an influential educational resource to aid in the self-development of learners, at their own pace (Zainuri et al., 2017; Aldaka, 2020).

Notwithstanding the above, in both developing- and developed economies, many education systems have not adapted with the transformation of education from a teacher-centred approach to a learner-centred approach (Robinson, 2019). More often than not, such education systems stem from 18th-century Industrialism – the aim being to "mass produce" the future workforce for a socio-economic system which is dominated by the manufacturing industry (Chetty, 2012; Van Zyl, 2019). The latter becomes disconcerting when taking into account that education-systems generally cater for a "one-size-fits-all" approach when both industries and organisations, in the 21st-century, have different needs in relation to 21st-century skills development (Robertson, 2005; Schleicher, 2012; Bruwer and Smith, 2018; Care et al., 2018). Such skills include that of inter alia collaboration, creativity, problem solving, communication and digital literacy (Green et al., 2012).

As time elapsed, the global socio-economic landscape has undergone substantial change, especially due to 4IRI (Pfohl et al., 2015; Renjen, 2019). Although the fourth industrial revolution was only officially recognised in 2013, 4IRI have become part of every-day life; disrupting all disciplines and industries (Dombrowski and Wagner, 2014; Maresova, 2018; Tadeu et al., 2019; Ndashe, 2019). Prior to the COVID-19 pandemic, though 4IRI were used to some extent in developing economies, their usage as more pertinently visible in developed economies such as the United States of America, the United Kingdom, Australia, China, and Russia (Gludovátz and Bacsárdi, 2016; Muyingo et al., 2020; Merten, 2020; Qukula, 2020).

When the focus is shifted to South Africa, a developing economy, it is not surprising that most industries and organisations did not make use of 4IRI prior to COVID-19 (Butler-Adam, 2018). The latter is

particularly evident in a HEI dispensation; prior to COVID-19, limited 4IRI were used to cover [outdated] curricula which did not cater for the development of 21st-century skills (Gachago et al., 2013; Maharaj, 2015; Adelabu and Campbell, 2020).

Using the above as a basis, while considering that COVID-19 catalysed the use of 4IRI in South African HEIs (Dwivedi et al., 2020; Thaba-Nkadimene, 2020), the question arises "*How did the catalysed use of 4IRI affect the efficacy of South African HEIs?*" To this end, the primary research objective of this study was to theoretically investigate whether the catalysed use of the 4IR, as brought on by COVID-19, influenced the efficacy of South African HEIs. For the remainder of this paper, relevant discussion takes place under the following headings: 1) research design, 2) theoretical framework, 3) discussion, and 4) conclusion.

## 2. Research Design

This study took on the form of exploratory research as limited research studies have been conducted on the identified research problem (Wang et al., 2014). In addition, this study was nascent in the sense that its primary objective was related to "*topics* [that] *have attracted little research or formal theorizing to date*" (Edmondson and McManus, 2007).

Furthermore, a qualitative research methodology was deployed which took on the form of an online desktop study. Such a study is related to the reviewing of "*secondary data ... gathered from pre-existing sources*" to provide clarity on phenomena (Muchonjo et al., 2017; Mbandlwa and Dorasamy, 2020). Although an online desktop study is similar to that of a traditional literature review – an approach which aids with the identification, analysis and interpretation of available evidence related to a specific research problem that is unbiased and trustworthy (Rowe, 2014; Kitchenham et al., 2009) – it was the best-suited approach for this study due to the exploratory nature thereof. To this end, the inherent limitations of scope selection author subjectivity and had to be tended to (Vukmirović, 2019). This was done by ensuring secondary data were searched for using keywords pertaining to, inter alia, "COVID-19", "Corona virus", "Coronavirus", "Corona-virus", "technology", "fourth industrial revolution", "4IR", "Higher Education Institutions", "HEIs", Universities", "South Africa", and "education". These keywords were searched for in an array of academic databases. In addition, although the finding in this study cannot be generalised, they do provide a foundation for further empirical research to be conducted. In quintessence, the online desktop study assisted with the attainment of the primary research objective, while allowing for both the conceptualisation of terminologies and the contextualisation of phenomena, where applicable.

