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Digital skills preparedness of higher education students for the "Real Estate, Finance and Business" sector in South Africa

by

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GLOSSARY OF ACRONYMS

P21	21st Century Skills
BCOM	Bachelor of Commerce
BRICS	Brazil, Russia, India, China and South Africa
CAD	Computer aided design
CAT	Computer Applications Technology
CGPA	Cumulative Grade Point Average
DQ	Digital intelligence
EU	European Union
ICDL	International Computer Driving License
ICT	Information and Communications Technology
ISO	International Organization for Standardization
IST	Information society technology
MOOC	Massive Online Open Courses
PPS	Proportionate to size
SAQA	South African Qualifications Authority
SETA	Sector Education and Training Authorities
SIC	Standard Industrial Classification
SMEs	Small-to-Medium Enterprises
T&L	Teaching and learning
TVET	Technical and Vocational Education and Training
VET	Vocational education and training

ABSTRACT

The 21st century is experiencing rapid technological advancements. Industry need to keep abreast of these advancements, in order to remain competitive. These rapid technological advancements create added pressure for higher education institutions to equip their graduates to meet industry demands. This means that graduates must possess the digital intelligence necessary for the workplace, in order to ensure a thriving economy. Research further suggests that society has high expectations of universities to provide employable graduates. However, with the job market changing so rapidly, universities are finding it difficult to deliver digitally prepared graduates to industry. Furthermore, while researchers view digital skills with the same importance as reading or arithmetic, the South African Qualifications Authority have not yet established and implemented a digital skills framework in their South African National Qualifications Framework with the aim of reducing the digital skills gap.

It is therefore important to understand the digital skills that are required of graduates by industry, the digital skills gap between graduates' digital abilities and the expectations of industry. Further to this, it is also essential to identify the incessant challenges that create the lag in the delivery of adequately equipping graduates with the necessary digital skills, as well as the challenges that impedes the alignment between industry requirements and higher education offerings. In order to achieve these aims, the study adopted a multiphase mixed methods approach, constituting three phases: (1) quantitative, (2) quantitative, and (3) qualitative. In phase one, professionals from the Real-Estate, Finance and Business Services sector in South Africa were surveyed by means of convenience sampling. In phase two, final year commerce students from the top four universities in South Africa that typically feed into the said industry sector, were surveyed by way of proportionate cluster sampling. In phase three, the academic leader of teaching and learning, or the equivalent, from each of the top four universities were purposively selected for structured interviews.

Phase one of the study has identified and outlined the digital skills that are required by the Real Estate, Finance and Business Services sector in South Africa, in addition to the level of importance of each digital skill from three individual constructs, namely use of software applications and Web tools, use of information systems, and security measures in digital environments. The results from phase one similarly prompted the development of the proposed digital skills framework, which was designed to be versatile and may be used as a 'blueprint' for other industry sectors in South Africa, as well as by other countries to determine the digital skills needed for their industry sectors(s). Phase

two results indicated that South African higher education institutions are not adequately preparing their students to meet the requirements of the said industry sector, and this is attributable to a number of challenges. The results from phase three presents ten challenges that hinders the alignment of academic curricula to industry's digital skills requirements. It further presents the mechanisms used to address the digital skills expected of graduates by industry, in addition to higher education's envisaged transformation needed to ensure that their digital skills offerings are aligned to industry requirements.

These findings will help higher education institutions to systematically align their curricula to meet this sector's digital skills need. Additionally, the proposed framework may be used to periodically determine the changing needs of the said sector, and may be applied by researchers to determine the digital skills requirements of other industry sectors within South Africa, as well as globally. Furthermore, scholars may use this framework to underpin their study by building additional constructs/items onto it that was not considered in this study. It can be further used as a benchmark by tertiary institutions to determine probable curriculum inadequacies. These findings will also help government in understanding the type of support required by higher education institutions to ensure that graduates are adequately equipped with the necessary digital skills for the said industry sector, which will ultimately sustain the economy and reduce the unemployment rate of graduates that ought to feed into Real-Estate, Finance and Business Services sector of South Africa.

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CHAPTER 1 - INTRODUCTION TO THE STUDY

Over two decades[1] ago, digital intelligence was not an essential component of a student's academic career. However, owing to the digital revolution, digital intelligence is now considered a 'core competency' for a successful career in most industries (Kivunja, 2015; Pagani *et al.*, 2016; Park, 2016; Phuapan *et al.*, 2016). Digital intelligence takes into consideration the 'talents and skills' developed by the 'masters of change' and 'symbol analysts' (Adams, 2004; Gardner, 1999).

Several disciplines have defined the concept of 'digital skill', and use the following terms, 'knowledge', 'skills', 'competence', 'literacy' and 'fluency', which all denote digital abilities (Meyers *et al.*, 2013). Digital literacy is known as depicting the skills, competencies and approaches of individuals that utilize digital technologies (Evangelinous *et al.*, 2016; Ferrari, 2012). Gardner (1993, p. 7) defines intelligence as "the ability to solve problems or fashion products, that are valued in one or more cultural or community settings." However, Adams (2004) advises that this definition allows for the advent of a 'digital intelligence', which she considers a consequence of the cultural transformation produced by the digital revolution. When coupled with Gardner's definition, digital intelligence can be described as the competence to solve problems that are important in one or more community or cultural settings by means of digital technology (Adams, 2004).

Efficient use of digital technologies necessitates talents and skills. As a result, it is suggested that people who have the proficiencies to understand and work with digital information to arrange, manipulate and organise it based on their comprehension, possesses digital intelligence (Adams, 2004). According to Funes *et al.* (2018, p. 1) conventional digital skills are the skills necessary to use digital technologies appropriately and differ from absolutely no skills to beyond basic and are assessed using five "competence areas (that is, information, communication, safety, problem-solving and content creation)". They also highlight that Information and Communications Technology (ICT) specialist skills, for instance network management and application development, are skills required to create information technologies (IT) products and services. Digitalisation has further sparked a change in the skills required for the job market, whereby digital skills are essential not only for employees in ICT professions, but to most traditional and digital industries. One of the major advantages of continuous technological advancements is to positively affect productivity in various economic sectors (Funes *et al.*, 2018).

[1] The researcher was a student at that time, therefore this specific timeframe was used.

Funes *et al.* (2018) point out that forty percent of European employers are battling to find employees with the necessary skills required to innovate and expand across all sectors. They also explain that the digital economy needs a skills enhancement in the workforce with particular attention to digital skills, as well as ICT specialist skills. In light of this, it is necessary for South African policy makers to understand what first world countries are doing right, in order to have a better understanding of the solutions required for the digital skills shortages in developing countries like South Africa. For example, the European Union (EU) uses the 'Digital Competence Framework', which defines essential factors of digital competence in the following five areas, namely: (1) information and data literacy; (2) communication and collaboration; (3) digital content creation; (4) safety; and (5) problem-solving, to assess their population's digital skill level (Funes *et al.*, 2018; Gekara *et al.*, 2017).

It is also important to note that the labour force in some EU countries like Denmark and the Netherlands exhibit above average levels of digital skills, and they have the least number of individuals that have no digital skills of any kind (Funes *et al.*, 2018). In addition, the Netherlands has comprehensive policies to ensure continuous growth in digital skills and the Netherlands government plays a major role by preparing its citizens for future challenges, such as digitalisation through the 'Dutch National Technology Pact' (Funes *et al.*, 2018). To remain globally competitive, Australia has adopted the ICT Workforce Skills framework and Europe has adopted the DigComp framework (Gekara *et al.*, 2019). These international policies and practices related to digital skills are being highlighted, since South Africa is considered to be lagging behind and can therefore adopt tried and tested practices from these successful countries (Schofield, 2016). Additionally, South Africa currently has no such action plans in place and are instead focusing on upgrading its infrastructure, which alone will not guarantee a thriving economy (Qoza, 2016; South African Government, 2016). More specifically, the South African policies focus on implementing digital infrastructure and competencies only for government employees and schoolteachers (Hinostroza, 2018).

Consequently, in preparation for the workplace, academic staff from all disciplines in higher education ought to endeavour to advance their students' digital intelligence. The 'ripple effect' is that by producing graduates who are digitally intelligent, they will be more prepared for present and future industry needs, thereby improving and sustaining the economy. In addition, research suggests the there is an urgent need to adequately prepare graduates for industry, however, there is insufficient research that provides a 'blueprint' for higher education to ensure that this can be achieved (Aasheim *et al.*, 2019; van Laar *et al.*, 2017). As a result of the rapid technological advancements, the digital

skills need of industry are regularly evolving to enhance the success of achieving industry's goals and objectives. Consequently, there is a need first to investigate the current digital skills requirements of industry, in order to understand the digital skills preparedness of higher education students that feed into industry. However, since investigating all industry sectors would have been a vastly broad study, the topic was narrowed down to investigate the digital skills preparedness of students for the Real Estate, Finance and Business sector in South Africa.

This study will contribute to curriculum development related to the teaching and learning of digital skills and offer pertinent information regarding the digital skills gap identified. In addition, this study contributes theoretically to the academia-industry digital skills alignment and offers a framework that may be adopted by policy makers to ensure such an alignment. The study further reveals the challenges being face by higher education institutions (HEIs), mechanisms used by HEIs to address the digital skills requirements of industry and higher education's envisaged transformation to ensure their curricula is better aligned to meet industry needs. This is important for the government in addressing the needs of higher education in reducing the digital skills gap.

1.1. Background of the Study

Due to its rapid advancements, ICT has played a prominent role in the educational system in recent years, therefore the learning process now requires a vast array of digital skills, in order to manipulate digital information. Despite the fact that digital technologies play a pivotal role in the development of digital skills, the more fundamental skills for 21st century education and professions do not only relate to the use of technology, but more significantly to the proficiency to engage in high-level problem solving, independent critical thinking, and frequently using technology (Kivunja, 2014).

With technological advancements, comes the need for new skillsets. Another issue is that technological development advances more rapidly than skills development, which creates a paradoxical situation, whereby millions of people are unemployed yet companies are faced with the challenge of recruiting digitally skilled employees (Phuapan *et al.*, 2016). In order to generate digitally skilled students to be competent in 21st century globalized trades, occupations and professions, it is imperative that digital technologies be embedded in curriculum and pedagogy (Evangelinous *et al.*, 2016; Kivunja, 2014). Consequently, students should be steered to improve their digital intelligence to effectively manipulate information with the aim of successfully functioning in the digital economy, and not just for academic purposes.

According to Park (2016), just as one would measure an individual's IQ (i.e. general intelligence or EQ (i.e. emotional intelligence), so too can one's proficiency and knowledge of digital media be measured. This measurement is referred to as digital intelligence (DQ) and is considered highly adaptive. Park (2016, p. 1) explains that DQ consists of three levels:

Level 1: "Digital citizenship" - The competence to employ digital media and technologies in responsible, safe and effective ways.

Level 2: "Digital creativity" - The competence to join the digital ecosystem by creating fresh content and materialising ideas by means of digital tools.

Level 3: "Digital entrepreneurship" - The competence to employ digital technologies and media to create more opportunities and/or resolve global challenges.

Digital citizenship is frequently disregarded by educators and leaders, even though it is essential to one's ability to utilise technology and survive in the 'digital world' (Park, 2016). Digital technology has undoubtedly created a change in world culture in many aspects, such as communication style, economic practice, lifestyle, and similarly in our thinking. The acknowledgement and incorporation of digital intelligence, as part of the multiple intelligences theory broadens the study of responsive teaching and learning (Adams, 2004). Consequently, it is important for South African institutions of higher education to transform their curricula, so that their graduates will have the digital intelligence necessary for the 21st century workplace. In addition to work-oriented training, even the Dutch adult education courses concentrate on three prime skills: namely problem solving, numeracy and literacy in technology-rich environments (de Greef *et al.*, 2015).

Research suggests that communities and governments have high expectations of universities to provide employable graduates, however the job requirements are changing at a faster rate than the institutions can deliver suitable graduates to meet the requirements (Oliver, 2015). This implies that higher education and government needs to do much more and at a faster pace, in order to minimize the growing digital skills gap. Consequently, in accordance with the trajectory of technological advancements underpinning the digital skills requirements of industry, this study has the subsidiary objective of understanding the aforementioned sector's current digital skills requirements. Achieving the subsidiary objective is fundamental in achieving the study's main objective of understanding the digital skills preparedness of students for the Real Estate, Finance and Business Services sector in South Africa. Achieving the main objective would reveal the magnitude of the digital skills gap that exists in South Africa.

If the researcher were to investigate the digital skills preparedness of graduates for all of South Africa's industry sectors, that would have meant that collecting data for:

- phase one - surveying industry professionals in each and every industry sector within South Africa;
- phase two – surveying students within each and every faculty within the top four universities;
- phase three – interviewing all academic leaders from each discipline in each of the top four universities.

Since there are several industry sectors in South Africa and many more academic disciplines within each university, whose graduates feed into these sectors, the study would have been enormous, needing considerably more time and financial resources. Additionally, the sample sizes would have needed to increase substantially to get an accurate statistical representation, in order to be able to generalize the population, with the aim of determining the digital skills preparedness of graduates for each industry sector. Consequently, the research decided to narrow the study to be more focused, so that it could be completed within the given timeframe and limited financial resources. The rational of investigating the Real Estate, Finance and Business Services sector in particular was that this sector consistently contributed largely to the South Africa's GDP. Narrowing the focus of the study to this particular sector was also more manageable to conduct three phases of data collection, and ultimately addressing all research objectives outlined in section 1.3.

1.2. Research Problem/Statement of the Problem

Globally, many students do not possess the core digital skills required for scholarship in the 21st century, such as electronic-communication, word processing, working with spreadsheets, delivering effective presentations and web searching (Phuapan *et al.*, 2016). It is typically assumed that digital skills can be acquired naturally, through trial and error. However, while the trial and error method of acquiring digital skills may have proven successful in the past, rapid technological advancements make it impractical for new generations to develop sound digital skills without prior training (van Dijk & van Deursen, 2014b). Students trained in multi-literacies gives them information, media and digital skills, which ought to help them relate their academic proficiencies in real-life contexts of the workplace (Kivunja, 2015; Klimczuk *et al.*, 2015). Hence, higher education needs to restructure the degree programmes, with the intention of incorporating the essential digital skills to adequately ready students for the working world.

In this regard, Craffert *et al.* (2014) conducted national survey with 82 South African companies that had a minimum of 500 employees from various sectors of the Standard Industrial Classification (SIC). They point out that South Africa was trailing behind with regard to the digital skills preparedness of their workforce, in comparison to the prevailing paradigm of an increasingly digitally permeated society and a progressively digitalised economy. The present shortage digital skills shortage in industry, Craffert *et al.* (2014) convincingly proposes that higher education groom students so that they are adequately prepared with the required digital skills to facilitate proficiency and efficiency in the workplace, thereby ensuring future digitally skilled employees. In addition, the rapidly advancing nature of digital technologies has prospective implications for all professions and jobs, and have to first be understood in order to train the future workforce.

Although Craffert *et al.* (2014) have identified that a digital skills shortage existed in the South African industry, they did not investigate the digital skills requirements of South African industries. Additionally, they found that industry is under-utilising their role to steer educational institutions in order to create a synergy between industry and academia. Consequently, it was highly recommended that partnerships be formed between industry and educational institutions, with the aim of guaranteeing that industry receives the necessary digital skills for a successful digital economy (Craffert *et al.*, 2014). Furthermore, many years have passed since their study was conducted, during which time technology has advanced significantly. This doctoral study is an attempt to not only investigate the digital skills needs of the Real Estate, Finance and Business Services sector in South African, but to understand the digital skills preparedness of this sector and uncover the challenges that higher education faces that hinders the alignment of digital skills curricula to meet industry requirements. These challenges may be largely resolved if addressed by government with some assistance from industry with the aim of reducing the unemployment rate and potentially improving the economy.

From an economical perspective, Chetty, Aneja*, et al.* (2018) recommended that G20 needs a holistic digital skills sustenance policy that recognises the essential digital skills required by organisations in developing countries, such as South Africa. They concur that training of digital skills is a vital constituent of acquiring better use of the large investments in technology and infrastructure. Essentially, the fundamental skills required in developing countries are basic entry-level skills related to the computer and information skill-sets. Although, this may no longer be the case with the advent of Cloud Computing, Internet of Things and Big Data. Nevertheless, they believe that digital skills are ‘gateway skills’, aiding students to grasp entry-level skills effectively, in subject areas like

Communication, Media and Technology, and that the lack of these skills denies the student the essential primary footing to acquire admission to formal employment.

In addition, it is important to note that South Africa possesses a significant digital skills shortage, owing to the shortcomings within its education system and inferior infrastructure, among other things. There are also inadequate policies and procedures in place to train individuals in digital skills (Schofield, 2016). Further to that, South Africa has a poor reputation in the articulation and implementation of policy, across its various departments, with prominent delays in data protection and cybersecurity (Sutherland, 2020). Although there has been some development in terms of funding for start-ups and the establishment of technology hubs, these have not yet had a sizeable economic effect (Giuliani, 2018). The country's productivity growth needs improvement, in order to sustain structural transformation. According to Sutherland (2020), African businesses fall behind global productivity measures in several labour attracting sectors, therefore businesses ought to enhance their productivity if they wish to sustain long-term growth. The South Africa government needs to evaluate the policies and practices of first world countries, in order to speed up the process of addressing the digital skills shortage. It may not be a 'one size fits all' solution, but the international policies and practices can be adapted to suite the South African context. However, the main issue is that South Africa is presently unaware of the magnitude of the digital skills gap, as well as the specific characteristics of the gap.

In contrast, with the aim of addressing the digital skills shortage, the United Kingdom's (UK) House of Lords' Digital Skills Committee expressed that digital skills should be a core subject equivalent to the level of literacy and numeracy (Lill, 2015). In another report on the UK's digital future, the committee recognised that the labour market is fundamentally changing due to the digital revolution (Lill, 2015). The European Commission claims that approximately 90% of jobs in the field of architecture, accountancy, art, medicine, engineering, nursing and other careers, may soon necessitate varying levels of digital skills (Lill, 2015; TurculeŢ & MihuŢ, 2015). Being a developed country, the United Kingdom (UK), has recognized that the digital transformation[2] has greatly impacted their economy, and as a result they have implemented policies to enhance its citizens digital skills. This endeavour was initiated to benefit the UK's economy. In addition, research advocates that skill-biased technological transformation is swiftly moved to the developing countries from first world countries (Vivarelli, 2014), such as the introduction of 5G networks into South Africa. For this

[2] Digital Transformation is about using innovative, high-speed and rapidly changing digital technology with the aim of solving problems.

reason, it can be argued that South Africa as a developing country ought to conform to a digital skills strategy similar to that of the UK, beginning with adequately skilling their graduates and later upskilling all their citizens, otherwise the economy may persist to suffer.