## 3. Theoretical Overview

### 3.1. An Overview of South African HEIs

In South Africa, HEIs are governed by the Higher Education Act No. 101 of 1997, and relevant Amendment Acts (South Africa, 1997). The intention of these legislative documents is to: "[R]*egulate higher education; to provide for the ... establishment, governance and funding of public higher education institutions; ... to provide for quality assurance and quality promotion in higher education; to provide for transitional arrangements and the repeal of certain laws; 'and to provide for matters connected, therewith*" (South Africa, 1997). This includes the Higher Education Amendment Act No. 55 of 1999, the Higher Education Amendment Act No. 54 of 2000, the Higher Education Amendment Act No. 23 of 2001, the Higher Education Amendment Act No. 63 of 2002, the Higher Education Amendment Act No. 38 of 2003, the Higher Education Amendment Act No. 39 of 2008, the Higher Education Laws Amendment Act No. 26 of 2010, the Higher Education Laws Amendment Act No. 21 of 2011, and the Higher Education And Training Laws Amendment Act No. 23 of 2012.

By these legislative documents, South African HEIs are, as mandated by the DHET, responsible to provide relevant qualifications to learners with the primary objective to graduate (DHET, 2018; Education Statistics, 2020). This is generally done by embracing the NQF to allow for cognitive development, of learners, though the achievement of specific outcomes and critical cross-field outcomes (Carmichael and Stacey, 2006; Mungal and Cloete, 2016).

Prior to the start of Democracy, in 1994, the South African HEI landscape was very different than what it is today; comprising of technikons, colleges and universities (Gumbo, 2018). Technikons were originally established to offer programmes that did not fit in with university criteria; programmes such as trades, crafts, nursing and teaching, requiring technically skilled workforces (Winberg, 2005). In turn, colleges were established to offer programmes to a market of learners that preferred to work with their hands (Ramdass, 2009).

During the mid-2000s, the South African HEIs started to undergo major structural changes through means of merger-and-incorporation-processes (Shaikh and Soni, 2015). This specifically entailed the transformation of technikons to universities of technology or comprehensive universities (Ogude and Motha, 2001). Where one technikon merged with another technikon, it transformed to a university of technology. In the event that a technikon merged with a university, it transformed into a comprehensive university. While comprehensive universities placed focus on qualifications where learners could amass theoretical know-how, universities of technology emphasised the offering of qualifications where learners could obtain "hands-on experience" in the workplace (Winberg, 2005; Chipunza, 2014; Hillerbrand and Werker, 2019).

As of 2020, a total of twenty-seven formally recognised South African HEIs were in operation (Grad Connect, 2020). Despite operating in a democratic country for nearly three decades, research shows that some HEIs are still regarded as historically disadvantaged due to their limited access to resources to optimally educate learners (Ivy, 2001; Zewotir et al., 2011; Bozalek and Boughey, 2012). Prior to democracy, South Africa experienced Apartheid where non-white South African citizens were socio-economically disadvantaged by limiting their basic human rights (Abidi, 2001; Sulla & Zikhali, 2018). Notwithstanding the latter, it is still expected of HEI to produce graduates for industries and organisations (Makoe, 2016). Ideally, this should take place through quality teaching and learning initiatives where up-to-date knowledge and insight is shared to assist in the development of 21st-century skills (Xing and Marwala, 2017; Robinson 2019; Oke and Fernandes, 2020). On the contrary, research (Sahlberg, 2012; Malatji, 2016; Laughton, 2018; Srivastava et al., 2018) does, however, suggest that many South African HEIs have still not optimally transitioned towards a learner-centred approach; make use of outdated curricula which do not encourage the development of 21st-century skills.

### 3.2. COVID-19 and 4IRI

During January 2020 the Coronavirus 2019 (COVID-19) was declared as a global pandemic after first being reported in Wuhan City, Hubei Province, China (Cennimo, 2020; WHO: 2020). COVID-19 is a lethal virus that can cause respiratory illness, similar to that of Middle East Respiratory Syndrome and Severe Acute Respiratory Syndrome; entailing symptoms such as dry coughing, fatigue, nasal congestion, sore throat, diarrhoea, as well as body aches and pains (Perold et al., 2020a). Due to the spreading of COVID-19, governments around the globe both explored and followed best practices, as advised by the World Health Organisation, which included the maintaining of social distancing distance between individuals (Bruwer et al., 2020a).

In a South African dispensation, various initiatives were implemented since 26 March 2020, under the Disaster Management Act No. 57 of 2002, to curb the spreading of COVID-19 which included inter alia the prohibition of gatherings exceeding 50 people, the sporadic prohibition of the sale of alcoholic- and tobacco products, the banning of international travel, the installation of curfews, the mandatory wearing of masks that cover mouths and noses, as well as the implementation of a national lockdown (Perold et al., 2020b).