Moreover, the 'South African Qualifications Authority' (SAQA[3]) have not provided for the development of digital skills in their SAQA Framework, (SAQA, 2013). The National Qualifications Framework (NQF) has been used by SAQA to organize levels of learning outcomes, since the NFQ Act of 2008. A few amendments were made to the NQF, but SAQA still did not cater for digital skills inclusion in their NQF Implementation Framework 2015-2020 (SAQA, 2015). South Africa acquires infrastructure and technology from first-world countries, but many of the end-users do not have the crucial digital skills to effective make use of the valuable technology and infrastructure investments by industry and the government. Present international studies on digital skills have mostly been carried out in first-world countries that have more ICT resources and greater ICT development (Ainley *et al.*, 2016). Subsequently, South Africa is yet to ascertain if tertiary students have the vital digital skills needed by their respective industry sector. Tertiary students are primarily pertinent to this digital skills study, as many South African institutions provide their students with computer access. However, a few studies examine the digital skills preparedness among South African university students, across different demographics.

Government, international educators, organisations and academic institutions have collectively identified the necessity to create and implement strategies to advance the digital skills of students as well as the digital skills of the workforce, in order to sustain the economy (Kivunja, 2014, 2015; Phuapan *et al.*, 2016). If students' digital skills do not meet the requirements of industry, it will potentially result in thousands more of unemployed graduates, which will consequently increase the unemployment rate, thereby negatively affecting the South African economy. Consequently, this study attempted to minimize the digital skills gap by first investigating the digital skills required by the Real Estate, Finance and Business Services sector in South Africa. Thereafter, these digital skills requirements were used as a measure to evaluate the digital skills preparedness of final year commerce students from the top four South African universities for the aforementioned sector.

[3] SAQA, a statutory body, oversees the progress of the National Qualifications Framework by articulating and publishing criteria and policies for the registering of organisations, as well as the application of the framework by guaranteeing the accreditation, registration and assignment of functions (South African Government, 2016).

A digital skills framework has been proposed, which can be used as a guide in tertiary institutions to ensure that their curricula is aligned to meet the sector's requirements, thereby producing commerce graduates with the necessary digital skills to be successful in the 21st century workplace. Additionally, it was important to understand the challenges faced by HEIs, the mechanisms used to ensure that their graduates are equipped with the digital skills that industry[4] needs, and the transformation that is required to overcome the obstacles that impede the alignment of the digital skills curricula to industry requirements, as well as to create a synergy between industry needs and academic offerings. The results of this study will contribute to enhancing the SAQA framework, to include in the digital skills aspects that have not yet been implemented.

1.3. Research Objectives

The overall objective of this study was to establish the digital skills preparedness of higher education students for the Real Estate, Finance and Business Services sector in South Africa. The secondary objectives are to:

1. Identify the digital skills that commerce graduates are required to possess for industry.
2. Assess the alignment of final year students' digital skills preparedness to their respective industry sector.
3. Investigate how South African public universities address the digital skills requirements of industry.
4. Identify, if any, the challenges that the top four universities face, which prohibit the alignment of students' digital skills to industry.
5. Explore the how the academic leadership at the top four universities envisage a change to address the needs of industry.

1.4. Research Questions

In order to achieve the study's overall objective, the key research questions were as follows:

1. What are the digital skills that industry requires university graduates to have when they enter the Real Estate, Finance and Business Services Sector in South Africa?
2. Are South African universities adequately preparing students with the necessary digital skills required by the aforementioned sector?

[4] From here on out the word 'industry' is used to refer to the Real Estate, Finance and Business Services sector of South Africa, in order to improve readability.

2.1. What are the tertiary students' digital skills preparedness for the career path they have chosen?

2.2. Are the students' digital skills preparedness aligned to industry requirements of the said sector?

3. What policies and procedures do these universities adopt with the intention of aligning the institution's curriculum to the industry requirements with regard to digital skills?
4. What are the challenges faced by these universities that reduces/impedes the curricula alignment to the digital skills requirements of industry?
5. How do South African public universities address the digital skills needs of industry?
6. How do the academic leadership at the top four universities envisage a change within their institution with the aim of addressing the needs of industry?

1.5. Theoretical framework

Chinien and Boutin (2011) reviewed nine theoretical frameworks based on digital literacy, ICT literacy, information literacy and digital skills from several countries, namely Australia, New Zealand, United Kingdom, United States and the Netherlands. Based on their systematic review of international literature, they developed the digital skills framework (see Figure 1). They performed online consultations with 20 Small to Medium-sized Enterprises (SMEs) that were selected from different industry sectors throughout Canada to authenticate their proposed digital skills framework. The key respondents for their consultation comprised a purposive sample of 20 SMEs delegates derived from the subsequent sectors: "manufacturing (n=3), accommodation and food services (n=3), primary health care and social services (n=4), utilities and construction (n=3), wholesale/retail (n=4), and transportation (n=3)" (Chinien & Boutin, 2011, p. 34).

Additionally, they selected informants based on suggestions made by key players in each industry sector. Their survey consisted of two sections:

- Section 1 - Assessment of the relevance, accuracy and clarity of the proposed Canadian Digital Skills Framework, its skills concepts and their definition;
- Section 2 - Validation of the digital skills included in the proposed Canadian Digital Skills Framework in terms of their perceived degree of importance, frequency of use and workers' proficiency level (Chinien & Boutin, 2011, p. 14).

Their framework consists of four constructs, namely Digital Information Processing Skills, Traversal Skills, Digital Technical Skills, and Foundational Skills. However, only one construct was adopted for this study (i.e. the Digital Technical Skills construct), which includes three sub-constructs (i.e. digital information processing skills, traversal skills and digital technical skills). The aim of the present study was to 'zoom' into the digital technical skills of commerce graduates to assess their digital skills preparedness for the Real Estate, Finance and Business Services sector of South Africa, therefore the remaining three constructs were excluded. The Digital Technical Skills construct was used to underpin the research instruments for phases one and two of this study. Given that this study adopted a multi-phased mixed methodology to achieve the research objectives, it was necessary to use a conceptual framework, as well. A conceptual model was created as a 'blueprint' for this study, since the methodology was somewhat complex, and has not been previously used in this context. The next section describes the conceptual model of this study.

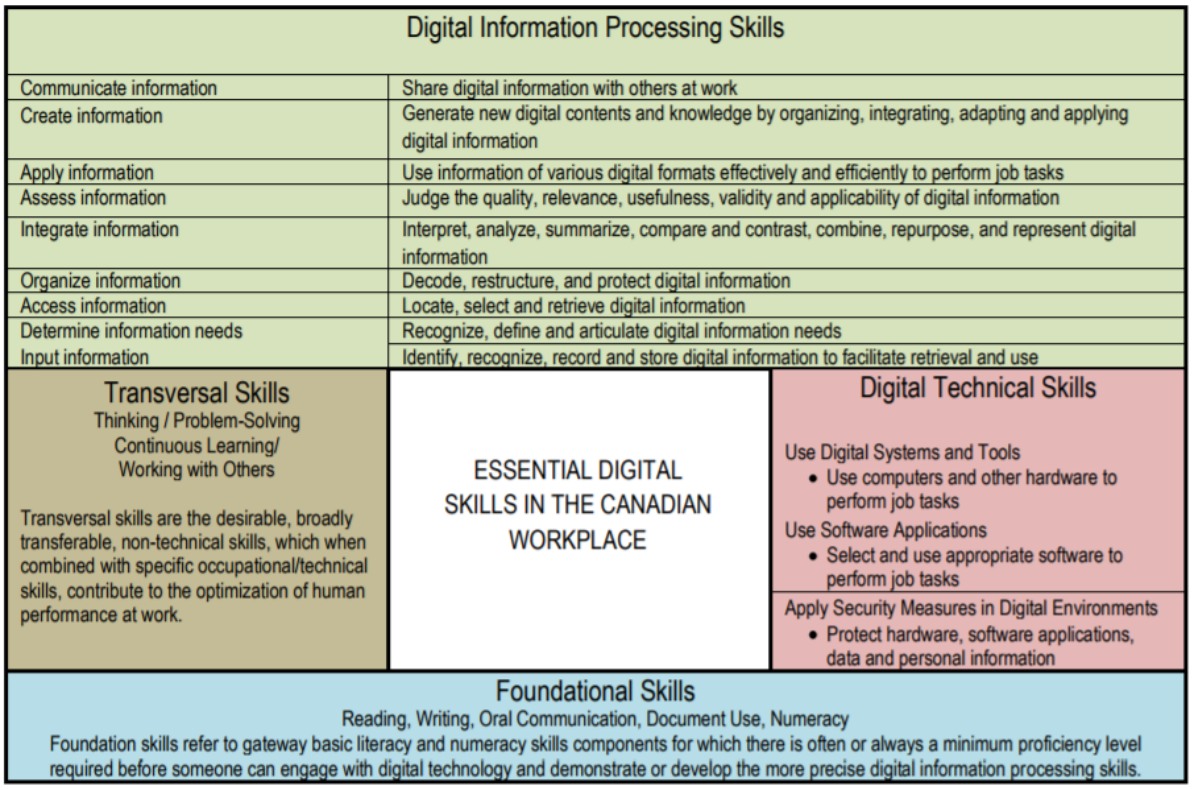

Figure 1 - Canadian digital skills framework: Essential digital skills in the Canadian workplace (Chinien & Boutin, 2011)

1.6. Conceptual framework

According to Sekeran and Bougie (2009), the independent variable is said to positively or negatively influence the dependent variable. Though, the dependent variable is of primary interest in a research

project, the dependent variable is the effect caused by the independent variable (Neuman, 2011; Sekeran & Bougie, 2009). In this study, the independent variable is the students' digital skills attained from the tertiary institution, and the dependent variable is the digital skills preparedness of students for industry. The independent variable will be manipulated in order to determine how it influences the dependent variable. Essentially, the degree of digital skills attained from the tertiary institution will elucidate the variance in the dependent variable (see Figure 2 for the conceptual model).

A few intervening variables have also been identified, which is said to have an impact on the relationship between the dependent and independent variables, and is typically "caused by the independent variable, and is itself a cause of the dependent variable" (Crossman, 2017, p. 1). The dependent variable (i.e. digital skills preparedness of students for industry) is further influenced by the following intervening variables:

- institutional teaching and learning (T&L) curriculum;
- institutional policies and procedures used to align T&L curriculum to the digital skills needs of industry;
- institutional challenges that impedes its students' digital skills development;
- required institutional transformation to better align their T&L to meet industry requirements.

The relationship between the digital skills obtained from a tertiary institution and the students' digital skills preparedness for industry will be influenced by these intervening variables. It is argued that to adequately prepare students with the needed digital skills to meet the demands of industry, students must be provided with a curriculum that aligns to the 21st century demands by highlighting digital skills development (Rosen, 2015). Policies and procedures of tertiary institutions should also be reviewed, in order to make certain that they meet industry demands. Institutional challenges would negatively influence the digital skills readiness of students; hence, it is important to identify these challenges. The institutional transformation of each of the top four universities is an important factor to better align T&L to meet industry needs and would positively influence the digital skills readiness of students.

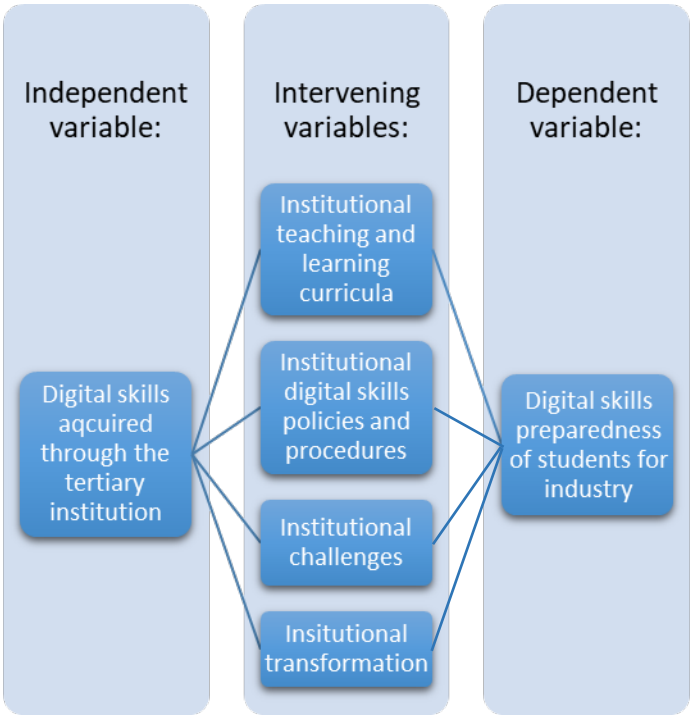

Figure 2 - Conceptual model

1.7. Significance of the study

The then South African Minister of Telecommunications and Postal Services, Siyabonga Cwele, and his Cabinet approved the 'National Integrated Information and Communication Technologies (ICT) Policy White Paper' (Qoza, 2016). The paper is a milestone towards using technology to develop "a seamless information infrastructure by 2030 that will underpin a dynamic and connected vibrant information society and a knowledge economy that is more inclusive, equitable and prosperous" as part of the National Development Plan (NDP) (Qoza, 2016, p. 1). This study is aligned to the approved ICT policy mentioned above, and since the policy aims at building a seamless information infrastructure, it is important that all sectors adhere to the approved policy. Specifically, it is imperative that institutions of higher education adequately prepare the future workforce of South Africa to embrace the ICT vision as proposed in the NDP. This can be achieved by ensuring that all graduates are equipped with the digital skills required by the ICT-driven industry structure.

It is also important that industry actors recognize the need to form partnerships with institutions of higher learning, in order to build a digitally sound workforce. This, in turn, will help the South African economy to thrive and be globally competitive. The new knowledge that is generated is an understanding of the alignment between industry requirements and higher education curricula in

South Africa. Furthermore, the findings from this study ought to help tertiary institutions' to better understand industry requirements, so they can adjust their curricula accordingly.

One of the outcomes of this study is a proposed digital skills framework that will involve all stakeholders (i.e. industry partners and higher education) to build a digitally sound society in preparation for the anticipated seamless information infrastructure that is envisioned to materialize by 2030. Additionally, the proposed framework will assist other countries that are struggling to improve the digital skills competence of tertiary students. Research suggests that digital skills offers many benefits, such as improving productivity and streamlining administrative tasks, therefore the end result of this study is envisaged to contribute to South Africa's economy (Abbas *et al.*, 2019). Consequently, the survival of an economy partly depends on the digital skills of its workforce. A report by Empirica (2019), emphasizes a pressing need for superior data to give stakeholders crucial insight into the magnitude and nature of shortages in digital skills, the returns on South Africa's training and education system, and business investment in training. They plan on establishing a new, central coordinating body in order to achieve their critical goals above. However, this study can provide immediate insight into some of the urgent unanswered questions that would take a significant amount of time to answer.

Furthermore, this study offers plausible solutions that may provide guidelines for policy documents on digital skills, so that South Africa may produce digitally skilled graduates more effectively than anticipated. If South Africa does not keep up with the 'digital revolution', this could have devastating consequences on the economy in due course. Furthermore, the digital skills framework ought to contribute to the South African National Qualifications Framework in addressing digital skills requirements. Kivunja (2014) emphasises that graduates ought to be prosperous in the present and future 'Knowledge Age Economy'.

1.8. Overview of the study

The chapter descriptions are presented below as an outline to the study:

- Chapter 1 provides the background of the study, outlines the research problem by presenting some of the national and global issues around the graduates' digital skills preparedness for the job market, and presents the research objectives and research questions. This chapter also discusses the theoretical and conceptual framework that underpin this study, and elucidates the significance of the study.

- The existing literature pertaining to the study's research objectives are explored in Chapter 2. This assists in positioning the study and defining the terms used. The evolution of technology has contributed to the digital skills crisis, which has implications for teaching and learning and greatly influences the economy, as well as the way in which organisations conduct business. Numerous studies and reports have found that many graduates entering the labour market lack the core digital skills required for a successful career. As a result, some industry sectors have identified the need to establish and implement plans and proposals for digital transformation in each sector, with the aim of digitally skilling the recruits in their sector. Furthermore, South Africa has not yet implemented a digital skills framework with the intention of aligning the curricula to meet the needs of industry. Many authors agree that this alignment is necessary if a country wishes to compete successfully in the digitised, global economy. The chapter further explores other studies that have investigated various components related to digital skills. The literature particularly pertaining to the second digital divide and policies regulating digital skills development are then scrutinized. Lastly, the chapter concludes by discussing the challenges that hinder the successful implementation of digital skills into curricula.

- Chapter 3 provides details about the pragmatic research paradigm applied to this study. Since, multiple research phases were necessary to achieve the study's objectives, a multiphase mixed methods approach was adopted by combining sequential and concurrent strands over a period of time. The study constituted three phases of data collection, therefore four key decisions had to be made and are thus discussed in relation to the study under investigation. The five elements pertaining to pragmatism (that is, ontology, epistemology, axiology, methodology, and rhetoric) are discussed, as well as data quality control and ethical considerations.

- With the intention of answering the research questions outlined in section 1.4, the study was divided into three phases. The first phase was to establish the digital skills needs of the Real Estate, Finance and Business Services sector and to answer the first research question. The findings and analysis of the quantitative data collected from the said sector for phase one are presented in Chapter 4. Descriptive statistics, frequency distributions and exploratory factor analysis were used to analyse the quantitative data for this phase. The mean, average and variability is calculated for most data sets. Correlations and cross-tabulations are used to describe the relationships between variables. Inferential statistics, such as Chi-Square analysis and Bartlett's Test of Sphericity, is performed, in order to make inferences about the population.