During 23 April 2020, the South African President announced the implementation of a COVID-19 Lockdown Alert System (see Figure 2) which comprises five alert levels (also referred to as Lockdown Levels), as a "risk-adjusted approach" to gradually ease restrictions brought on by Lockdown while being cognisant of relevant statistics such as the capacity of health facilities, COVID-19 infections, COVID-19 transmissions, and socio-economic indicators (South Africa, 2020). South Africa remained under Lockdown Level 5 between 26 March 2020 and 30 April 2020; was placed under Lockdown Level 4 between 1 May 2020 and 31 May, moved to Lockdown Level 3 from 1 June 2020 to 17 August 2020, and moved to Lockdown Level 1 from 18 August 2020 to present (South Africa, 2020). The aspect of social distancing resulted in almost all South Africans to embrace the power of technology, particularly through means of 4IRI (Adepoju, 2020; Bruwer et al., 2020a).

For the sake of clarity, the fourth industrial revolution is described as an era that is synonymous with "*ubiquitous, mobile supercomputing, intelligent robots, self-driving cars, neuro-technological brain enhancements and even genetic editing*" (Schwab, 2016). Since 2013, at least, 4IRI have revolutionised industries in an international dispensation allowing for "*machines* [to] *form part of everyday life, in normal society, with the main intent to forecast, regulate and design better outcomes for businesses and societies*" (Bruwer, et al., 2020b). It is however not surprising that 4IRI has changed all spheres of global economies, particularly through reducing geographical boundaries in order to collaborate especially in South African HEIs (Setyaningsih, 2020).

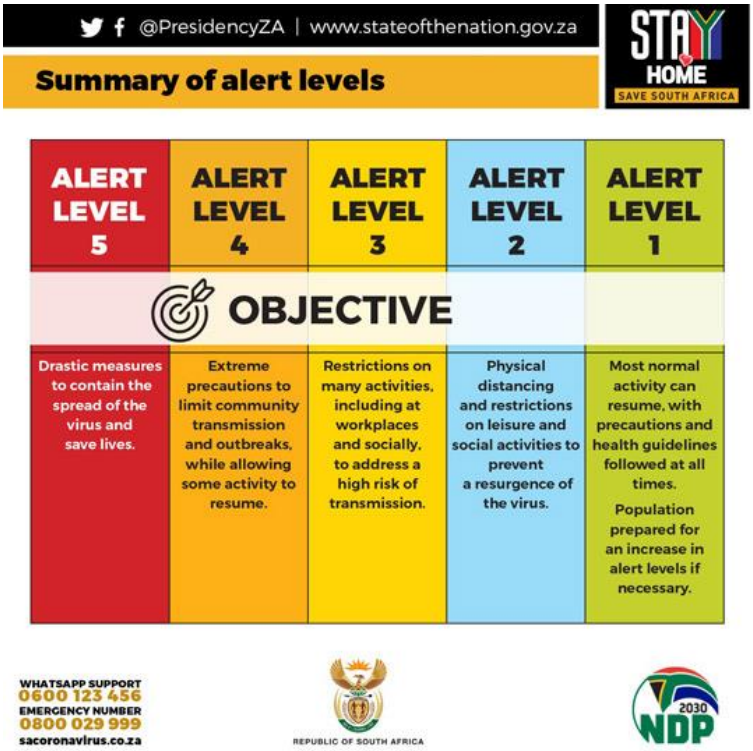


***Figure 2**. Summary of Lockdown Alert Levels in South Africa*
Source: South Africa (2020)

### 3.3. The Efficacy of South African HEIs amidst a Catalysed 4IR

The term "*efficacy*" is broadly defined by an array of researchers. According to Eden (2001), it pertains to "*the overall assessment of available resources that may be applied to successfully achieve an objective(s)*"; Rubenstein and Vinning (2004) are of the view that it relates to "*the extent to which a phenomenon provides beneficial results under ideal conditions*", and Manila (2014) regards the term to be associated with "*the power to produce an effect*". For the sake of this study, the term "*efficacy*", in a South African HEI dispensation, is conceptualised as follows:

> *It is the measurement of how well South African HEIs utilise their available and authorised resources with the intent to benefit relevant stakeholders to, in turn, attain their primary mandated objective of producing graduates.*

Prior to the outbreak of COVID-19, South African HEIs have been operating in a socio-economic environment that is influenced by the fourth industrial revolution (Gleason, 2018). Notwithstanding the aforesaid, research shows that, prior to 2019, South African HEIs did not equally utilise their available resources in a similar manner, with some South African HEIs using 4IRI far more than others (Suganya, 2017; Oke and Fernandes, 2020). The utilisation of 4IRI in South African HEIs have however been catalysed by the global pandemic while bringing about significant change (Maisiri et al., 2019). Despite the fact that South African HEIs were forced to embrace 4IRI, research shows that a teacher-centred approach was still largely evident; covering outdated curricula (Yusuf et al., 2020).