- Chapter 5 presents a proposed digital skills framework constituting three main constructs that emanated from Chapter 4 of this study. The first construct is pertinent to digital skills related to the use of software applications and Web tools, while the second construct is pertinent to digital skills related to the use of information systems and the third is pertinent to digital skills related to the application of security measures in digital environments. Each construct within the framework is broken down into individual digital skills and then explained. Thereafter, the importance and contribution of this framework is also discussed.

- Chapter 6 discusses the findings and analysis of the quantitative data collected from final year commerce students at four leading universities in South Africa for phase two, which entailed a survey of final year commerce students at the top four universities in South Africa. This phase was to determine the perceived digital abilities of these students and their digital skills preparedness for the industry that they typically feed into (i.e. Real Estate, Finance and Business Services). Therefore, this phase was designed to answer the second research question. The data from phase one was then compared to the data from phase two, in order to determine the digital skills preparedness graduates for the said industry sector. Descriptive statistics, frequency distribution and factor analysis were used to analyse the quantitative data for this phase. Correlations, cross-tabulations and inferential statistics was also employed for phase two, in order to make sense of the data.

- The penultimate chapter discusses the findings and analysis of qualitative data collected for phase three, which involved interviewing the academic leader (AL) of Teaching and Learning, or the equivalent, in the school/college/faculty of commerce, from each of the top four universities in South Africa. This phase helped to understand the policies and mechanisms used by these universities to address industry's digital skills requirements, the challenges faced by these institutions that hinder the curriculum alignment to industry requirements, and the envisaged transformation needed to ensure that the curriculum of these institutions meet the digital skills needs of industry. Hence, this phase was designed to answer research questions three to six.

- Chapter 8 concludes the study and presents recommendations which are structured by first revisiting the research questions, summarising the key contributions of the study, following a discussion of the study's implications and recommendations. Thereafter the limitations of the study are highlighted, suggestions for future research are offered and finally concluding remarks of the study are made.

1.9. Chapter summary

Some of the global issues around digital skills preparedness were presented in this chapter. Studies have found a digital skills shortage of graduates entering the labour market, which ultimately affects a country's economy. Additionally, this chapter discusses the background of the study, highlights some of the main problems regarding the graduates' digital skills preparedness, and outlines the research objectives and key research questions. It also explores the theoretical framework adopted, presents a conceptual framework necessary for this study, provides definitions of relevant terms, points out the study's limitations and provides an overview of the study.

Research advocates that there is inconsistency with the definitions of digital skills, literacy and competence, and that these terms are frequently used interchangeably. The discussion of these varying definitions ensues in Chapter 2.

CHAPTER 2 – LITERATURE REVIEW

'Information and Communications Technology (ICT)' is now a pervasive means of enhancing supporting economic development, educational systems, offering access to information and expertise to aid agriculture, health and educational developments, in addition to connecting learners, educators and communities (Ainley *et al.*, 2016). However in order to utilise ICT effectively, requires digital skills, and Internet access and technology provisions (Ainley *et al.*, 2016). Before getting into the details of these concepts, it is necessary to first unpack their definitions.

Chapter 2 discusses the definitions of digital literacy, ICT literacy and digital competence, as well as the digital skills crisis that a developing country, such as South Africa faces and its influence on the economy. In addition, this chapter explores the attributes of digital skills with regard to teaching and learning (T&L), digital skills in organisations coupled with the plans and proposals to expand the proficiency pertaining to the digital skills of the workforce. It also highlights a crucial need for a digital skills framework in South Africa's higher education policies, digital literacy in relation to academic success and further explores digital skills/literacy frameworks, as well as similar studies investigating digital skills.

Various journals, e-books and databases were searched for relevant literature related to digital skills. Owing to the vast amount of literature available on the Internet, it was necessary to narrow down the search criterion by aligning it in a manner that addressed the research questions of this study. Some of the search terms/phrases used were: digital skills preparedness in higher education, digital skills policies; institutional challenges associated with the implementation of digital skills, alignment of digital skills curriculum to industry needs, digital transformation, plans and proposals for digital skills, digital skills frameworks and many more. As the researcher was reading each study, other themes began to surface, which lead to the growth of this chapter. It was also necessary to search for terms that were related to the conceptual framework, in order to better understand each variable, and to investigate what other researchers have already found on the variables.

2.1. Digital literacy vs. ICT literacy skills vs. digital competence

Digital literacy and ICT literacy are conceptualised in various ways. However, the term digital literacy has generally been used with regard to a broader variety of technologies, although these terms overlap to a significant extent and are frequently used interchangeably (Ainley *et al.*, 2016). On the other

hand, Phuapan *et al.* (2016) found that the terms 'literacy' and 'competence' were used interchangeably. Van Deursen (2010) suggests that literacy denotes certain proficiencies and knowledge, while skills signifies the more technical attributes of these proficiencies and knowledge. According to Trilling and Fadel (2009) there are four digital literacy skills, namely*: information literacy, computing literacy, ICT literacy and media literacy*.

The International ICT Literacy Panel (2002, p. 2) defines ICT literacy as the use of "digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society." However, computing and information literacy is defined by Fraillon, Schulz, & Ainley (2013) in Ainley *et al.* (2016) as one's ability to utilise computer technology to create, research and communicate, so as to effectively participate at home, school, the place of work and in society. Additionally, Ala-Mutka (2011) defines competence as one's proficiency to utilise knowledge and abilities to diverse contexts, for example leisure, work or learning.

Ferrari (2012) broadly defines digital competence as the vital, creative and confident use of ICT to attain objectives associated with learning, work, leisure, employability and participation in society. She further explains that digital proficiency is a crucial competence that facilitates other key competences (e.g. mathematics and language). Moreover, digital competence is associated with several 21st century skills that should be obtained to ensure active participation in the economy and society (Ferrari, 2012). Islas and Rafael (2013) explains that digital literacy encompasses prerequisites of access, abilities, attitudes, skills and competencies that network among themselves to advance the potential of exploiting the probable advantages of utilising digital technologies. Ainley *et al.* (2016) reviewed numerous definitions of ICT and digital literacy and found that in spite of differentiations in terminology, there are many similarities across those definitions. However, there is still much debate around the definitions of digital skills, digital knowledge and digital competence (Iordache *et al.*, 2017).

To be 'digitally literate' comprises concerns of privacy and safety, cognitive authority, ethical, responsible and resourceful use of digital media, amongst other matters (Meyers *et al.*, 2013). However, a skill is largely defined as the educated ability to accomplish actions with mastery and ease, without needing a great deal of conscious effort (Belin *et al.*, 2014). When associated with a digital tool, a skill incorporates the proficiency to operate and manipulate the tool, and to utilise it appropriately, with other resources, to attain assigned goals (Belin *et al.*, 2014). A complete

understanding of digital literacy must encompass a spontaneous understanding of oneself with respect to digital services and technologies, knowledge of social and technical networked structures, as well as an awareness of the social attributes that shape the digital engagement in the digital age of Web 2.0 and social media (Meyers *et al.*, 2013). Gekara *et al.* (2017, p. 6) define the term digital skills as "a combination of a digital mindset (hardware, software, information, systems, security and innovation), knowledge (theoretical comprehension and understanding), competence (cognitive and practical knowhow) and attitude (value and beliefs)". This definition will be adopted for the purpose of this study, since the concept of 'digital skills', as opposed to digital competence/literacy is the focal point of this study.

2.2. The digital skills crisis

The literature that has been explored below reveals that digital skills is a core skill, on the same level as mathematics, and is required by most sectors, globally. It was necessary to examine global research and reports, as there are not many local studies to explore. In addition, the examination of international studies and reports also highlights that digital skills are a core competence necessary to compete successfully in the digital economy. Mills *et al.* (2018) carried out a survey of 2,700 newsroom managers and journalists from 130 countries. It was found that numerous newsrooms were deficient in 23 fundamental digital skills, which include engaging the audience on social media platforms, digital photography, using Web statistics and analytics, video creation and editing, in addition to working with graphics. The calls from industry leaders to resolve these issues have been addressed, as educational institutions have created reports or organised workshops concentrating on incorporating digital skills into the revised curriculum (Mills *et al.*, 2018).

Chetty, Qigui*, et al.* (2018) suggests that equal emphasis should be given to digital skills growth and to infrastructure improvement, with the intention of promoting digital transformation. They point out that inadequate attention has been given to the digital skills need, and is to some extent caused by the issue of measuring and defining 'Digital Literacy'. Developing countries, like South Africa, are investing millions in infrastructure. However, they maintain that it is unlikely that these developing economies will leverage the maximum potential from these investments if it fails to have a comprehensive skilling programme to educate its citizens.

Schofield (2016) conducted a South African Skills Survey to identify pertinent skills required by corporations, as well as practitioner's current digital competence and their objectives for potential skills development. He found that there exists a critical necessity for digital skills, and thus envisages

the situation to worsen. For this reason, continuous and substantial investment in education and training is needed to minimize this skills gap for all levels of education (Schofield, 2016). An insert from the Sector Skills Plan (2014, p. 62) in Schofield (2016, p. 12) emphasizes the following:

> The ICT industry cannot afford to wait for local, regional, or national government to provide solutions to the skills crisis. Tertiary education institutions do not possess the required responsiveness. The ICT profession will have to own, and solve, the crisis through an ecosystem of scalable initiatives. A culture of 'learn from at least one other, and train twice as many' is required.

This implies that HEIs ought to take a larger role with regard to expanding their students' digital skills. Globally, a growing number of individuals believe that they require further formal adult education in order to acquire and enhance their digital skills (de Greef *et al.*, 2015). Some large corporate, such as Google Africa have identified the seriousness of the lack of digital skills in Africa and promised to train a million people, in order to contribute to Africa's developing digital economy (Banjo, 2016). However, the actual number of people from Africa that have been trained to-date, by Google, is not available.

The first digital divide dealt with the problem of access to technology. However, technology and services are now widely available, but people seem to frequently lack the basic skills necessary to use those services (Oyedemi, 2014; Vītoliņa, 2015). Digital skills are said to be basic to digital competences, which mean that citizens need to be provided with the education, skills and lifelong learning methods to improve employability, social inclusion and prosperity of their lives. The lack of digital skills is considered the 'second-level digital divide', which is becoming the fundamental factor causing the existing broad inequalities of why and how people use technology and the Internet (Pagani *et al.*, 2016). The e-inclusion process correlates to attaining digital skills, as the lack of these skills is considered a barrier in the learning process of fresh digital competences (Vītoliņa, 2015).

However, Oyedemi (2014) found that content creation for most students was a challenge and that hardly any of them have ever posted an online video, a few have posted photos, but a worryingly large number have not once created online content. His study mainly focuses on Internet skills, but he suggests that the terms 'Internet skills' and 'digital skills' can be used interchangeably. This is a major cause for concern, since Internet skills is a component of digital skills, which comprises several other components. According to Schofield (2016), another major concern is South Africa's ability to expand economic activity and generate more jobs, which is largely constrained by the digital skills shortage. He further points out that the South African education system constantly fails to deliver

students' who are competent in applying technology in routine tasks and those who are adequately trained for the job market, after exiting the education system. In addition, he claims that there are a few individuals in the education system, as well as in industry who hold the needed digital skills to attract the investment they deserve. Frequently assuring that policies are sufficiently agile to the changing attributes of digital skills and assessing digital literacy, will ensue digital competence across a country (Chetty, Qigui*, et al.*, 2018). The mere absence of digital literacy hinders an individual's full potential of being a proficient student, an involved citizen and/or an empowered employee.

2.3. Digital skills in teaching and learning

Kivunja (2014) maintains that over the centuries, frameworks were provided by foundational paradigms that directed T&L, particularly associated with the Industrial Age where productivity and profits were amplified by memorization, specialization and compartmentalization. However, in recent decades, the ubiquitous penetration of technology into routine activities has altered the lifestyle of millions of people, over and above the methodologies adopted by 21st century industries and professions to function (Kivunja, 2014). He explains that to sustain a competitive advantage, every industrial company were forced to adopt technology or risked dropping profit margins, which is what obliged companies to establish innovative technologies in the manufacturing activities and therefore required their staff to acquire new skills, which is how 21st century essential digital skills requisites transpired (Kivunja, 2014).

Mills *et al.* (2018) conducted a pilot study to examine the undergraduate curricula for communication programs and journalism, in the Middle East, in order to assess if and in what way digital skills were included in their programs. The authors collected university catalogues, course descriptions and program descriptions from each university, which were analysed to assess the inclusion of 23 digital skills into their mass communication and journalism programs. Their research shows that programs have been gradual to integrate digital skills into their curriculum regardless of demands from industry leaders for nearly a decade. Furthermore, skills concentrated mainly on video production, audio production and website design, while programs highlighting analytics, virtual reality and podcasting were barely offered.

According to Park (2016), digital skills were once considered niche skills, but they are now considered a core competency essential to prosper in most careers, and are therefore regarded as a vital element of a comprehensive framework for higher education. She emphasises that the absence of a national digital skills education programme, results in the unequal access to and distribution of

technology, thereby exacerbating inequality and impeding socio-economic mobility. She thus recommended that each individual should possess the following skills (see Figure 3) for digital citizenship, which has frequently been disregarded by leaders and educators. National leaders need to recognise the significance of digital citizenship as the basis of digital intelligence and they should prioritize to implement digital citizenship curricula as part of a general digital intelligence education framework (Park, 2016).

Figure 3 - Digital Skills That Every Citizen Should Have (Park, 2016)

Evangelinous *et al.* (2016) evaluated the proficiency of students when presented with digital badges in acknowledgement of the digital skills developed by taking courses in their fields of study. HEIs are compelled by rising pressures for the workforce to be digitally proficient to appraise their syllabi and to make certain that digital skills are entrenched as a graduate attribute (Evangelinous *et al.*, 2016; Quality Assurance Agency, 2014). The UK has expressed, on various occasions, by numerous stakeholders their determination to expand the digital skills that their labour force possessed, in addition to the overall population. The Unites States' ICT assessment comprises computers and software proficiency, hand-held digital devices, protocols and networking systems, and technologies that allow users to communicate, access and create information, as well as participate in innovative articulation (Ainley et al., 2016).

The fundamental incentive for nurturing students' digital skills have been recognized as a prerequisite by professional bodies, employers, and government tactics and policies (Evangelinous *et al.*, 2016; Quality Assurance Agency, 2014). Although they have identified that employers and professional bodies require digital skills in the UK workforce, they have failed to investigate the exact digital skills requirements by employers. Their study focused only on healthcare professionals and curriculum. They assert that digital skills are developed when using digital technologies to accomplish specific tasks. They further maintain that initiating institutional quality-control processes will assure that graduates possess the fundamental digital skills essential to their particular field. Moreover, digital skills training corresponding to their particular field encourages graduates to become mentors and pioneers of digital technologies in their disciplines (Evangelinous *et al.*, 2016).

In 2006, the European Council recommended fundamental competences for lifelong learning (TurculeȚ & MihuȚ, 2015). The council explained that digital competence encompasses the critical and confident utilisation of 'information society technology' (IST) for learning, employment, communication and leisure. Digital competence is supported by fundamental ICT skills, such as the computers usage to produce, retrieve, access, store, exchange and produce information, in addition to participate and collaborate by means of the Internet (TurculeȚ & MihuȚ, 2015). Their findings revealed that, from an international perspective, a large percentage of teachers require professional development in ICT skills for teaching. Additionally, their study revealed that ICT is used in schools for instructional delivery systems intended to enhance knowledge and skills in the learning process.

A great deal of research explores the diverse dimensions of digital skills levels and Internet use among young adults. Vītoliņa (2015, p. 86) conducted a study based on the "e-inclusion digital skills model". The aim of her study was to explore the strategies of assist students in utilising the digital skills that they developed during training and to evaluate the effect of students' former skill level. She found that digital skills were being employed pragmatically only when the student's level of knowledge before studying a new area is greater than the average. Additionally, Tiatri and Jap (2015) asserts that technology development positively impacts complex thinking skills, when assessed by verbal intelligence. Following the study of learning paradigms that has guided education over time, Kivunja (2014) concludes that a curriculum and pedagogy modification to a paradigm that focuses on problem solving and critical thinking is necessary.

Moloney and Farley (2015) observe that the healthcare industry is rapidly advancing parallel to the plea for better agility in the education system of a fast-changing world and students who want

to progress in healthcare should make sure that they have a broad range of digital knowledge, specifically since they provide vital information regarding the health conditions of their patients. Consequently, strong investments in infrastructure is required to enable the implementation of healthcare education technologies, like electronic health records, remote access systems, patient tracking systems, telehealth, and, above all, patient and staff education in these areas (Moloney & Farley, 2015). They suggest that owing to the fact that technologies are constantly evolving, student nurses should become familiar with technologies and digital skills that ensure their application in the healthcare context is efficient, secure and comprehensible. PriceWaterhouseCoopers, has estimated that enhancing the use of technologies may save the health sector around $5.7 billion a year, seeing as digital literacy is now crucial in the medical profession (Lill, 2015).

Pagani *et al.* (2015) examined how digital skills influence academic performance. They surveyed 2,025 students from 51 Italian schools. Their study showed that better Internet information skills yield improved scores in math and literacy. According to Vītoliņa (2015), digital skills are typically cultivated by T&L. So, it is therefore crucial to provide practical training. Brown (2015) insists that digital skills are compulsory for success, scholarship through physical and virtual environments, invention and creativity, supporting digital and open resources, and research in real-time. Trilling and Fadel (2009) identified digital literacy skills as a key domain necessary for an educated person in the 21st century, in addition to literacy and numeracy. They discovered that graduates from school level to tertiary level in the United States, lacked majority of the required skills that are necessary in today's industries, which are the conventional primary skills, life and career skills, learning and innovation skills, digital literacy skills (Trilling & Fadel, 2009). It is therefore essential for students to be educated so that they are fully equipped with skills of the new learning paradigm for the 21st century workplace.

It is recommend that to educate students in digital literacy skills, they should be taught methods to analyse media, to interpret messages, as well as to apply the importance of ethical and legal matters associated with the use and access of media (Kivunja, 2014; Trilling & Fadel, 2009). A pedagogical paradigm shift is essential, in an attempt to equip students with valuable education, so that graduates are geared up with the necessary competencies needed for the 21st century workplace, such as problem solving, critical thinking, teamwork and directing others to succeed in the knowledge/digital economy. According to Adams (2004), the multiple intelligences theoretical framework by Gardner (1983) reveals that another intelligence has emerged, 'digital intelligence'. This framework is considered successful in impacting teaching methodologies. She explains that acknowledging the

presence of digital intelligence, will increase our competence to establish effective strategies based on the new intellectual style that will have positive implications for education and communication. Research reveals a link between technology and the multiple intelligences theory.

The dynamic digital skills needs of organisations should guide HEIs, in redesigning their curriculum to meet the digital skills needs of its respective industry sector. After business' digital skill needs are integrated into higher education curricula, graduates will most probably attain employment in their area of study. With greater employment prospects, there will be greater incentives for individuals to sign up for digital skills modules (Chetty, Liu*, et al.*, 2017). Gekara *et al.* (2017) found that employers articulated digital skills largely from a tool's perspective. For example, instead of indicating the digital skills required, they merely describe the preferred tools prospective employees should be able to employ. Their findings also reveal that Australian vocational education and training (VET) colleges offered many modules of digital skills as electives instead of core modules to the qualifications, which indicates that the training system does not correspond to the 'essential skills status' of digital skills, as would be anticipated bearing in mind their rising significance. Digital materials in training programs is articulated generally, with not much reference to particular tools and systems, in order to make the package adaptable to a range of business systems and tools utilised by various industries throughout all sectors (Gekara *et al.*, 2017).

Gekara *et al.* (2017) revealed that such training is geared more towards developing low-level skills for the simple computer software and hardware usage in data processing from organisational databases and Internet sources. However, contradictory to the increasing industry evidence, which shows a growing demand for high-level skills in cyber-security, data analytics, mobile-related digital skills and social media (Gekara *et al.*, 2017). In light of the inconsistent articulation of digital skills needs and training content, they strongly recommend that a 'national digital skills framework', similar to the 'National Literacy and Numeracy Framework', will help in supporting the digital skills requirements of employers. They claim that the framework may possibly guide the growth of adequate and appropriate skills for the Australian emerging economy. Moreover, a framework of this nature is required to help characterise digital skills training curricula to incorporate the fundamental informational, technological and contextual aspects for continued workforce efficiency in the evolving digital environment (Gekara *et al.*, 2017).

2.4. The impact of digital skills on the economy

Digital literacy is considered a vital ability for absolute participation in a digital economy, as well as in an information society (Ainley *et al.*, 2016). In addition, a director of Google who is South African in nationality, stressed that the Internet has brought about economic development, therefore additional digital skills training programs are required to assist people in Africa to participate in the digital economy (Mosupi, 2016). Furthermore, "Sector Education and Training Authorities" (SETA[5]) have recognised digital skills development to be an essential prerequisite for the economic growth of South Africa (South African Government, 2016, p. 1). Individuals who lack such knowledge and digital skills do not possess the vital capabilities to sustain a thriving digital economy.

It is argued that increasing the quantity of employees who possess globally competitive skills in the services sectors, will benefit not just employers, but also the national economies, holistically (Chetty, Liu*, et al.*, 2017). Kivunja (2015) emphasizes that graduates who lack digital skills will be at a big disadvantage, especially when there exists global competition for such skills. "It is therefore essential that students graduate, having been taught not only how to access useful information, but also how to analyse it, how to evaluate its trustworthiness, validity and reliability, how to use it to solve real life problems, and how to communicate its content effectively with clients in the local and global village" (Kivunja, 2015, p. 177). Funes *et al.* (2018) explains that with the current economic climate, an effective policy to cultivate digital skills may secure a country's private and public sector, and offer a technological benefit and resilience to global competition. On the contrary, not dealing with the digital skills gap the skills shortage will increase further as a result and this will have significant implications for organisations concerning cost-effectiveness, productivity and efficiency (Funes *et al.*, 2018).

Chetty, Aneja*, et al.* (2017) explain that digital skills comprise three levels, namely literacy, fluency, and mastery. Being digitally literate implies that one has the ability to perform basic functions by utilising a variety of digital tools. To be digitally fluent means being further digitally skilled than a digitally literate user, as this user is capable of analysing and processing numerous information types. They describe digital mastery as one possessing the skill to fully utilise the range of digital tools available and be able to generate fresh digital content (Ridsdale et al., 2015 in Chetty, Aneja, e*t al*, 2017). With this in mind, the "South African Department of Basic Education" offers only a single curriculum stream for grades 10 to 12, which is called "Computer Applications

[5] SETA ensures that the skills requirements of the different sectors are recognised, and that ample and suitable skills are immediately available.

Technology" (CAT), and only those students taking this subject are trained in basic ICT skills (Chetty, Aneja*, et al.*, 2017). Their CAT strategy ought to negatively affect the digital skills preparedness of graduates for industry, especially those graduates who require digital skills for their profession, but have not had much exposure during their secondary or tertiary education.

Chetty, Aneja*, et al.* (2017) stress the point that entry level jobs in today's economy requires general digital skills to employ technologies in the workplace, such as routine and physical tasks associated with computer skills. They maintain that intermediate and expert jobs call for ICT specialist skills like developing applications, managing networks and programming, subject to the sophistication of the task. Individuals who have mastered ICT tools have complementary skills, since they incorporate and apply their proficiency in communication and problem solving (Chetty, Aneja*, et al.*, 2017). They further suggest that a 'holistic digital skills upliftment approach is necessitated for developing countries for its citizens to empower themselves and break free from poverty. "Against this changing paradigm towards a progressively digitalised economy and an increasingly digitally infused society, South Africa is reported to lag behind in terms of its digital readiness" (Craffert *et al.*, 2014, p. 4).

2.4.1 The digital economy

It is important to understand what the digital economy is and why it is important to South Africa. The digital economy is a global phenomenon and deals with the manner in which intranets and the Internet are utilised to support economic activity, and includes the usage of electronic facilities to establish lifestyle developments (comprising education, health and well-being), wealth and sustainability (Australian Associated Press Telecommunications White Paper, 2014). For example, the devices used on a daily basis, like phones, computers and game consoles, as well as online maps, Web searches and electronic banking. For many businesses, involvement in the digital economy has become an economic necessity, and they have realised that in order to manage the business proficiently and maintain a competitive advantage, they must embrace electronic commerce. Glavaš *et al.* (2019, p. 1392) explain that the use of digital technologies ought to boost economic growth and "positive overflow effects within and between sectors". In addition, they maintain that smart applications and other technology innovations may also improve services in digital economy and help solve the rising policy challenges in many sectors (Glavaš *et al.*, 2019).

Businesses are progressively adopting electronic tools to process straightforward transactions, support enhanced customer interactions, product advancement or to conduct in-house processes more

efficiently. The electronic tools and services comprise information management, data warehousing, context awareness, information searches, Cloud services, Web 2.0, social media, user generated content, capturing processes and services, collaboration, and visualisation and immersive environments. However, according to the Australian Associated Press Telecommunications White Paper (2014), the challenges of the digital economy are inadequate investment, change management and disruptive services, security, trust and privacy, and skill requirements. Consequently, only those businesses that have adequately prepared will successfully reap the benefits associated with the digital economy, such as novel business opportunities.

2.5. Digital skills in organisations

Information and communication technologies (ICTs) were introduced to business in order to automate specific processes, to attain economies of scale, and to include suppliers and customers. Manufacturing, production and supply chains largely benefited from the usage technology, as well as customer interaction with retailers, which makes extensive use of Point-of-Sale systems (Craffert *et al.*, 2014). Several ICT benefits relate to increasing the effectiveness and efficiency of business, which in turn produces direct benefits to customers. Craffert *et al.* (2014) maintains that regardless of the similarities in the manner in which users experience ICTs, the various business sectors experience varying effects, subject to the adopted business paradigm and the prospect of ICTs to produce substantial gains within the scope permitted by their model. Several studies suggest that modern ICTs, social technologies and the Internet have radically changed industry and business, therefore numerous aspects of their business paradigms should be re-considered (Baby, 2019; Qi & Tao, 2018; Sutherland, 2020).

Craffert *et al.* (2014) emphasises that integrating key digital skills requirements throughout an organisation will not only enhance proficiencies and efficiency, but will also enable the practical talents and progress necessary for nourishing the organisation's competitiveness in the digital economy. Technological advancements have made a profound impact on the transformation of some businesses, to an extent that they are barely recognisable from what they were a decade ago, such as the music and publishing industries. Craffert *et al.* (2014, p. 21) found the most significant challenges that large South African companies experience when participating in digital economies is the "availability of ICT practitioner skills", "the availability of e-user skills in functional business", "understanding the impact of technology", "senior executive e-leadership skills", and organisational agility. They maintain that demand for digital skills to sustain the economy will continue to grow and

as a result, organisations that possess sufficient digital skills will be in a better position to take full advantage of ground-breaking opportunities to adopt electronic processes.

Comprehensive digital skills are needed to unlock notable business value in the digital economy, instead of basic competence within functional and transactional systems, or software packages. Small businesses (SMEs), being the backbone of the South African economy, represent above 90% of businesses in all economies, besides constituting most of a country's employment, practically worldwide (BusinessTech, January 19, 2017).

2.6. Plans and proposals for digital skills (Digital Transformation)

The banking sector has revealed the subsequent implications for digital skills in their skills plan (BankSETA, 2013 in Schofield, 2016). Owing to the merging of technologies, there is a larger need for advanced digital skills. Since numerous companies have been integrated, staff should be conversant in the technologies throughout diverse business units, therefore it is important to finance more digital skills development initiatives. Technology advancements has caused scarce skills to be no longer associated with banking activities alone, because they now include computer programmers, process engineers, as well as personnel from the ICT industry. Evidently, the banking sector largely uses information systems and other technologies in their routine business activities, therefore their employees need to be sufficiently skilled in these digital technologies (Schofield, 2016).

In addition, Schofield (2016) highlighted that the education sector in South Africa also identified implications for digital skills. For example, universities pointed out that they need 200 Systems/Business Intelligence Analysts and 300 Computer/Software Specialists. The universities of technology mainly give attention to network and information security, thereby creating 40 key talent opportunities for both enterprise systems engineers and database administrators (EDTP SETA, 2013 in Schofield, 2016). It is therefore essential to identify the correlation between the 'supply' of digital skills provided by HEI training programmes and industry's 'demand' for digital skills. Furthermore, HEIs must swiftly adapt to meet the digital skills needs of industry. Although the alignment between higher education and industry is multifaceted, this alignment is necessary for developing countries to make progress in the international area. Many studies focus on training learners at school level for the workplace, however the problem needs to be studies at tertiary level. Many graduates pay hefty tuition fees each year, but in South Africa many graduates remain unemployed even after years of searching for employment in their field of study. Resolutions to this dilemma need to be quickly

found, in order to break this cycle immediately, before people start losing confidence in the education system, particularly tertiary education (Calonge & Shah, 2016).

A few researchers have noted a discrepancy of skills among the needs of prospective employers and university graduates (Calonge & Shah, 2016; Kaka *et al.*, 2014; Mourshed *et al.*, 2014). As a result, many organisations have turned to Massive Online Open Courses (MOOC), which behave as a supplementary mechanism with the aim of bridging the skills gaps (Calonge & Shah, 2016). One method of reducing the mismatch of skills is to employ a strategy that fosters sound collaboration between industry organisations and universities. Not only will this initiative assist HEIs in better understanding industry's digital skills requirements, but it also will provide graduates with greater access to employment opportunities. Sequentially, organisations will receive a cohort of digitally skilled graduates, making this a 'win-win' initiative. Furthermore, graduates will be more prepared to handle uncertainties of the job market, as well as to acquire essential future skills making them more employable (Funes *et al.*, 2018).

2.7. South Africa's need for a digital skills framework

World economists concur that digitally skilling workforce is imperative, so as to gain from the vast prospects offered by the digital economy. For this reason, most first world countries have already established, or are currently establishing a digital economic strategy. For instance, the European Union has effectively standardised and certified digital skills with their "International Computer Driving License (ICDL)" module (Chinien & Boutin, 2011, p. 8). Possession of technological infrastructure does not guarantee that South Africa will be successful in the digital economy. Therefore, it is necessary to train the workforce with the ability to employ these vital assets effectively.

There are several skills lists available, but majority of them emphasise computer literacy, digital literacy or information literacy. Furthermore, numerous skills identified were advocated for K-12 education, higher education and/or research students. However, only a few empirical studies investigated the digital skills requirements of industry. The South African government has recognised that digital skills are becoming increasingly vital to their workforce in various sectors and that digital literacy and e-learning programs are therefore vital to growing employability (Cwele, 2016). Hence, the government intends to create a directory of the fundamental digital skills that is needed to partake in a digital society, which includes training and support at public access sites, as well as the

incorporation of digital skills in official primary, secondary and tertiary educational institutions (Cwele, 2016).

The South African government already founded an e-Skills Institute and embarked on a process to prepare an e-skills[6] policy called "National e-Skills Plan of Action (NeSPA)", via the Department of Communication (Van Audenhove *et al.*, 2018). At the time of developing the National Integrated ICT Policy white paper, there were a range of challenges with the existing framework being used (Cwele, 2016). These challenges were disproportionate access to ICT facilities, framework definitions were dated as they did not change in accordance with technological advancements, funding was focused on infrastructure, but no support was available to guarantee that people possess the necessary skills to use ICTs, and the institutional framework and ranks were duplicated and lacked alignment. Hence, in order to successfully implement digital skills training, one would first require an appropriate digital skills framework to form the basis of the training, which meets the digital skill needs of industry. Although each industry sector might warrant different skills, a significant amount of digital skills will overlap across sectors.

2.8. Studies investigating digital skills

Gekara *et al.* (2017) identified the digital skills needs for the Australian workforce and investigated the scope of the "vocational education and training" (VET) system, in addition to industry training programs to successfully meet the rising need for digital skills. Utilising by means of case studies, their study was based on two sectors, that is, public safety and correctional services, and transport and logistics, with the aim of broadly transferring the findings across the economy. Their study used a mixed method approach, where qualitative and quantitative methods were combined. Additionally, it involved the content analysis of industry training packages, the content abstraction and analysis of online job advertisements, and interviews with key industry players, including an employer survey.

Iordache *et al.* (2017) categorised 39 indicators based upon 13 digital literacy frameworks and found it challenging to identify the indicators, particularly owing to the absence of a clear distinction of the definitions and the overlapping of concepts. They highlight that considering the prospective application of the 13 frameworks for the evaluation, comparison and measurement of digital literacy

[6] "In the South African context, e-skills are broadly defined as the ability of people to use and create all forms of Information and Communication Technologies (ICT) in order to achieve equitable prosperity and global competitiveness in general, and to improve their life opportunities in: (i) personal and educational space, (ii) work environments, (iii) community interactions and (iv) participation in government processes" (DoC, 2012, p. 9).

levels, there is a strong need for a predominant unique framework that can be used as a general starting point. The majority of the digital literacy models that they examined, explored skills associated with 'knowing and using digital tools and software', 'knowing and using hardware', and 'knowing and using the Internet'. According to Iordache *et al.* (2017), the following highly relevant competencies are totally absent from these digital literacy frameworks: strategic skills, the ability to use information for personal and/or professional goals, managing a digital identity.

Iordache *et al.* (2017) used the quick-scan analysis method to explore 13 digital literacy models between 2004-2014. They suggest that an individual's socio-economic background is not completely accountable for digital exclusion, and catalysts of digital exclusion extend further than those groups who are socio-economically vulnerable. For this reason, the adequacy of digital skills is of growing significance to guarantee one's complete societal contribution. Consequently, the advancement of digital skills and competencies is a fundamental constituent on the agenda of policymakers, scholars and practitioners globally with the intention of ensuring citizens' proficiency to participate fully in the present progressively digitized society (Iordache *et al.*, 2017).

Pagani *et al.* (2016) conducted their study by merging two data sets to determine how digital literacy affects educational performance. Their study focused on informational digital skills, specifically a content-related aspect of Internet skills that are essential to choose, evaluate and reuse digital information. They surveyed 2025 students from 51 schools, which provided demographic traits of students and a detailed description of how early learners use digital devices, the frequency and nature of Internet usage, and the existence of computer labs and digital devices in the school. Their findings revealed that digital skills have a significant and positive effect on academic performance, and the influence of digital skills differs by student characteristics (Pagani *et al.*, 2016). Consequently, they suggest that curricula directed at increasing Internet skills can play a vital role in decreasing educational inequality and thereby reducing labour market inequalities.

Phuapan *et al.* (2016) conducted their study to determine the digital literacy skills that were most prominent in using digital technology, communication tools and networks to access, create, manage, integrate, evaluate and communicate information so as to function in a 'knowledge society'. They used a multistage random sampling method to survey 400 university seniors. Their digital literacy skill indicators are based on their literature review, Bloom's Digital Taxonomy and five domains from the 'Thai Qualifications Framework for Higher Education'. Assessments of '21st Century Skills' were primarily conducted in developed/industrialised countries and there was scarce

or no experience concerning the application of this kind of research in low-income countries (Ainley *et al.*, 2016). As assessment domains in general may well be conditioned to changes over, an assessment of ICT and digital literacy skills should react to developments in the usage patterns of ICT (Ainley *et al.*, 2016).

The past few decades have presented rapid developments in ICT-related technologies that have influence the way ICT is utilised. Jara *et al.* (2015) used a mixed methods approach to determine and characterise aspects relating to the digital skills of tenth grade Chilean students. A Hierarchical Linear Model was used to establish the factors affecting student performance on the national standardised test. In addition, an exploratory case study was conducted for a detailed inspection of the attributes of low and high-performing students on the test. They found that the most significant factors contributing to the development of digital skills were linguistic capital, access to a home computer, socioeconomic status, and the extent of prior usage of a computer. Their study also indicated that students who performed well in the test were usually able to concentrate on their Internet-based class assignments.

According to the P21 framework[7], the "Information Media and Technology Skills" domain encompasses a variety of critical thinking and practical skills associated with information media and technology, which we all need to exhibit in order to be prosperous in the '21st century economy' (Kivunja, 2015, p. 166). The elements of this domain are three literacies characterized by P21 as media literacy, information literacy, and ICT literacy. Kivunja (2015) asserts that since the current generation of students are 'wired' differently, pedagogues are accountable to ensure that their graduates are prepared with the necessary skills to enable them to reflect, absorb and access, comprehend and utilise information for their individual benefit, in studying, at work, as well as citizenship in the current 'information, media and technology economy'.