## 4. Discussion

South African HEIs have the mandate to provide relevant qualifications to learners in order for them to graduate (DHET, 2018). To achieve the latter, leaders should achieve specific outcomes and critical-cross field outcomes (Carmichael and Stacey, 2006; Mungal and Cloete, 2016) which, in turn, will stimulate their cognitive abilities (Toko, 2014; Swart and Daneti, 2019; SAQA, 2020). Unfortunately, the South African education system has not undergone significant change as it is still (Robertson, 2005; Chetty, 2012; Schleicher, 2012; Bruwer and Smith, 2018; Care et al., 2018; Robinson, 2019; Van Zyl, 2019):

- Strongly associated with 18th-century Industrialism,
- Greatly unfocused on the development of 21st-century skills, and
- Predominantly reliant on a teacher-centred approach.

At present time, twenty seven South African HEIs are formally recognised by the national government (Grad Connect, 2020); comprising of a mixture of universities of technologies, colleges, comprehensive universities and traditional universities (Winberg, 2005; Chipunza, 2014; Shaikh and Soni, 2015; Hillerbrand and Werker, 2019). Notwithstanding the fact that not all South African HEIs had similar resources to achieve their mandate, all of these institutions are still expected to do so (Ivy, 2001; Zewotir et al., 2011; Bozalek and Boughey, 2012; Makoe, 2016).

Ideally, South African HEIs should adopt a learner-centred approach where quality and up-to-date knowledge and insight are shared to, inevitably, assist in the development of 21st-century skills (Xing and Marwala, 2017; Robinson 2019; Oke and Fernandes, 2020). Unfortunately, many South African HEIs still embrace a teacher-centred approach while making use of outdated curricula which do not encourage the development of 21st-century skills (Sahlberg, 2012; Malatji, 2016; Laughton, 2018; Srivastava et al., 2018).

Prior to the outbreak of COVID-19, though some South African HEIs used 4IRI more than others, most South African HEIs did not optimally utilise it (Suganya, 2017; Greason, 2018; Oke and Fernandes, 2020). After the outbreak of this global pandemic, South Africans were forced to adapt to the fourth industrial revolution through the implementation of initiatives to prevent the spreading of COVID-19, particularly that of social distancing (Bruwer et al., 2020a; Perold et al., 2020b). South African HEIs were forced to follow suit but still, research shows that even amidst COVID-19, most of these institutions still had a teacher-centred approach where outdated curricula were covered (Yusuf et al., 2020).

For this reason, clear tangent planes emerge that where South African HEIs embraced 4IRI, it may not necessarily result in improved efficacy. The primary reasons for the latter relate to the soundness and/or feasibility of curricula, the teaching approach(es) that are adopted, as well as the extent to which 21st-century skills are developed by these institutions. To this end, the following propositions are suggested for further research, among others:

- The feasibility of current curricula as offered by South African HEIs.
- The influence of circulation amendment (re-curriculation) on the efficacy of South African HEIs.
- The influence of prioritising 21st-century skills and the efficacy of South African HEIs.
- The influence of teaching approaches on the efficacy of South African HEIs.

## 5. Conclusion

Throughout this study, the focus was placed on whether the catalysed use of 4IRI, by South African HEIs, had an influence on the efficacy of these institutions. Apart from the fact that a learner-centred approach to education is favoured around the globe, learning, especially in South Africa, is still mostly bound to 18$^{th}$-century Industrialism. In other words, workforces are still "*mass-produced*" by HEIs, as enforced by the South African education system, where graduates are expected to instantly fill vacancies that exist in industry. The latter becomes very disconcerting when considering that most qualifications offered by South African HEIs have outdated curricula and make use of practices that do not accommodate for the development of 21st-century skills.

Prior to the outbreak of COVID-19, some South African HEIs made use of 4IRI more than others. The global pandemic did serve as a catalyser for the adoption of 4IRI by South African citizens, organisations and industries, one of which is the South African Higher Education Industry. From the research conducted, it is disconcerting to note that while all South Africa HEIs had to embrace 4IRI amidst COVID-19, most of these institutions still preferred a teacher-centred approach while covering outdated curricula.

With the above in mind, it becomes apparent that the catalysed use of 4IRI may not have any influence on the efficacy of South African HEIs, at least in a theoretical dispensation. Although the findings in this study cannot be generalised, it is strongly recommended that the proposed propositions are further investigated in an empirical dispensation.

## References

Adelabu, O.S. and Campbell, A.D. 2020. Appropriate knowledge: An exploration of South African Industrial Design curricula in the era of 4IR. In *DS 104: Proceedings of the 22nd International Conference on Engineering and Product Design Education (E&PDE 2020)*, VIA Design, VIA University in Herning, Denmark. 10th-11th September 2020.

Abdi, A.A., 2001. Integrated education and black development in post-apartheid South Africa: critical analyses. *Compare: A Journal of Comparative and International Education*, 31(2), pp.229-244.

Adepoju, P., 2020. Africa's COVID-19 health technologies' watershed moment. *The Lancet Digital Health*, 2(7), pp.e346-e347.

Aldaka, F., 2020. Flipped Classroom Approach in Increasing EFL Learners' Higher-order Thinking Skills: An Overview. *RETAIN*, 8(3), pp. 24-34.

Bozalek, V. and Boughey, C., 2012. (Mis)framing Higher Education in South Africa. *Social Policy and Administration*, (46)6, pp. 688 - 703.

Bruwer, J-P. and Smith, J., 2018. Basic business skills requiring development and their influence of Fast Moving Consumer Goods Small, Medium and Micro Enterprise sustainability in the Cape Metropole. *Journal of Economics and Behavioural Studies*, 10(2), pp. 48-62

Bruwer, J-P., Hattingh, C. and Perold, I., 2020a. *Probable measures to sustain South African Small Medium and Micro Enterprises' existence, post COVID-19: A literature review.* (working paper BRS/2020/004). 12 June 2020. Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3625552.

Bruwer, J-P., Smit, Y., Le Roux, S. and Siwangaza, L., 2020b. Conceptualising the modern Internal Auditor amidst the 4th Industrial Revolution: A literature review. *International Journal Critical Accounting* (publication in process).

Care, E., Kim, H., Vista, A. and Anderson, K., 2018. Education System Alignment for 21st-century Skills: Focus on Assessment. *Center for Universal Education at The Brookings Institution.*

Carmichael, T. and Stacey, A., 2006. Perceptions of SAQA's critical cross-field outcomes as key management meta-competencies. *South African Journal of Business Management*, 37(2), pp.1-15.

Cennimo, D.J., 2020. *What Is COVID-19?.* [online] Available from: https://www.medscape.com/answers/2500114-197401/what-is-covid-19 [Accessed on 02/09/2020].

Chan, A.P., Lo, A.A. and Ma, L.S. *Outcome-based curriculum-Impact on tertiary education.* [online] Available from: https://www.semanticscholar.org/paper/Outcome-based-Curriculum-Impact-on-Tertiary-Chan-Lo/2f44a695ec718b93bad772d15716986a6b620aff?p2df [Accessed on 23/10/2020].

Chen, R.J., 2010. Investigating models for preservice teachers' use of technology to support student-centered learning. *Computers and Education*, 55(1), pp.32-42.

Chetty, Y., 2012. Graduateness and employability within the higher education environment: A focused review of the literature. *Developing student graduateness and employability: Issues, provocations, theory and practical application*, pp.5-24.

Chipunza, C., 2014. Gender and Field of Study as Determinants of Perceptions Regarding Employment Prospects Among Final Year Students: Case of a University of Technology in South Africa. *Mediterranean Journal of Social Sciences*, 5(20), p.3017.

DBE., 2019. *Education in South Africa*. [online] Available from: https://www.education.gov.za/EducationinSA.aspx [Accessed on 31/08/2020].

DHET., 2018. *The funding of universities.*. [online] Available from: http://www.dhet.gov.za/Financial%20and%20Physical%20Planning/Ministerial%20Statement%20of%20University%20Funding%20201819%20and%20201920%20February%202018.docx [Accessed on 08/09/2020].

Dombrowski, U. and Wagner, T., 2014. Mental strain as a field of action in the 4th industrial revolution. *Procedia CIRP*, 17(1), pp.100-105.

Dwivedi, Y.K., Hughes, D.L., Coombs, C., Constantiou, I., Duan, Y., Edwards, J.S., Gupta, B., Lal, B., Misra, S., Prashant, P. and Raman, R., 2020. Impact of COVID-19 pandemic on information management research and practice: Transforming education, work and life. *International Journal of Information Management*, 55, p.102211.

Eden, D., 2001. Means efficacy: External sources of general and specific subjective efficacy. *Work motivation in the context of a globalizing economy*, 65(1), pp.73 - 85.