Oyedemi (2014) investigated the perceived and actual digital skills of students at ten South African universities. A mixed method study was conducted by surveying 1044 students over 15 months at ten universities (i.e. online and paper-based), and performing skill experiments at two universities to explore the present trends of digital skills amongst university students. His study showed that the high cost of access, methods of Internet access, inequalities and social stratification all have implications on digital skills, with many students facing the challenge of content creation.

[7] The P21 framework illustrates the knowledge and skills needed to succeed in the 21st century society and workplace. It was developed by the US Department of Education and industry.

While the study by Oyedemi (2014) seems similar to this study, there are a few shortcomings. Firstly, the theoretical framework used is based on only a few Internet skills. Secondly, the study fails to investigate the various types of high-level and low-level digital skills required by industry. Merely, knowing what digital skills students possess does not imply that these skills will fulfil all the digital skills requirements by industry. This knowledge gap is a vital component of this study, in determining if tertiary students are adequately prepared with the necessary digital skills for the workplace.

Ferrari (2012) reports on 15 frameworks that foster digital competence, which vary in target groups and scope. She identified three areas requiring attention: a digital competence definition, the recognition of competence themes and an examination of the levels. She points out that numerous frameworks advocate that technical skills represent a key constituent of digital competence. However, she suggests that if technical competence is placed at the centre of digital competence, this would not provide adequate value to other comparably pertinent aspects, as digital competence ought to be recognised, as a multi-faceted model. Ferrari (2013) later conducted another study to distinguish the main constituents of digital competence with regard to skills, knowledge and attitudes required to be digitally competent. The table below is based on some studies that have investigated digital and ICT skills, the type of study method used, the sample size, as well as the outcome of the study.

Table 1 - Studies on digital and ICT skills

Author (Year)	**Location**	**Study Method/ (Target population)**	**Outcome/ Conclusion**
Iordache *et al.* (2017)	Belgium	Quick-scan analysis to explore 13 digital literacy models between 2004-2014	The following competencies are totally absent from the 13 digital literacy frameworks: strategic skills, the ability to use information for personal and/or professional goals, managing a digital identity.
Ainley *et al.* (2016)	Australia	Systematic review of cross-national studies	They identified the criteria to steer the creation of a universal gauge of ICT and digital literacy skills.
Pagnani et al. (2016)	Italy	Random-stratified sampling used to survey (2025 Italian students from 100 classes in 51 schools)	Digital skills are positively correlated to academic achievement.
Phuapan *et al.* (2016)	Thailand	Multistage random sampling method (survey 400 university seniors)	Developed a three-dimensional model illustrating different digital literacy skill indicators.
Continued on next page…			

Schofield (2016)	South Africa	Survey engine hosted online (Employers from 21 sectors represented by SETAs)	All learners must be exposed to and familiar with ICTs with the aim of preparing them to adapt to 21st century ICT technologies to their daily lives.
B. Brown (2015)	Bermuda	Case study summarizing three frameworks	AT21CS, P21 and the Content Standards framework recognise that members of society should be digitally skilled or 'skilled in ICT'.
Jara et al. (2015)	Chile	Mixed method study –Quantitative (23) Qualitative (15) 10th grade Chilean students	High performance in the digital skills tests is due to access to a home computer.
Kivunja (2015)	Australia	Systematic review	Students need to be taught digital skills as an essential skill for the survival of any economy in the 21st century's digital world.
TurculeȚ and MihuȚ (2015)	Romania	Not specified. TALIS[8] survey method (Romanian educational system)	ICT is used as a tool for retrieving resources, analysing, collaborating, and running simulations.
Vītoliņa (2015)	Latvia	Survey of 12 teachers from different vocational schools	The level of ICT activity depends on prior experience and interests.
Oyedemi (2014)	South Africa	Mixed method - purposive sampling to survey 1044 students from 10 universities and skill experiments at two universities	Internet Usage for economic, social, political, e-government, as well as educational activities, posting a video and creating wiki's and blogs.
Islas and Rafael (2013)	USA	Mixed methods – online test 1, online survey, online test 2 (2000 students randomly selected)	The study confirmed that digital literacy ought to be studied more broadly, instead of investigating minor issues.

2.9. Digital skills/literacy frameworks

Table 2 lists some of the existing digital skills/literacy frameworks. Numerous frameworks were examined, but only a handful fitted the selection criteria, which was that the framework be based on digital skills, digital literacy or digital competency, since these terms were found to be used interchangeably (Ainley *et al.*, 2016; Phuapan *et al.*, 2016). The framework also needed to be based on studies concerning adults and not on adolescents. Some of these frameworks will be discussed in more detail below Table 2.

[8] "TALIS examines teachers' beliefs, attitudes and practices, and compares teachers, schools and countries, and it highlights factors which have been shown to be related to student outcomes" (TALIS 2009) in (TurculeȚ & MihuȚ, 2015, p. 355).

Table 2 - Existing Frameworks on Digital Skills/Literacy

Author	**Methodology**	***Framework*/Findings**
Gekara *et al.* (2019)	Mixed-methods: case studies, surveys, literature review, job advertisements, training packages, and existing digital skills frameworks	*The Australian Workforce Digital Skills Framework*.
Van Laar *et al.* (2019)	Quantitative: Survey of 1222 professionals in the Netherlands	Van Laar and her team proposed a conceptual digital skills model that is sequential and conditional in nature. A model name was not provided.
Coward and Fellows (2018)	n/a	*Digital Skills Toolkit*
Health Education England (2018)	n/a	*Health and Care Digital Capability Framework*
Chetty, Liu, *et al.* (2017)	n/a	Identified five digital literacy dimensions that is, "Information Literacy, Computer Literacy, Media Literacy, Communication Literacy and Technology Literacy". Each dimension is affected with respect to three views, that is, Cognitive, Technical and Ethical (Chetty, Liu*, et al.*, 2017, p. 2).
Iordache *et al.* (2017)	Qualitative: Quick-scan analysis to explore 13 digital literacy models between 2004-2014	Categorised 39 indicators based upon 13 digital literacy frameworks and found that the following competencies are widely discussed in almost all 13 frameworks: technical and formal skills, operational, information and cognition skills, the ability to 'evaluate and analyse' content, digital communication skills, and the ability to produce and amend new content and build novel knowledge.
Ainley *et al.* (2016)	Qualitative: Systematic review of cross-national studies	Recommend that any comprehensive learning assessment of ICT and digital literacy should preferably have the four specific features.
Phuapan *et al.* (2016, p. 27)	Quantitative: Survey of 400 university seniors from nine universities in Thailand	*Digital Literacy Skills Indicators*
Continued on next page…		

B. Brown (2015)	Qualitative: Case study summarizing three frameworks	*Bermuda College 21st Century Skills Framework*
Kivunja (2015)	Qualitative: Systematic review	Kivunja (2015, p. 166) studied the digital literacy skills domain and explains that these skills are categorised into four areas, "which the Partnership for 21st Century Skills (P21) identify as the Traditional Core Skills, the Learning and Innovation Skills, the Career and Life Skills, and the Digital Literacy Skills; also known as the Information, Media, and Technology Skills".
Islas and Rafael (2013)	Mixed methods: online test 1, online survey, online test 2 using 2000 students randomly selected	Digital literacy is context specific with regard to technology used. The provision of telecommunications networks would be as unsuccessful in narrowing the digital divide, especially in developing countries
Ferrari (2013)	Mixed methods - conceptual mapping, case studies, online consultations, expert workshop, draft proposals	Presented a multi-faceted digital competence framework of 21 competencies, categorized as five areas of digital competence, namely: content creation, information, communication, safety and problem solving.
Ferrari (2012, p. 43)	Mixed methods – previous work, colleague suggestions, Google searches, curricula documents, international and organizational reports, European Union reports	Studied 15 frameworks to develop the components of the Digital Competence (DIGCOMP) framework for all citizens in Europe. The competency areas that appeared from the 15 frameworks are: "information management, collaboration, communication and sharing, creation of content and knowledge, ethics and responsibility, evaluation and problem solving and technical operations".
Chinien and Boutin (2011)	Systematic review of tools and techniques aimed at evaluating digital skills and suggestions on how to establish a digital skills evaluation mechanism were presented.	Proposed Canadian digital skills framework consisting of four groups of core skills: "(1) foundational skills; (2) transversal skills; (3) technical digital skills; and (4) information processing skills, together with cognitive and metacognitive skills".

Gekara et al. (2019) proposed a digital skills framework pertaining to the Australian Workforce that comprises four general digital skills dimensions, namely: (1) Digital ways of thinking, (2) Digital ways of working, (3) Digital tools for working, and (4) Living in the digital age. Digital ways of thinking, which encompass digital innovation and creativity, problem-solving expertise, practical and

cognitive competence, proficiency and approach that employers require workers to possess. Digital ways of working, which denote analytical, communicative, and collaborative expertise, practical and cognitive competence, proficiency and approach that employers require workers to possess in relation to this digital skills category. Digital tools for working, which comprise ICT and IS knowledge, practical and cognitive competence, proficiency and approach that employers require workers to possess in relation to this digital skills category. Living in the digital age, include digital security, safety, awareness of ethical and social responsibility, practical and cognitive competence, proficiency and approach that employers require workers to possess in relation to this digital skills category.

Van Laar *et al.* (2019) proposed a digital skills model that is sequential and conditional in nature. The sequence of the digital skills model begins with "information and communication digital skills", following "collaboration, critical thinking, and creative digital skills", all of which lead to the problem-solving digital skills (Van Laar *et al.*, 2019, p. 3462). Their statistical results confirmed that the digital skills build one another, sequentially. Additionally, in order to understand which interventions may be effective, the relationships between digital skills must be considered. For example, they found that, apart from the digital skills related to critical thinking, their results verify that all skills directly lead to digital skills related to problem-solving.

Coward and Fellows (2018) developed the Digital Skills Toolkit in the U.S.A. with the goal of digitally skilling the youth nationally, so that the youth will be job ready. Their toolkit contains guidelines for policy makers, an overview of digital skills frameworks, basic and intermediate skills required to be successful in life and work, advanced skills for specialized jobs, organizing campaigns and stakeholder initiatives, leveraging existing training resources, and sample digital skills roadmaps. This toolkit deals with assisting government and other institutions with guidelines on how to go about implementing digital skills. They recommend the "Digital Competence Framework for Citizens (DigComp)" and the "21st Century Skills" frameworks.

Health Education England (2018, p. 2) developed the "Health and Care Digital Capability Framework" to enhance the health and social care provided in England. Their framework consists of six domains: information, data and content; learning, teaching and self-development; communication, collaboration and participation; wellbeing, safety and security; digital identity; technical proficiency; as well as creation, innovation and research. Each domain has a detailed description and constitutes several levels. Within each level, exists several digital skills. This framework was adapted from the "JISC Digital Capacity Framework" by Jisc and Helen Beetham in 2015 (Health Education England,

2018, p. 6). However, although this framework is very detailed, it was designed specifically for the digital skill needs of England.

Ainley *et al.* (2016) reviewed various definitions of ICT and digital literacy used in cross-national studies and explored the assessment approaches of ICT and digital literacy utilised in those studies. They recommend that any comprehensive learning assessment of ICT and digital literacy should preferably have the following features: (1) It should comprise all characteristics of ICT and digital skills, which ought to range from rudimentary skills to expert competence in ICT use. (2) It should enable strong associations among greatly varied countries that range from developing conditions to industrialised conditions. (3) It should facilitate the addition of new-found attributes in forthcoming assessments with the aim of new developments in this agile domain to be incorporated when necessary. (4) It should allow all sub-groups in the population to be assessed, whilst generating comparable measures across a vastly diverse populace.

Phuapan *et al.* (2016) used the multistage random sampling method to survey 400 university seniors and they developed a model with multiple dimensions illustrating various digital literacy skill indicators (see Figure 4). Dimension one was a result of their literature review on digital literacy skills. Dimension two stemmed from Bloom's Digital Taxonomy and Dimension three resulted from "Thai Qualifications Framework for Higher Education" (Phuapan *et al.*, 2016, p. 27).

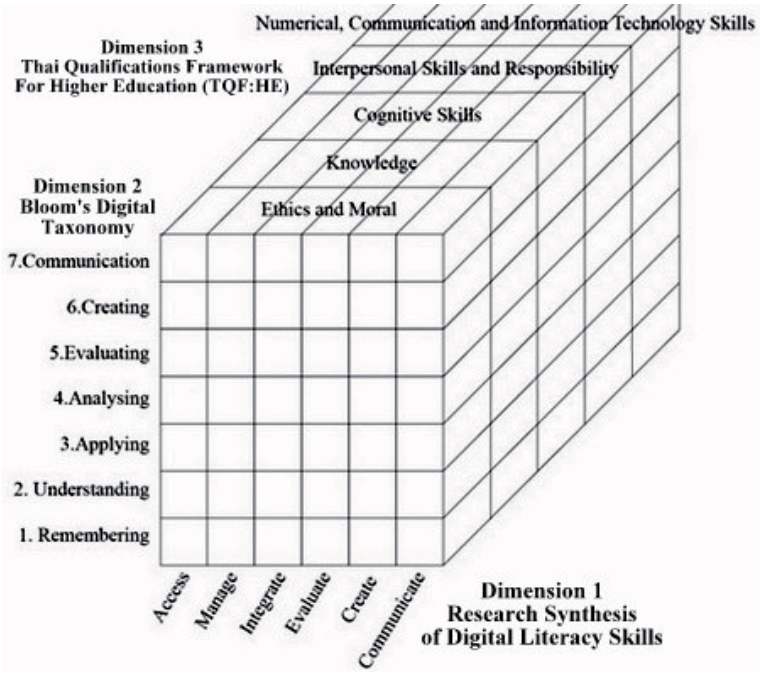

Figure 4 - Multiple Dimensions Showing Digital Literacy Skill Indicators *(Phuapan et al., 2016)*

Brown (2015) investigated the perceptions of Bermuda College employees, by means of a case study, as to which 21st century skills they perceived as essential and why. Brown's Bermuda College 21st Century Skills Framework reveals that digital skill is an essential skill in the 21st Century. Brown (2015, p.60) summarises the three skills frameworks: "Alternative Thinking 21st Century Skills (AT21CS), Partnership for 21st Century Skills (P21), and Content Standards (Stein)". The "Partnership for 21st Century Skills (P21)" has recognized 11 skills essential for college and workplace preparedness (Brown, 2015, p.60). Several of the skills from the three frameworks necessitated the use of technology either as a medium or as a tool. These three frameworks have identified ICT literacy as an essential skill in the 21st century, but they failed to indicate what exactly constitutes ICT/digital skills.

Islas and Rafael (2013) used path analysis as the methodological tool to test a model that measured the series of variable effects that combine the digital literacy construct on academic performance. Furthermore, the study concluded that possessing suitable provisions of access to technology is essential, but it is inadequate for improving digital literacy. Their results revealed that context-specific skills (that is, those skills that pertain to the particular domain in which digital technology is used), also affects academic performance, in addition to conditions of general skills and access. The provision of telecommunications networks would be as unsuccessful in narrowing the digital divide, especially in developing countries (Islas & Rafael, 2013).

Chinien and Boutin (2011) developed a digital skills framework for the digital technologists in the Canadian workforce. Their digital skills framework was developed by integrating numerous skills concepts identified by means of a review of literature: "Digital skills, digital competence, digital literacy, ICT skills, ICT literacy, e-skills, computer literacy, information literacy, media literacy, technological literacy, literacy" (Chinien & Boutin, 2011, p. 6). Their framework comprises four skills clusters: "(1) foundational skills; (2) transversal skills; (3) technical digital skills; and (4) digital information processing skills, including cognitive and metacognitive skills" (Chinien & Boutin, 2011, p. 6). Within each skill cluster, there are several sub-skills embedded. A group of important informants from 20 SMEs and representing different economic sectors validated the framework.

2.10. The second digital divide

Digital technology is a vital component of education, globally. However, in spite of its increasing significance, there exists a usage and digital skills gap in students', which is cultivated by their socioeconomic status (a.k.a. the 'second digital divide'), in several countries globally. The study by

Ma *et al.* (2019, p. 133) was based on the "OECD Programme for International Student Assessment", where they measured two characteristics of the second digital divide of 15-year-old students from 55 countries: (1) Internet literacy, (2) the gaps in educational software usage at home. Their findings revealed that the digital divide is influenced by national revenue and that investments possess varying outcomes subject to a country's income. Research and development expenditure was found to lessen the socio-economic inequality in the usage of pedagogic software solely in low-income nations (Ma *et al.*, 2019). Additionally, they further suggest that educational outlays decrease the Internet literacy variance in countries that acquire high-incomes, although intensifying it in low-income countries.

Litt (2013) suggests that using the Internet holds the ability to alleviate existing economic and social inequalities by offering access to a variety of people and information, the inability to traverse the Internet or make educated conclusions about Internet use, might have the adverse effect, which could intensify such inequalities. This can be seen as a paradoxical result of Internet usage. KAN'AN (2018) points out the existence of a substantial disparity between the Cs21 mean scores of the rural and urban students, which illustrates that the students from villages have problems in using technology. Having access to digital literacy skills is identified as one of four elements necessary for securing digital equity (A. Brown *et al.*, 2019). The 'second digital divide' may be defined as the separation of individuals who can employ ICT effectively and people who do not, and in isolation may be understood as digitally literate and digitally illiterate (Scheerder *et al.*, 2017). However, according to Sunkel and Ullmann (2019, p. 223), the various degrees of ICT interaction are related to the "second digital divide, which affects the type of use (in terms of intensity and variety) and is determined by people's computer and Internet access and skills". Incidentally, Van Dijk and Van Deursen (2014a) maintain that essential to the appropriation process of new technologies are digital skills, and constant motivation and effort are necessary to grow those skills.

2.11. Digital skills and its importance to industry

The use of digital systems and tools has immense benefits at tertiary level, therefore industry employs it to carry out business activities and to gain from its advantages. However, much research focuses on the usage of digital systems and tools in teaching and learning, the health-care industry and forestry. Generic digital tools, like games and social networking devices are being used increasingly more in educational environments, even though they were not explicitly created to support students to cognitively participate in inquiry learning, problem solving, or collaborative knowledge construction (Näykki *et al.*, 2019). The following subsections describes some of the digital systems and tools that are used today, as well as the digital skills importance to industry.