Edmondson, A.C. and McManus, S.E., 2007. Methodological fit in management field research. *Academy of Management Review*, vol. 32, pp. 1246-1264.

Education Statistics, 2020. *South Africa's Education statistics*. [online] Available from https://www.southafricanmi.com/education-statistics.html [Accessed on 08/09/2020].

EduConnect, 2020. *Complete Guide to NQF Levels (2020)*. [online] Available from: https://educonnect.co.za/nqf-levels-whats-that-stuff-about/ [Accessed on 27/11/2020].

Gachago, D., Bozalek, V. and Ng'ambi, D., 2013. Transforming teaching with emerging technologies: Implications for higher education institutions. *South African Journal of Higher Education*, 27(2), pp.419-436.

Gleason, N.W., 2018. *Higher education in the era of the fourth industrial revolution* (p. 229). Springer Nature.

Gludovátz, A. and Bacsárdi, L., 2016.Production related IT solutions in the operation of factories. In *2016 IEEE 17th International Symposium on Computational Intelligence and Informatics* (CINTI), pp. 187-192.

Grad Connection., 2020. *All 27 universities in alphabetical order*. [online] Available from: https://za.gradconnection.com/universities/ [Accessed on 08/09/2020].

Green, L., Jones, B. and Miles, I., 2012. Skills and innovation. *Innovation Policy Challenges for the 21st-century*, 27(1), pp.185–224.

Gumbo, J.R., 2018. Contextual Factors in Higher Education: Impact on My Teaching and Learning@ University of Venda.

Halliwell, G., 1977. An Interactional Model for Early Childhood Education.

Hannafin, M.J. and Land, S.M., 1997. The foundations and assumptions of technology-enhanced student-centered learning environments. *Instructional Science*, 25(3), pp.167-202.

Hillerbrand, R. and Werker, C., 2019. Values in University-Industry collaborations: The case of academics working at universities of technology. *Science and Engineering Ethics*, 25(1), pp. 1633 - 1656.

Ivy, J., 2001. Higher Education institution image: a correspondence analysis approach. *International Journal of Educational Management*, 15(6), pp. 276 – 282.

Justice, 2020. *Chapter 2: Bill of Rights*. [online] Available from: https://www.justice.gov.za/legislation/constitution/SAConstitution-web-eng-02.pdf [Accessed on 27/11/2020].

Kitchenham, B., Brereton, O.P. Budgen, D., Turner, M., Bailey, J. and Linkman, S., 2009. Systematic literature reviews in software engineering–a systematic literature review. *Information and Software Technology*, 51(1), pp. 7–15.

Laughton, P., 2018. Needs analysis of university knowledge management education.

Maharaj, S., 2015. The status of usage of information technology systems within campuses of the KwaZulu-Natal College of Nursing (Doctoral dissertation).

Maisiri, W., Darwish, H. and Van Dyk, L. (2019). An investigation of industry 4.0 skills requirements. *South African Journal of Industrial Engineering*, 30(3), pp. 90 - 105.

Makoe, M., 2016. The future of Open Distance eLearning: Realising the 2030 sustainable goal. In Third Open and Distance Learning Conference in Namibia (p. 1).

Malatji, K.S., 2016. Moving away from Rote Learning in the University Classroom: The Use of Cooperative Learning to Maximise Students' Critical Thinking in a Rural University of South Africa. *Journal of Communication*, 7(1), pp. 34 - 42.

Manila, V.M., 2014. Parental efficacy in nursing practice: A concept analysis and derivation. *International Journal of Human Caring*, 18(4), pp.7-13.

Maresova, P., Soukal, I., Svobodova, L., Hedvicakova, M., Javanmardi, E., Selamat, A. and Krejcar, O., 2018. Consequences of Industry 4.0 in business and economics. *Economies*, 6(3), p.1-14.

Mbandlwa, Z. and Dorasamy, N., 2020. The impact of substance abuse in South Africa: a case of informal settlement communities. *Journal of Critical Reviews*, Vol. 7, pp. 1 - 15.

McKay, V., 2015. Measuring and monitoring in the South African Kha Ri Gude mass literacy campaign. *International Review of Education*, 61(3), pp.365-397.

Mckenna, S., 2013. The Dangers of Student-Centered Learning-A Caution about Blind Spots in the Scholarship of Teaching and Learning. *International Journal for the Scholarship of Teaching and Learning*, 7(2), pp. 1-5.

Merten, M., 2020. Covid-19 *State of Disaster vs State of Emergency: What's the difference?*. *[online]* Available from: https://www.dailymaverick.co.za/article/2020-03-19-covid-19-state-of-disaster-vs-state-of-emergency-whats-the-difference/ [Accessed on 08/09/2020].