2.11.1. Big data analytics skills

Owing to the rise of big data, enthused organisations have made vast investments towards solutions for business analytics, which is another reason that items 10 and 11 are significantly important (Müller *et al.*, 2018). Most enterprises are now storing Big Data, which is categorised by the 4 V's (i.e. volume, velocity, variety and value), therefore industry fundamentally views this skills as 'very important' (Russell *et al.*, 2018). In order to extract the value from Big Data, organisations need to ensure that their employees are adequately skilled to use software for analysing Big Data, therefore they view item 11, as 'very important'. Furthermore, Müller *et al.* (2018) provides empirical evidence that shows a positive impact of Big Data Analytics on business performance. The 21st century business domain has rapidly evolved by adopting data driven business models, such that many businesses cannot function without accurate analysis of their data. This approach is designed to assist businesses in making informed decisions for the daily running and even gaining a competitive advantage. Therefore, graduates who possess the knowledge of using data management software and software for analysing big data, will be a huge asset to their organisation.

2.11.2. Cloud computing skills

Industries are realising the benefits derived from cloud computing and are therefore investing a great deal in this phenomenal business mechanism. Gartner Inc. (2019) forecasts that the global public cloud services market will grow from $227.8 billion in 2019, by 17% to a total of $266.4 billion in 2020. Owing to subscription-based software's characteristic of scalability, software as a service (SaaS) remains the biggest market segment, and the projection for 2020 is to grow to $116 billion (Gartner Inc., 2019). IaaS is predicted to escalate 24% year on year, and when compared across all market segments, this is the largest growth rate (Gartner Inc., 2019). This expansion is credited to the requirements of present workloads and applications, which demands infrastructure that traditional data centres are unable to support (Gartner Inc., 2019). Cloud computing has made a large impact on many organisations, particularly during the COVID-19[9] pandemic, where many employees needed to work and collaborate from their home. Digital skills pertaining to cloud computing tools are highly valuable for many business professions, therefore graduates who possess such skills may be more efficient at their job responsibilities, since "time is money" for business professionals.

[9] "On 7 January 2020, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was confirmed as the causative agent of coronavirus disease 2019 (COVID-19)" (National Institute for Communicable Diseases, 2020).

2.11.3. Computer Aided Design software skills

Computer aided design (CAD) software is a relatively new technology that has altered architectural endeavours in Nigeria and the areas of use can be encapsulated as follows: Automated documentation and design; electronic provision for project management; support for marketing and presentation of design via rich software tools, together with electronic document management; 3D images; CAD tools automating current work process; including other benefits that ICT has augmented to the attraction of the architectural profession (Arif & Karam, 2001; Gambo, 2017). Gambo (2017) maintains that there are many benefits associated with CAD software, such as improved productivity, enhanced accuracy, more effective delivery and minimal quality performance, cost, time, and so on. In addition, design software may be used for a variety of other purposes, such as calendar, directional map 3D, floor plan, basic electrical diagram, home plan, office layout, and much more. While computer aided software may not be used in all business sectors, it is becoming increasingly popular among some professions, such as architects and electricians.

2.11.4. Coding skills

According to Tuomi *et al.* (2018), coding skills are considered a combination of computational thinking, problem solving, logical thinking, and design skills, and are valuable 21st century skills. In Finland, the Ministry of Education has highlighted that ICT skills, particularly coding, is a fundamental component of the "Finnish curriculum (Finnish National Board of Education" (Tuomi *et al.*, 2018, p. 420). Tuomi *et al.* (2018) explains that until recently, coding is now a compulsory school subject at Finnish schools, as well as in Estonia and the United Kingdom (UK). Coding can be appreciated as a digital skill that every citizen ought to master, as it will be required progressively more in future job descriptions (Tuomi *et al.*, 2018; Wilson & Moffat, 2010). Additionally, coding has the potential to boost self-confidence, enhance creativity and foster systematic thinking among other things, all of which are essential for the workplace (Kafai *et al.*).

Research suggests that learning how to code is associated with particular cognitive benefits. Scherer *et al.* (2018) found that students who learned how to code performed better than those who did not, in coding and other cognitive skills, for instance mathematical skills, creative thinking, reasoning and metacognition. In addition, Manches and Plowman (2017) discuss traits regarding coding in early childhood: (1) ICT education has been accepted as an essential area of learning; (2) coding plays an integral role in ICT education; and (3) there are a growing number of tools currently available to aid the teaching of coding. England commences the ICT curriculum at school-level from

as early as five years for all students (Manches & Plowman, 2017). Clearly, England sees the benefits associated with ICT education for all citizens, and how this endeavour will boost their economy.

2.12. Security measures in digital environments

The business sector and governments are progressively concentrating on safeguarding the data they collect from their customers and citizens, respectively, as an element of a developing compliance infrastructure (Chatterjee & Sokol, 2019). Data breach risks are a component of recurring risk assessment by businesses, yet, the attributes of how to theorize compliance with reference to data breaches is barely studied. Earlier research has used various terms to explain data breaches, for example security breaches, information breaches, and privacy breaches. Spanos and Angelis (2016) encapsulate an information security breach as a successful attack by hackers, through the information systems, intending to destroy the availability, confidentiality, or integrity of a system.

However, according to Goode *et al.* (2017) the term data breach is more appropriate because, while an organization is aware of their data breach, it usually is unaware of the content of breached data once the event is detected and investigated. Consequently, a data breach may integrate information, security and privacy breaches. They further explain that a data breach is considered an electronically facilitated service failure that ensues once confidential personal, financial, or consumer data is accessed by individuals external to the organization. The data disclosure might be deliberate, for instance by means of hacking or attributable to the activities of disgruntled employees, or even unintentional, such as a misplaced laptop. Additionally, a crucial issue for many organisations is that clients who fall victim to a data breach habitually terminate the customer relationship and they prefer not to acquire services or products again after a data breach has occurred. Nevertheless, Janakiraman *et al.* (2018) found that while data breaches result in a considerable reduction in consumer spending, consumers of the breached firm move to more secure channels of the business. Goode *et al.* (2017) allege that if customers are compensated to meet their expectations and the breach remains within the perceived tolerance zone, compensation is a successful means to coerce customers' continuance intention and quality perceptions.

Data breaches is said to point to larger issues of corporate governance and compliance (Chatterjee & Sokol, 2019). There are several forms of cyber-attacks and when cyber-security is of concern, ignorance is definitely not bliss for an organisation. Hence, it is imperative for employees in all types and sizes of organisations to be familiar with the types of cyber-attacks and how to avoid them. Breaches can occur for diverse reasons, subject to the objective of the breach. For instance,

Donald Trump's election team worked with a data analytics firm, Cambridge Analytica, and the triumphant Brexit canvass harvested approximately 50 million Facebook profiles of US citizens (Cadwalladr & Graham-Harrison, 17 Mar 2018). This data breach was one of Cambridge Analytica's largest ever data breaches, where they used the Facebook profiles to create a powerful software program to influence and forecast the voters' preferences at the ballot box.

According to Constance *et al.* (2020), data breaches are becoming costly to firms, are increasingly pervasive, and its consequences extend far beyond just the breached firms. In light of this, spill over effects of data breaches occur even in stock markets, owing to negative aggregate irregular returns to supplier stocks, after breaches were disclosed by major customers. They also revealed that the repercussions of a breach not only affect the breached firm's customers, but also their suppliers, as the suppliers decrease their trade credit allowance after breaches are disclosed, as well as curb certain related investments in research and development. The trade credit allowances of non-breached competing firms in the same industry are subsequently increased, in addition to their research and development expenditure (Constance *et al.*, 2020).

Bada *et al.* (2015) studied research on cyber security awareness campaigns and they explain why firms did not achieve the desired cyber-security result and why they were unsuccessful at transforming peoples' behaviour. They assert the importance of critically reflecting on the challenges concerned with enhancing information-security conduct for consumers, employees and citizens in general. Internationally, industry and governments extensively use ICT, therefore their security is tremendously important. So, they implement expert technological security measures and security policies to stipulate acceptable behaviour of consumers, employees and citizens. Regrettably so, many people fail to comply with the anticipated behaviours and/or stipulated policies. There numerous possible explanations for non-compliance, however, two significant factors are that individuals' are ignorant of the risks or do not completely understand what acceptable behaviour is (Bada *et al.*, 2015).

Cyber-security awareness campaigns are designed to motivate people to adopt secure online behaviour, but successful motivation commands more than just creating awareness around what people must and must not do. Firstly, people need to accept that the information is important, secondly, they need to understand how they should take action, and thirdly, they need to be keen on cyber-security compliance, in addition to various other pressures that their day job necessitates (Bada *et al.*, 2015). Effectively teaching cyber-security skills may result in the deterrence of hazardous online behaviour, because what may appear to be demotivation may occasionally be inexperience.

Bada *et al.* (2015) suggest the following elements to be particularly valuable at improving the efficiency of awareness campaigns related to cyber-security:

a) Security awareness ought to be professional and organised in a manner that works;
b) Instilling fear in individuals is an ineffective tactic, because it may intimidate those whom are most affected by risks;
c) Security training should provide more than just information to end-user, as it must be directed, legal, achievable and deliver feedback;
d) After users are agreeable to transformation, proper teaching and constant feedback is necessary to support them during a period of change;
e) Emphasis is important in various cultural settings, in addition to attributes when establishing cyber security awareness campaigns.

Progressively more organizations become increasingly perturbed about cyber threats affecting their business and have thus devoted a large quantity of resources to address this problem, so ultimately they are anticipating a positive return on their investment. Li *et al.* (2019) found that when an employee is cognisant of his/her organisation's information systems' security policy, s/he is able to handle cyber-security issues in the workplace. Their results also revealed that peer behaviour is a significant component in developing employee's prompts to counteract, whilst they are encountering cyber-crimes. These prompts to counteract cyber-crime also encourages employees to attend security training that aids employees to develop their information security skill. Their study indicates that an organization's information security environment positively affects an employee's threat evaluation and coping skills, which sequentially contributes to positive cyber-security compliance behaviour. Furthermore, when employees are knowledgeable of their organisation's information security policies and practices, they are more proficient in handling cyber-security responsibilities than those employees who are ignorant of their organisation's cyber-security policies (Li *et al.*, 2019).

Since the last decade, there has been an unparalleled escalation in cyber-crime, worldwide, however Africa has one of the highest cybercrime rates and substantial financial losses. In spite of this, the citizens in African countries are barely educated on cyber-risks, and initiatives aimed to design and implement awareness campaigns are non-existent (Bada *et al.*, 2019). Once again, the lack of awareness amongst the African citizens is a major factor that creates a liberal environment for cyber-crime. Bada *et al.* (2019) advocates that cyber criminals depend on the extremely poor security practices of the general public and policy makers are advised to participate in awareness campaigns. They found that the most of the African countries they examined are classified at a 'start-up' stage of

development, with regard to initiatives on creating cyber-security awareness. This implies a scarcity of national programmes aimed at raising cyber-security awareness.

Furthermore, the requisite for cybersecurity awareness of vulnerabilities and threats across all sectors has not been recognised, or is currently just at early stages of discussion. One of the key deterrents regarding the execution of a national cyber-security awareness programme is the overall absence of cybersecurity awareness external to technical groups, which investors indicated is a consequence of the scarce ICT literacy among the citizens of these countries (Bada *et al.*, 2019). They advise that incorporating cybersecurity awareness activities into ICT literacy programmes may offer a reputable medium for cybersecurity awareness campaigns. Additionally, culture can also influence the efficacy of cyber-security awareness programmes. These programmes are urgently required in African countries to reduce the number cyber-attacks, whilst improving cyber-security compliance (Bada *et al.*, 2019). The government, academia and industry in Africa need to work together to develop and implement such programmes in order to achieve a return on their investments.

South Africa has had its own share of data breaches in recent years. In 2017, personal data, such as identity numbers and business directorships, of approximately 60 million South African citizens were leaked (Veerasamy *et al.*, 2019). Shortly after about one million personal records were made public by a company in charge of online payments of South African traffic fines (BusinessTech, 2018a; Veerasamy *et al.*, 2019). Liberty Holdings was another major firm affected by a data breach in 2018, where the firm's customers received a text message via their cellular telephones informing them that their confidential information relating to insurance policies may have been hacked by a third party (Niselow, 2018; Veerasamy *et al.*, 2019). In 2017, a data breach typically cost R32 million, and this value escalated to R36.5 million in 2018 (BusinessTech, 2018b). Research from the Ponemon Institute in the United States reveals that a data breach in South Africa costs companies almost R50 million on average in 2019 (BusinessTech, 2019). The standard data breach costs in 2019 are significantly higher than that of 2018.

In 2019, the average data breach costs the United Kingdom R60 million, Germany R73 million and the United States R130 million, being the highest from all countries (BusinessTech, 2019). The Ponemon Institute discovered that standard cost of business lost following a data breach was about R22 million. Detailed interviews were conducted with 20 companies that suffered a data breach, and they all agreed on the numerous cost implications of a breach, starting with notifications to technical inquiries and recovery, cost of lost reputation and business, as well as legal and regulatory activities

(BusinessTech, 2018b). Lost business is the greatest loss stemming from a data breach (i.e. 36% of the total cost), which comprises lost business, like business disruption, revenue loss, customer acquisition, and system downtime (BusinessTech, 2019). According to the global leader for "IBM X-Force Incident Response and Intelligence Services (IRIS)", Wendi Whitmore, "The truth is there are many hidden expenses which must be considered, such as reputational damage, customer turnover, and operational costs. Knowing where the costs lie, and how to reduce them, can help companies invest their resources more strategically and lower the huge financial risks at stake" (BusinessTech, 2018b, p. 1).

These breaches have been investigated pertaining to the response of the South African government and other relevant agencies and institutions. According to Veerasamy *et al.* (2019), the South African government has established the Protection of Personal Information (POPI) Act to enforce greater controls, but its implementation is faced with certain challenges, therefore just specific stipulations of the act is put into effect. They surveyed 83 respondents from the security departments of the following sectors: government and defence, finance, higher education, research IT and telecommunications. Their study shows that the top three threats that South African organisations face is: targeted malicious e-mails, ransomware, and the theft of laptops and mobile devices, respectively. Moreover, they strongly recommend that South African organisations need to address the following fundamental issues: employ a cyber-security strategy; upskill cyber-security experts to meet international standards; enhance cyber-security training and awareness; conduct risk assessments; enhance business endurance and disaster recovery planning.

Walaza *et al.* (2019) investigated South Africa's current ICT use and their school learner's ICT security awareness, and found that there is certainly a problem. In light of their findings, they created a framework called the "South African ICT Security Awareness Framework for Education (SAISAFE)" (Walaza *et al.*, 2019, p. 330). This framework may be useful for educational institutions to achieve greater ICT security awareness. Venter *et al.* (2019) highlighted that to date, there is still no official curriculum focusing on cyber-security in South African schools. This topic area is typically left to HEIs to educate students on the principles of cyber security, and when they do so it is usually with students who enrol in computer related modules (Venter *et al.*, 2019). Consequently, only a minute percentage of the total South African population (i.e. students who do computing modules at tertiary institutions), are knowledgeable of cyber security risks and preventative measures. Venter *et al.* (2019) highlights that since this group of students is mainly male, this learning tactic makes young South African females susceptible to cyber-attacks.

Hence, it is imperative that every individual be knowledgeable in cyber security with the same level of importance as the "3 R's[10]", since teaching this vital skill at tertiary level does not sufficiently prepare the South African youth with the 21st century cyber security skills for the workplace (Venter *et al.*, 2019). Cyber-security awareness should commence at primary school, and concurrently embedded across other levels of the curriculum to ensure that users have the necessary skills when required, and that the existing gender imbalance in cyber security awareness is ceased (Venter *et al.*, 2019). ICT usage is now interwoven with Internet use. These days a cellular phone may be found in the hands of many children, whose activities range from watching YouTube videos to playing online games. Some malicious apps have the ability to use the cellular phones camera on 'selfie mode' to look at the user. These techniques are used to identify individuals for human trafficking purposes. For these reasons, anyone who uses the Internet, irrespective of their age should be in a position to secure their devices.

Another major cyber-security concern for government and industry is ransomware. Ransomware is an example of cyber extortion, and is fast growing into one of the greatest challenging and recognizable manifestations of cybercrime, as it is intended to directly generate revenue. Ransomware is a kind of malware that is designed to take a computer system 'hostage' until a ransom stipulated by the criminals is paid by the victim. This type of cyber-attack has become popular predominantly owing to the rising popularity of Bitcoin (i.e. a cryptocurrency that used to be untraceable) (Mabunda, 2019). However, due to an increase in cyber-crime, some companies have developed software programs that can trace the movement of bitcoins to assist law enforcement trace illegal remunerations. There are many forms of cyber-attacks as discussed, therefore South Africa has finally established the "Cybercrimes and Cybersecurity Bill, which criminalizes cyber extortion in section 10 of the Bill" (Mabunda, 2019, p. 143).

Section 3(1) of the cyber-security bill makes it unlawful for any person to illegally and deliberately weaken any security measure that prevents access to data and data acquisition, contained in or transmitted via a computer system (Mabunda, 2019). Section 6(1) criminalizes the illegal and deliberate interference with a computer system or a computer data storage medium. While, section 5(1) criminalizes the illegal and deliberate interference with a computer program or data, section 6 deals with a computer system or computer storage medium. Mabunda (2019) explains that interference in this instance suggests to temporarily or permanently modify any resource of a

[10] 3 R's – reading writing and arithmetic.

computer system or a computer data storage medium. Section 14 of the bill stipulates the penalties that may be enforced upon the offender when being convicted. These offences are considered to be in the same category of crimes hence, anyone who disobeys the stipulation will be fined or imprisoned (not exceeding 10 years), or both. Although this study is not based on cyber-security, the researcher felt it necessary to include a short review on cybersecurity studies, since the third construct of the two surveys deal with the application of security measures in digital environments.