Modiba, M. and Stewart, S., 2018. Changing teaching practice in South African schools. Leading Change in Teacher Education. In Al Barwani, T., Assunção Flores, M., Imig, D., (Eds): *Lessons from Countries and Education Leaders around the Globe*. London, UK: Routledge.

Muchonjo, A.K., Wanyembi, G. and Makori, C., 2017. An Investigation into Ipredation in Cyberspace towards Developing a Framework for Preventing Ipredators' Attacks. *IOSR Journal of Computer Engineering*, vol. 19, pp. 28-36.

Mungal, A. and Cloete, M., 2016. Preparing underprepared students for higher education and beyond: The development and implementation of an integrated project. *Accounting Education*, 25(3), pp.203-222.

Muyingo, R.I., Mpoza, A. and Kasadha, J., 2020. Coronavirus in the era of digital connectivity: Opportunities and challenges. *Journal of Public Affairs*, e2246, pp. 1-3.

Ndashe, N., 2019. *The power of social media and influence in today's 4th Industrial Revolution*. *[online]* Available from: https://www.bizcommunity.com/Article/196/669/192629.html [Accessed on 05/05/2020].

Ogude, N.A. and Motha, N.A., 2001. A proposal for an incentive tool for development of research capacity at technikons. *South African Journal of Higher Education*, 15(3), pp. 58–65.

Oke, A. and Fernandes, F.A.P., 2020. Innovations in Teaching and Learning: Exploring the Perceptions of the Education Sector on the 4th Industrial Revolution (4IR). *Journal of Open Innovation: Technology, Market and Complexity*, 6(31), pp. 1 - 22.

PCubed, 2018. *Bloom's taxonomy*. [online] Available from: http://ffolliet.com/2018/10/06/blooms-taxonomy/ [Accessed on 27/11/2020].

Perold, I., Hattingh, C. and Bruwer, J-P., 2020b. *The forced cancellation of four jewel events amidst COVID-19 and its probable influence on the Western Cape economy: A literature review* (working paper BRS/2020/002). Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3604132.

Perold, I., Hattingh, C., Bama, H., Bergh, C. and Bruwer, J-P., 2020a. *The forced cancellations of four selected annual sport events (ASEs) due to COVID-19 and its socio-economic influence on South Africa: A literature review*. (working paper BRS/2020/005). 24 June 2020. Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3634508

Pfohl, H.-C., Yahsi, B. and Kurnaz, T., 2015. *The Impact of Industry 4.0 on the Supply Chain*. [online] Available from: https://www.econstor.eu/bitstream/10419/209250/1/hicl-2015-20-031.pdf [Accessed on 23/10/2020].

Qukula, Q., 2020. *President Cyril Ramaphosa Implemented Travel Bans With Immediate Effect After Declaring the Covid-19 Outbreak a National Disaster*. [online] Available from: http://www.capetalk.co.za/articles/377878/10-interventions-announced-by-president-cyril-ramaphosa-to-curb-covid-19-spread [Accessed on 08/09/2020].

Ramdass, K., 2009. The challenges facing education in South Africa. *Tomorrow People Organisation.*

Renjen, P., 2019. How leaders are navigating the Fourth Industrial Revolution. *Deloitte Review*, 1(24), pp. 38-42.

Robertson, S.L., 2005. Re-imagining and rescripting the future of education: Global knowledge economy discourses and the challenge to education systems. *Comparative education*, 41(2), pp.151-170.

Robinson, K., 2019. *Creative schools revolutionizing education from the ground up*. [online] Available from: https://www.youtube.com/watch?v=a76CGdrIu2E&list=RDa76CGdrIu2E&start_radio=1 [Accessed on 08/09/2020]

Rowe, F., 2014. What literature review is not: diversity, boundaries and recommendations. *European Journal of Information Systems*, 23(3), pp. 241-255.

Rubenstein, J.E. and Vining, E.P., 2004. Efficacy of the Ketogenic Diet. In *Epilepsy and the Ketogenic Diet* (pp. 95-102). Humana Press, Totowa, NJ.

Sahlberg, P., 2012. *Global Educational Reform Movement is here!*. [online] Available from: https://pasisahlberg.com/global-educational-reformmovement-is-here/ [Accessed on 08/09/2020].

Setyaningsih, E., 2020, April. Adapting Elementary School Curriculum Innovation in Line By 4IR and Cultures. In *2nd Educational Sciences International Conference (ESIC 2019)* (pp. 81-91). Atlantis Press.

Shaikh, A. and Soni, D., 2015. The South African Universities post-merger mess: Problems and challenges of Transformation. *Mediterranean Journal of Social Sciences*, 6(3), pp. 326 - 343.

Schleicher, A., 2012. Preparing teachers and developing school leaders for the 21st-century: Lessons from around the world. *OECD Publishing*. 2, rue Andre Pascal, F-75775 Paris Cedex 16, France.

Schwab, K., 2016. *The Fourth Industrial Revolution*. Cologny: World Economic Forum.

Srivastava, V.P., Srivastava, A. and Gambhir, S., 2018. Curricular aspect with Special Focus on Skill Development. *ESSENCE Int. J. Env. Rehab. Conserv.* IX (1), pp.28-34.

South Africa, 1996. *The Constitution of the Republic of South Africa*. [online] Available from: https://www.gov.za/sites/default/files/images/a108-96.pdf [Accessed on 08/09/2020].

South Africa, 1997. *Higher Education Act No. 101 of 1997*. [online] Available from: https://www.gov.za/documents/higher-education-act [Accessed on 08/09/2020].

South Africa, 2020. *About alert system*. [online] Available from: https://www.gov.za/covid-19/about/about-alert-system [Accessed on 27/11/2020].

Suganya, G., 2017. A study on challenges before Higher Education in the emerging fourth industrial revolution. *International Journal of Engineering technology Science and Research*, 4(10), pp. 1 - 3.

Sulla, V. and Zikhali, P., 2018. *Overcoming poverty and inequality in South Africa: An assessment of drivers, constraints and opportunities* (No. 124521, pp. 1-148). The World Bank.

Swart, A.J. and Daneti, M., 2019. April. Analyzing Learning Outcomes for Electronic Fundamentals Using Bloom's Taxonomy. In *2019 IEEE Global Engineering Education Conference* (EDUCON) (pp. 39-44). IEEE.

Tadeu, H.F.B., Duarte, A.L.D.C.M., Taurion, C. and Jamil, G.L., 2019. Digital Transformation: Digital Maturity Applied to Study Brazilian Perspective for Industry 4.0. In *Best Practices in Manufacturing Processes* (pp. 3-27). Springer, Cham.

Thaba-Nkadimene, K.L., 2020. COVID-19 and e-learning in higher education. *Journal of African Education*, 1(2), pp.5-11.

Toko, G., 2014. Software Systems Versus Intellectual Property Rights. In *Proceedings of the 6th International Conference on Computer Supported Education*-Volume 1 (pp. 250-259). SCITEPRESS-Science and Technology Publications, Lda.

Van Zyl, E., 2019. *Assessing the creativity levels of Retail Business Management Students Studying at the Cape Peninsula University of Technology*. Unpublished MTech: Business Administration thesis, Cape Peninsula University of Technology, Cape Town, South Africa.

Vukmirović, V., 2019. Entrepreneurship Education among University Students as a Predictor of Female Entrepreneurial Undertakings. *Journal of Women's Entrepreneurship and Education,* 3, pp. 86-102.

Wang, L., Lin, J. and Cui, W., 2014, September. Where do breakthrough ideas come from? Characteristics of scientists' research behaviors. In 2014 IEEE International Conference on Management of Innovation and Technology (pp. 61-65). IEEE.

WHO, 2020. *Coronavirus Disease - Answers* [online] Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/coronavirus-disease-answers?query=What+is+COVID19%3F [Accessed on 02 September 2020].

Winberg, C., 2005. Continuities and discontinuities in the journey from technikon to university of technology. *South African Journal of Higher Education,* (19)2, pp.189-200.

Xing, B. and Marwala, T., 2017. Implications of the fourth industrial age for higher education. *Science and Technology*, 73 (1), pp. 10-15.

Yusuf, B., Walters, L.M. and Sailin, S.N., 2020. Restructuring Educational Institutions for Growth in the Fourth Industrial Revolution (4IR): A Systematic Review. *International Journal of emerging technologies in Learning*, 15(3), pp.93-109.

Zainuri, M., Sutarto, S., Supeno, S., Indrawati, I. and Prihatin, J., 2017. Student Worksheet Science Based on Process Image Of Light Concept For Learning In Junior High Schools. *Pancaran Pendidikan*, 6(4), pp. 23-40.

Zewotir, T., North, D. and Murry, M., 2011. Student success in entry level modules at the University of Kwa-Zulu Natal. *South African Journal of Higher Education,* 25(6), pp. 1233 - 1244.