Although organisations typically have IT companies to deal with cyber-security, Kaspersky (2019) explains that there are seven ways that employees make an organisation vulnerable to cyber-attacks:

- Opening e-mails from an unknown source
- Possessing weak login credentials
- Writing down passwords in clear view of others
- Authorised to access everything in the organisation
- Lack effective cyber-security training
- Failure to update anti-virus software
- Utilising unsecured mobile devices

This denotes that graduates should possess these fundamental security skills to reduce an organisations vulnerability to cyber-threats. The implementation of policies and procedures are another means of preventing cyber-attacks, as well as ensuring that graduates possess the needed digital skills for the workplace.

2.13. Government policies and procedures related to digital skills development

After more than two decades, the South African government felt it necessary to create a new a new policy entitled: “National Policy Framework for ICTs”, which is meant to replace the white papers on “Telecommunications (1996)” and “Postal Services (1998)” (Government Gazette, 2016, p. 14). The main reasons for this policy change is that: (1) technology has transformed the way people interact, transact and communication; (2) South Africa is has changed their development approaches; and (3) they needed to address the ICT challenges and improve the benefits derived from ICT (Government Gazette, 2016). The vision of National Development Plan (NDP) of South Africa is: “A single cohesive strategy is essential to ensure the diffusion of ICTs in all areas of society and the economy. Like energy and transport, ICT is an enabler – it can speed up delivery, support analysis,

build intelligence and create new ways to share, learn and engage" (National Development Plan, 2012, p. 171).

2.13.1. Current policy status in digital skills

The South African government has acknowledged that digital skills are expected to become progressively crucial to several industry sectors and fundamental digital literacy and e-learning courses are therefore vital to growing employability. Hence, the government plans to create a list of the fundamental digital skills that is required for citizens to participate in a digital society, which includes training and support at public access sites, as well as the incorporation of digital skills in official primary, secondary and tertiary educational institutions (Cwele, 2016). To the best of the researcher's knowledge, there does not seem to be a current digital skills '*list*' that has been implemented by the Department of Education, and the South African Qualifications Authority has not yet made provisions, as they are still in the planning stages. In 2007, the "Presidential International Advisory Council" placed the issue of digital skills on their agenda (Van Audenhove *et al.*, 2018, p. 4). Following this, in 2010 the South African government founded an e-Skills Institute and embarked on a mission to prepare an e-skills[11] policy called "National e-Skills Plan of Action (NeSPA)", via the Department of Communication (Van Audenhove *et al.*, 2018, p. 4).

According to Van Audenhove *et al.* (2018), the NeSPA policy categorizes skills according to various sectors or fields and some of the categories are closely related. The example they provide is e-user skills related to the efficacy of private and public sector knowledge workers, and e-government skills related to the efficacy of service delivery processes. Although the reason for this specific categorizations is not clear, several e-skills may be used in other sectors and areas (Van Audenhove *et al.*, 2018). However, a possible explanation for NeSPA's e-skills classification may be attributable to the reality that the process began by trying to resolve what e-skills were essential in a South Africa at that point in time (Van Audenhove *et al.*, 2018). The researcher felt it necessary to maintain a similar stance in terms of the categorization, therefore the digital skills outlined in phase one of this study pertains to the Real-Estate, Finance and Business Services sector, in South Africa. Though, some of the digital skills may overlap with other sectors.

[11] "In the South African context, e-skills are broadly defined as the ability of people to use and create all forms of Information and Communication Technologies (ICT) in order to achieve equitable prosperity and global competitiveness in general, and to improve their life opportunities in: (i) personal and educational space, (ii) work environments, (iii) community interactions and (iv) participation in government processes" (DoC, 2012, p. 9).

One problem is that technology changes occur at a rapid pace, but government is not fast enough to address these technological advancements in their policies. For example, in 2012 the government Cabinet commenced an appraisal of all ICT related policies, and in January 2013 the Minister of Communications then arranged a Policy Review Panel, which comprised delegates from academia, the South African ICT industry, NGOs, state-owned companies and public institutions (DoC, 2012). A White Paper was later developed in March 2016, once the Panel's contributions and suggestions were deliberated and feedback was received from stakeholders during the policy review process. Three years on and this is just confirmation of policy, but no implementation yet.

Another problem is with current policies and frameworks, as that they address the strategies of implementing digital skills in South Africa, but these only answer the 'how' question (i.e., How will digital skills be implemented across South Africa?). They have not quite answered the 'what' question (i.e., What are the digital skills required by the various sectors of South Africa?). It is more pragmatic to first understand WHAT is needed, in order to determine the best approach to achieve the HOW. Additionally, government documents, such as the National Integrated ICT Policy White Paper, use the terms e-skills and digital skills interchangeably. It also uses the terms e-literacy, digital literacy and e-astuteness[12], which essentially refer to the term 'digital skills', as defined in this study.

2.13.2. Future policy plans for digital skills

Given that a decade has passed since the NeSPA policy, technology has advanced and digital skills requirements have changed, therefore it is imperative to develop and implement a digital skills framework that address current technology trends and business requirements. However, an immediate policy goal for the South African government is to make sure that nationwide ICT infrastructure sufficiently sustain the demands of the economy, permitting parties external to the public sector to participate (National Development Plan, 2012). The National Development Plan envisages that before the end of 2030, ICT will support the growth of a connected and vibrant digitized society and a dynamic knowledge economy. Additionally, the NDP envisions a seamless information infrastructure that will be accessible and available nationally, to sustain business needs, the public sector and the citizens.

[12] E-astuteness is defines as "closely related to developing e-competent individuals by giving them appropriate ICT-related knowledge and skills and training them to develop a competent attitude and knowledge to use it and to adapt to the rapidly changing new forms of ICT devices and associated software." (DoC, 2012)

This is meant to provide access to a variety of connected services essential for efficient economic and social involvement. Within this vision, fundamental ICT institutions and infrastructure will be the heart of a pervasive digital communications system (National Development Plan, 2012). Ultimately, in their 'big plan', digital literacy needs to be improved by means of training at school level, at HEIs and adult-education colleges, in addition to supplier training. "A larger audience will, in turn, help stimulate market demand for multilingual, relevant local content and make it practical to develop online and mobile government-service applications" (National Development Plan, 2012, p. 192).

As a developing country, with the current lack of adequate infrastructure, the South African Government wishes to first get the ICT infrastructure right. Subsequently they see a need to create a demand for this infrastructure by establishing training programs at various educational levels. However, this is an indication that their rational for providing digital literacy training seems to be driven by financial gains. Nevertheless, the National Development Plan maintains that the education system, which is supported by the government's investment in ICT skills development, must prepare for this (National Development Plan, 2012). Although Van Audenhove *et al.* (2018) suggests that the government's e-skills goals are nearly entirely driven by employment and economic development, and the only reference made to individual use is correlated to e-literacy skills, which concentrates on employability and in e-participation, which presumes skills needed by citizens to interact with government.

The South African e-Skills Institute (e-SI), which comprises Government and various other stakeholders in education, business, organised labour and civil society, has observed that a national approach, fostered by effective collaboration from stakeholders has the capacity to address immediate and future requirements of South Africa via the universal adoption of ICT (DoC, 2012). In order for their efforts to be fruitful, their efforts first need to be receptive to international standards and trends, stakeholder requirements, and be evidently aligned with the national developmental plans/policies (DoC, 2012). Thus far, of South Africa's nine provinces, only Western Cape and Gauteng have programmes and policies directed specifically towards digital skills training (Empirica, 2019).

2.14. Challenges prohibiting successfully implementing digital skills in curriculum

HEIs are guided by industry and government. Some issues that confound academic institutions are: (1) a disconnect between industry and academia, (2) inadequate government funding support, or government inadequately addressing ICT-education issues. There are numerous obstacles preventing

curriculum overhaul, which include lack of faculty expertise and accreditation, resulting in digital skills to be applied ineffectively and less proficiently than industry leaders expect (Mills *et al.*, 2018). However, ultimately government, industry and academia need to work together to address the major obstacles impeding the successful implementation of digital skills in curriculum can be overcome.

Furthermore, the National Integrated ICT Policy highlights nine key challenges identified by the National Development Plan, which are:

(1) The ICT sector needs a policy to increase employment and to unlock its potential.
(2) Low standard of school education.
(3) The infrastructure is insufficient, badly situated and maintained.
(4) Spatial boundaries stagger comprehensive advancement.
(5) An excessively resource intensive economy.
(6) The public health system cannot sustain quality or meet the demands.
(7) Public services are frequently of poor quality and irregular.
(8) Extreme corruption levels.
(9) South Africa as a society continues to be a segregated (Cwele, 2016).

These challenges faced by government ought to have a ripple effect on many HEIs, as they depend on the government for funding support and curriculum guidance to some degree. Although government attempts to overcome these challenges, the solutions are not always straightforward and corruptions levels is the biggest challenge in overcoming all other challenges.

2.15. Studies on the digital skills preparedness of graduates

While there are several studies investigating the preparedness of graduates for the workplace, very few studies have investigated the *digital skills preparedness* of graduates and other studies investigate high school students' digital skills preparedness. Other studies investigate preparedness in relation to research skills, soft skills, foundational skills, etc. Glavaš *et al.* (2019) studied students' perceived preparedness for the workplace, as well as their perceptions of studying in digital spaces. They explain that 32 OECD countries all agree on the importance of digitally skilling individuals who are about to join the workforce. Having surveyed 190 students at a university in Republic of Croatia, most of their respondents were aware of the importance of digital literacy. They asked their respondents about the present situation regarding the use of ICT in higher education, in addition to students' readiness for the digital economy (Glavaš *et al.*, 2019). Based on the students' subjective assessment, 63,7% of

them perceived to possess above average digital skills, while 4,2% of them believed that they did not possess very good digital skills (Glavaš *et al.*, 2019).

Salunke *et al.* (2020) studied the preparedness of management graduates for the workplace during the COVID-19 pandemic and recommend that the digital skills of graduates need to improve by focusing more towards digital technologies. Abdullah *et al.* (2020) suggest that technical skills should comprise information literacy, digital analytics skill and media skills, which graduates should have practical experience in, with the aim of mastering them. They also maintain that graduates should be able to blend various skills, such as digital skills and soft skills which they are expected to apply when facing challenges in the Industry 4.0 environment (Abdullah *et al.*, 2020). Another study by Thaba-Nkadimene and Mmakola (2019) was conducted in Limpopo, where the performance of teacher graduates were examined. Their findings revealed teaching incompetence, inadequate pedagogical knowledge; and particularly inadequate digital literacies, which was found to compromise the quality of teaching and learning. Although their study was not based on the commerce graduates, as in the case of this study, however, it does reveal that the inadequate digital literacies of teachers potentially impact the digital skills of students.

Numerous studies were scrutinised to identify research that has investigated graduates' digital skills readiness for the Real Estate, Finance and Business Services sector in South Africa in relation to. To the best of the researcher's ability no such study was found, which is comprised of a mixed methods data collection where industry's digital skills needs has been compared to the digital skills of tertiary students. Furthermore, no such study was found locally or internationally.

2.16. Chapter summary

Research suggests that there is an urgent need for South Africa to upskill their citizens, especially their students in higher education, so that the country can successfully compete in the digital economy of the 21st century. The South African government has also accepted that digital skills are becoming more and more critical to employment in various industry sectors, and that basic digital literacy, as well as e-learning programmes are fundamental in growing employability. Although there are current plans in place, the South African government has explored frameworks on *how* to successfully digitally skill students at various academic levels, but there is currently no framework being employed on *what* training is required. They plan on putting together a task team to identify what digital skills are needed by South African industries, but there is still much work to be done.

Existing frameworks are either dated or fail to cover fundament digital skills necessary to successfully engage in today's digital society. This study provides insights on existing frameworks employed by other countries, along with a proposed digital skills framework based on one of South Africa's major GDP contributor. Cyber-security is another major concern, as a lack of awareness and non-compliance of security policies are the leading reasons for security breaches in South Africa. Cyber-security awareness is not just a risk to organisations, but to any individual that has access to a mobile device. Hence, cyber-security should be taught to students in primary schools, as they need to be aware of the cyber-threats that exist and how to avoid them. A wide range of skills are required by industry, in order for South African citizens to contribute to the economy, but it would be close to impossible to cover all aspects of digital skills at tertiary level. Therefore, South Africa needs to follow in the footsteps of first world countries and initiate basic digital skills curricula from as early as grade one, so that more focused and advanced digital skills may be taught at tertiary level.

This chapter reviewed the definitions of digital literacy, ICT literacy and digital competence, as well as the digital skills crisis developing countries, like South Africa face and the impact of digital skills on the economy. In addition, this chapter explored the attributes of digital skills with regard to teaching and learning, digital skills in organisations and the plans and proposals to improve digital skills of the workforce. It also highlighted the critical need for a digital skills framework in South Africa's higher education policies, studies that investigated digital skills, digital skills/literacy frameworks, as well as digital literacy in relation to academic success. More crucial matters were also discussed, such as the second digital divide, security measures in digital environments, digital skills needed to use digital systems and tools, government policies and procedures related to digital skills development, and lastly the challenges prohibiting the successful implementation of digital skills into curriculum.

The review of related literature was used to support the research questions in this study, as well as to confirm the theoretical framework that was used to underpin this study. Existing research formed the foundation of this study, which also offered the researcher greater insight into each of the research questions and helped in modifying/upgrading the research instrument by Chinien & Boutin (2011), which was adapted for this study. Seeing as technology is dynamic in nature, it was necessary to adapt Chinien & Boutin's survey to incorporate new digital skills, such as the ability to use cloud computing applications, that was non-existent during the timeframe when they conducted their study. The literature review also assisted the researcher in ensuring that the study made original contributions to the body of knowledge. The themes within the literature review were correlated to the research

instruments to ensure that the correct questions were asked and to support further development of the research instruments by aligning the questions to incorporate current technologies, for all three phases of the study.

The next chapter discusses the research methodology, which constitutes the research design, research paradigm, study site and target population, sampling strategy and sample size, research instrument, data collection method, data analysis, data quality control and ethical considerations. In order to achieve the study's research objectives, it was necessary to employ the mixed methods research approach, which consisted of three phases.

CHAPTER 3 – RESEARCH METHODOLOGY

3.1. Research design

This study combined sequential and concurrent strands over four months, therefore the researcher believed that a multiphase mixed method approach was best suited the study (Creswell & Clark, 2011). Moreover, multiple research phases were necessary to achieve the study's objectives. This study included both qualitative and quantitative research methods, techniques, approaches and concepts (Johnson & Onwuegbuzie, 2004). However, it is important to first explore the nature of the mixed methods research design, in order to understand its complexities and successfully carry out the study (Molina-Azorín *et al.*, 2018).

The definitions of a "mixed methods" design has greatly evolved since the 1980's, since initially the mixed methods design merely involved including at least one qualitative method and one quantitative method, whereby neither method was linked to a particular paradigm (Creswell & Clark, 2011). While they do not provide a definition per say, Creswell and Clark (2011) suggest that in a mixed methods research design, the researcher needs to accomplish the following:

- Collect and analyse persuasively and meticulously the quantitative and qualitative date, which are based on the study's research questions.
- 'Mix' the two data forms either concurrently by sequentially merging/combining them, where one builds on another, or embedding one form within the other.
- Emphasise either one or both data forms.
- Use the procedures in one study or in several phases of a study.
- Frame the methods in theories and philosophical worldviews.
- Merge methods into particular research designs that establishes a blueprint for the study.

The literature review acted as a guide to identify the research designs used in past research, so that the researcher could make an informed decision on adopting the most suitable research design. The next step is to recognise the advantages and challenges of using mixed methods. This approach is said to offer strengths that counteract the weaknesses (Abro *et al.*, 2015; Creswell & Clark, 2011). The mixed methods approach also offers greater evidence for exploring a research problem than either qualitative or quantitative research on its own (Green *et al.*, 2015). Additionally, it helps to answer questions that cannot be answered by either approach alone and encourages the use of multiple paradigms (i.e. values and beliefs) (Creswell & Clark, 2011). Another advantage is that the mixed

methods approach is considered 'practical', since researchers can solve problems using words and numbers (Creswell & Clark, 2011).

The advantages are relatively promising for many research problems, therefore the mixed method approach may be the method of choice for several studies. However, it is important to note the challenges, so that it may be avoided, and/or easily subdued. Mixed methods research necessitates extensive resources, time and effort (Molina-Azorín *et al.*, 2018). It is considered a challenge, because this method typically requires greater effort, financial resources, and takes more time than the other two methods. Increased time demands results from the time needed to employ the qualitative and quantitative components of the study (Molina-Azorín *et al.*, 2018). Furthermore, the mixed methods approach compels researchers to develop a comprehensive set of proficiencies that traverse the qualitative and the quantitative methods (Creswell & Clark, 2011; Molina-Azorín *et al.*, 2018).

Creswell and Clark (2007) are renowned authors of the mixed methods research approach. They explain that there are four research designs, namely ethnography, experimental research, survey research and mixed methods. This is a fixed mixed methods design, since the qualitative and quantitative methods is decided on and planned at the beginning of the research process (Creswell & Clark, 2011). The fundamental objective of the mixed methods approach is that the quantitative and qualitative approaches collectively offer a deeper understanding into the variables being studied than either approach individually (Creswell & Clark, 2007). In this mixed methods research design, the quantitative method aimed to accomplish the first and second research objectives, and the qualitative research method aimed to accomplish remaining research objectives.

3.2. Research approaches/paradigms

Creswell and Clark (2011, p. 64) explains that when selecting an appropriate mixed methods design, four key decisions need to be made, namely: "(1) the level of interaction between (2) the relative priority of the strands, (3) the timing of the strands, and (4) the procedures for mixing the strands". The study adopted an independent level of interaction, whereby the qualitative and quantitative strands are implemented such that they are independent of each other. What this means is that the three stands in this case, are distinct and the research keeps the research objectives, data collection and analysis autonomous. Equal priority was placed on each of the three strands as they played an equally important role in addressing the research problem. The researcher implemented the multiphase combination timing, in that the three strands were implemented sequentially and concurrently. Lastly, the procedure for 'mixing within a program-objective framework' was adopted.

Here, the researcher mixed the qualitative and quantitative strands with the main objective that directs the joining of studies in a multiphase research project (Creswell & Clark, 2011). The reason for mixing the strands is that each strand answered different research questions.

There are five worldviews/paradigms employed in research, that is advocacy, postpositivism (associated with quantitative approaches), constructivism (associated with qualitative approaches), participatory (mostly qualitative approaches influenced by political concerns) and pragmatism (associated with mixed methods approaches) (Creswell & Clark, 2011). Since this study adopted the mixed methods approach, it is therefore pragmatic in nature and addresses the research objectives. Each paradigm consists of five elements that is ontology, epistemology, axiology, methodology, and rhetoric. The ontology (i.e. the nature of the reality) was multiple, as the researcher tested hypotheses and provided multiple perspectives. The epistemology (i.e. the relationship between the researcher and that being researched) is practicality, whereby data was collected by "what works" to answer the research questions. The axiology (i.e. the role of values) is multiple stances, as both biased and unbiased perspectives were included. The methodology is combining, since quantitative and qualitative data were collected and mixed. The rhetoric (i.e. the language of the research) is formal.

Previous studies have used varied methodologies to extract the necessary data regarding digital skills. However, mostly single methods were used, such as interviews, observational studies, surveys and online tasks. Since this study employed the mixed methods research paradigm, qualitative and quantitative methods were used to collect primary data, via structured interviews and questionnaires. This study comprises three distinct phases. The study used only primary sources of data, through two surveys and one interview. In the first phase, convenience sampling was used to select participants for the survey from the Real Estate, Finance and Business Services sector. In the second phase, proportionate cluster sampling was used to survey students at each of the top four universities in South Africa, as identified by Times Higher Education BRICS (Times Higher Education, 2016, 2019). In the third phase, one academic leader of teaching and learning, or the equivalent, in the school/college/faculty of commerce, from each of the universities purposively selected for the interviews.

3.3. Phase 1

Study site and target population – There was no typical study site, since the data was collected by means of an online survey. There are several industry sectors in South Africa, and including every sector as part of this study would have vastly increased the magnitude of this study. In a South African

policy document called the 'National e-Skills Plan of Action (NeSPA)', the classification of skills is sector- based or field oriented (Van Audenhove *et al.*, 2018). Additionally, the Real Estate, Finance and Business Services sector is one of South Africa's 'economic engines', as it contributed the most to South Africa's economy (Brand South Africa, 2014; Statistics South Africa, June 1, 2017). Three years later and this sector is still a major contributor to South Africa's economy (Statistics South Africa, June 1, 2017). These two factors were the rationale for choosing business professionals' that belonged to the Real-Estate, Finance and Business Services sector, for the first phase of this study.

Sampling strategy and sample size - Creswell and Clark (2011) explains that there are six major mixed method designs, namely: convergent parallel, explanatory sequential, exploratory sequential, embedded, transformative and multiphase. This study employed the multiphase design, which is used for blending the sequential and/or concurrent collection of qualitative and quantitative data sets over several phases of a study. They further explain that the participants of the qualitative phase are usually not the same participants who provide the qualitative data in the first phase (Creswell & Clark, 2011). Convenience sampling was used to survey 389 participants from the Real Estate, Finance and Business Services sector, which is considered an appropriate sample size (Creswell & Clark, 2011).

Research instrument - An online survey (viz. GoogleDocs) was conducted with business professionals in the Real-Estate, Finance and Business Services sector in South Africa, for the data collection of phase one. The aim of this phase is to achieve the first research objective, which is to identify the digital skills requirements of industry from university graduates. Understanding industry requirements will assist in achieving the third research objective, that is, to assess the students' digital skills preparedness for their chosen profession. A five-point Likert-scale was used, that is, 'not important', 'slightly important', 'moderately important', 'important' and 'very important'. The precision of the instrument was regulated by including a relatively high number of items. The instrument consisted of four parts: (1) background information (four items), (2) use of software applications (22 items), (3) use of information systems (12 items), and (4) application of security measures in digital environments (20 items) (*see Appendix E*).

Since the research instruments for phase one and two of this study was an adaptation of the research instrument by Chinien & Boutin (2011), the literature review confirmed that majority of the questions in the research instrument needed to be closed-ended, and that there was very little need for open-ended questions, other than for respondents to specify additional digital skills that were not included in the research instrument. Survey questions were largely closed-ended, however, there were

only a few open-ended questions. There are several advantages of closed questions, namely: it speeds up the response time for the respondent as well as for the researcher, accelerates the processing of data, improves reliability, provides a more precise meaning by outlining the array of appropriate responses, and increases the reliability of each question (Dey, 2005). The answers to the open-ended questions were intended to reveal the respondent's thoughts and is believed to be more useful to analyse even though it may be more time-consuming (Dey, 2005). In this case the open-ended questions were designed to allow the respondent to add any additional digital skills that were necessary for industry, which the researcher many have unintentionally left out.

The instrument used for this study was a modified version of the instrument used by Chinien and Boutin (2011). Technology has dramatically advanced since 2011, therefore, it was necessary to update the items in each construct. Furthermore, this study zooms in on the Digital Technical Skills construct of their model, which is one of four constructs. This exclusion was necessary, in order to achieve the objectives of this study. Digital Technical Skills constituted three sub-constructs: namely (1) Use Digital Systems and Tools; (2) Use Software Systems; and (3) Apply Security Measures in Digital Environments. After conducting the literature review and pre-testing, it was necessary for the researcher to modify the names of these sub-constructs to: (1) Use of Software Applications and Web Tools; (2) Use of Information Systems; and (3) Apply Security Measures in Digital Environments. Although much of the digital skills in the survey were those by Chinien and Boutin (2011), many other digital skills needed to be included due to technology advancements. Therefore, it was subsequently necessary to modify the names of the first two sub-constructs.

The Use of Software Applications and Web Tools is the digital skills required by the graduate to select and use appropriate software applications and Web tools, in order to perform their job responsibilities. The Use of Information Systems construct is the digital skills required by the graduate to use information systems, in order to perform their job responsibilities. The Apply Security Measures in Digital Environments construct is the digital skills required by the graduate to protect digital content and to work securely on various networks, while complying with legal regulations. These three sub-constructs formed the three constructs for the research instruments in phase one and two of the study (see *Appendix E and F*). All items of the questionnaire were tested for reliability and validity, which is discussed in the subsequent chapter.

Pretesting and the pilot study - The terms 'pre-testing' and 'pilot study' are sometimes misunderstood, and the terms are occasionally used in the wrong context. Hilton (2017) suggests that pretesting is a

method of examining that questions function as expected and are comprehended by those that need to respond to them. While, Hassan *et al.* (2006) defines a pilot study as a mini study that tests research procedures, sample recruitment approaches, data collection instruments, and other research practices in preparation for the main study. An advantage of pilot testing is that it "provides advance warning about where the main research project could fail, where research protocols might not be followed, or whether proposed methods or instruments are inappropriate of too complicated" (Van Teijlingen & Hundley, 2002, p. 33).

Two research instruments were developed for this study. The first instrument was a survey that contained questions on digital skills, which needed to be answered by business professionals from the Real-Estate, Finance and Business Services sector in South Africa. The second instrument was also a survey that contained questions based on the same digital skills listed in the first questionnaire, but were phrased differently and needed to be answered by South African students in higher education. The research instruments were pre-tested by academic experts in the field of Information Systems and Technology, as they were appropriate in offering insight to the digital skills listed in the survey. Pre-testing was also necessary to ensure that and ambiguity and inconsistencies were picked up and corrected, before the pilot testing. Minor typing errors were found and the researcher needed to merge a few of the digital skills items, as they were basically covering the same digital skill. The pre-testing of the research instrument for phase one guided the development of the survey questions for phase two. This is because the digital skills used for both phases were identical, however, the target population differed, as well as the research objective of each phase.

The questionnaire for phase one was completed by 10 candidates that fitted the characteristics of the target population (viz. business professionals). The responses from the pilot study did not form part of the main study. The pilot study revealed that there were too many digital skills listed in the survey, and a few candidates circled all the options of digital skills, as 'very important'. This led the researcher to combine some digital skills that were similar, thereby reducing the number of digital skills in the survey, and in doing so, shortening the survey. 'Time is money' for business professionals, so a shorter survey was more appealing than a lengthier one. It is also more likely that respondents gave more accurate responses, than if the initial number of digital skills were used.

Data collection method – The first survey (i.e. phase one) was an online survey (via. GoogleDocs), which was administered to organisations in the Real Estate, Finance and Business Services sector in South Africa. Initial attempts to choose business professionals' by means of obtaining email addresses

from an online business directory proved unsuccessful, as the response rate of the emailed survey, which had a link to the GoogleDocs survey, was 0.08%.

Eventually, business professionals were selected through means of LinkedIn, based on the three South African sub-sectors that they belonged to: that is, Real-Estate, Finance and Business Services. By viewing prospective candidates' profile, the researcher was able to establish the sub-sector that the respondent belonged to. The research selected each respondent, and first sent them a message introducing herself, as well as the aim of the study. This method proved to be highly successful, as most business professionals were highly interested in the topic and indicated that the results of this study will be largely beneficial to HEIs, and especially their industry sector. The participants acted in his/her personal capacity as business professionals, therefore gatekeeper's letters were not submitted. The response rate via LinkedIn was 49%, which was far greater than the email approach. The data was exported from GoogleDocs to SPSS (version 25) and was then statistically analysed.

Data analysis - It is imperative to perform data analysis in order to check the data for comprehensibility, completeness, internal consistency, ambiguity, reliability and relevance (Babbie & Mouton, 2001). Seeing as an electronic survey was used, the quantitative data was prearranged to be captured via GoogleDocs by the respondent, and then checked for completeness and accuracy. The unfortunate effect of inaccurate data is inaccurate reporting of findings. It is thus imperative to check the captured data. Descriptive statistics, frequency distributions and factor analysis were used to analyse the quantitative data for this phase. Bar graphs and histograms provided a graphical representation of the data. The mean, average and variability was calculated for most data sets. Statistical tests of significance tested for large differences that may be attributable to chance (Welman *et al.*, 2006). Correlations and cross-tabulations were used to describe the relationships between variables. Inferential statistics, such as Chi-Square analysis and Bartlett's Test of Sphericity, were performed in order to make inferences about the population.

3.4. Phase 2

Study site and target population - There are 26 universities in South Africa. However, due to the nature of this mixed methods study, it was more practical to use the top four universities as identified by the Times Higher Education BRICS, so as to ascertain the digital skills readiness of South African tertiary students for the said sector (see Table 3). The 'Times Higher Education BRICS' and 'Emerging Economies University Rankings' comprises institutions in countries that are classified as

'secondary emerging', 'advanced emerging' or 'frontier' by the FTSE, comprising the BRICS nations of 'Brazil, Russia, India, China and South Africa' (Times Higher Education, 2016, 2019).

Initially, the researcher attempted to include the top 10 South African universities, as identified by the Times Higher Education BRICS, as these would have been manageable to conduct the data collection for this study. However, the other institutions did not provide a gatekeeper's approval letter, and the researcher was only able to get the gatekeepers approval letters from the top four South African universities, therefore this was the rationale behind selecting the top four South African universities. Furthermore, attaining full ethical clearance took almost a year, and waiting for all 26 universities to submit their gatekeeper approval letters would have taken substantially more time and the researcher would not have completed the thesis within UKZN's maximum time allocated to complete the doctoral degree.

Table 3 - Top four South African Universities by Times Higher Education (2016, 2019)

University Name	**Location**
University of Cape Town (UCT)	Cape Town
University of the Witwatersrand (WITS)	Johannesburg
University of Stellenbosch (SUN)	Stellenbosch
University of KwaZulu-Natal (UKZN)	Durban and Pietermaritzburg

The participants for the survey were final year students in the 'commerce' faculty from each of the four universities listed in Table 3. For example, in the case of the UKZN, only students from the College of Law and Management studies were surveyed. These students would have gained some digital skills in the first few years of their undergraduate degree, either by experience or by training. Since the survey constituted students from traditional universities only, this will allow the researcher to compare the digital skills of students from each of these four institutions. In addition, it will be more representative of the diverse student population in the South African landscape.

Sampling strategy and sample size - Cluster sampling is a probability sampling technique that was used to collect the data. This sampling technique involved first dividing the target population into clusters, followed by drawing a random cluster of clusters, which consisted of a sample of participants (Sekeran & Bougie, 2009). Each of the top four universities formed one cluster in order to ensure that each institution was not overrepresented or under represented, thereby minimising the selection bias (see Table 4). It was also necessary to apply the probability proportionate to size (PPS), in order to

ensure that each participant had an equal probability of being surveyed (Neuman, 2011). PPS is a modification made in cluster sampling, where the number of participants in each cluster is proportionate (Neuman, 2011). According to Sekeran and Bougie (2009), a trade-off between confidence and precision is required, therefore a 95% confidence level was used to determine the sample size, which resulted in 381 participants required for this study. Small sample sizes is said to impede the extrapolation of the findings (Faber & Fonseca, 2014). However, this sample size of 381 participants overcomes the limitations of small sample sizes.

Cluster sampling offers greater heterogeneity within groups and greater homogeneity among groups, which is considered the contrary to what is found in stratified random sampling (Sekeran & Bougie, 2009). However, this sampling technique also presents a few disadvantages, in that it is the least efficient and reliable among the various probability sampling techniques, as the subset of clusters are less heterogeneous than homogenous (Sekeran & Bougie, 2009).

Table 4 - Proportions of final year students at each university

Clusters	**Population Size**	**Percentage in each cluster**	**Sample Size**
University of Cape Town	6636	16%	61
University of the Witwatersrand	8520	21%	79
University of Stellenbosch	6901	17%	64
University of KwaZulu-Natal	19067	46%	177
Total number of students	**41124**	**100%**	**381**

Research instrument – The aim of phase two is to achieve the second research objective, which is, to assess the students' digital skills preparedness for their chosen profession. A questionnaire was used with a five-point Likert-scale was used, that is, 'very poor', 'poor', 'fair', 'good' and 'excellent'. The precision error was regulated by including a relatively high number of items in the questionnaire. The instrument consisted of four parts: (1) demographic information (three items), (2) use of software applications and Web tools (22 items), (3) use of information systems (12 items), and (4) application of security measures in digital environments (20 items) (*see Appendix F*). These were the identical digital skills used in the phase one instrument. The questionnaire was designed to establish the level of digital skills preparedness that the final year students at the top four South African universities for industry.

The instrument was based on their perceived abilities, since doing practical tests in a computer lab to establish their digital skill levels would have required a few hours per participant. This almost

impossible to achieve at the other HEIs, as lecturers pointed out that they were behind schedule with their lectures due to load shedding, and other unforeseen circumstances. Survey questions were all closed-ended. There are several advantages of closed questions, namely: it speeds up the responses for the respondent, accelerates the processing of data, improves reliability, provides a more precise meaning by outlining the array of appropriate responses, and increases the reliability of each question (Dey, 2005).

Data collection method - The surveys were personally administered to the participants in this phase. The advantage of this method is that the timeframe within which the responses were collected was greatly reduced compared to other electronic forms (Sekeran & Bougie, 2009). Furthermore, the response rate of emailed questionnaires is a very low, which makes it challenging to determine the representativeness of a sample population (Sekeran & Bougie, 2009).

Data analysis – Similar to phase one, once all the data had been captured to SPSS (version 25), it was completeness and accuracy. The unfortunate effect of inaccurate data is inaccurate reporting of findings. It was thus imperative to check the captured data. Data cleansing was also necessary to check for accuracy and completeness, so the data went through a process of eliminating undesirable or flawed data and was then examined for the presence of all required data. Descriptive statistics, frequency distribution and factor analysis were used to analyse the quantitative data, once again. Bar graphs and charts provided a graphical representation of the data. The mean, average and variability was calculated for each data set in this phase. Statistical tests of significance tested if there exists large differences that may be attributable to chance (Welman *et al.*, 2006). Correlations and cross-tabulations were used to describe the relationships between variables. Inferential statistics, such as Chi-Square analysis and Bartlett's Test of Sphericity, were performed in order to make inferences about the population.

3.5. Phase 3

Study site and target population - The top four universities, as identified by Times Higher Education were the study sites used to determine how these institutions envisage addressing the digital skills requirements of industry (see Table 3). This helped in aligning the requirements of most career paths in the Real Estate, Finance and Business Services sector to the curricula in the commerce discipline. Since one industry sector was used for this study, the academic leader(s) (AL) of Teaching and Learning, or the equivalent, in the school/college/faculty of commerce, from each of the four universities were interviewed. In the case of UKZN, one AL of Teaching and Learning from the

School of Management, IT and Governance was interviewed. This specific faction of interviewees was at the most appropriate level to provide the necessary information in order to answer research questions three to six.

Sampling strategy and sample size - One academic leader of teaching and learning, or the equivalent, in the school/college/faculty of commerce, from each of the top four universities was purposively selected for the interviews. The sample size is typically dependent on a few factors. However, in this case, the main contributing factor to sample size was the nature of this sample for phase three, which was limited due to the adopted sampling technique (Browne & Russell, 2003). Purposive sampling is a non-probability sampling technique, where it is not probable to determine which member of the research population will be part of the sample (Welman *et al.*, 2006). Purposive sampling is considered the most important form on non-probability sampling, since researchers depend on their experience, skills and/or previous research outcome to obtain a sample that can be considered representative of the target population (Welman *et al.*, 2006). Creswell and Clark (2011) advises that there are a few purposive sampling strategies available, each can be used for a different purpose, namely: maximal variation, extreme case and homogenous sampling. The maximal variation sampling will be adopted, whereby diverse interviewees are selected who are expected to have diverse perspectives on the phenomenon under investigation (Creswell & Clark, 2011). The main idea of the maximal variation sampling strategy is that since the interviewees themselves are different, then their views will exhibit this difference and present a valuable qualitative study designed to paint a phenomenon's complex picture (Creswell & Clark, 2011).

Research instrument – The aim of phase three was to achieve research objectives three to six, so structured interview questions were considered more appropriate (*see Appendix G*). This type of structured interview enabled the researcher to solicit the identical series of questions for each interviewee and in the precise sequence, with the aim of collecting data that is comparable and consistent. This technique of interviewing is the "Standardized Open-Ended Interview" that uses a pre-determined and limited set of questions and is open-ended in that interviewees are free to express the responses accordingly (Patton, 2002). The advantages of structured interviews are: (1) minimal interview bias, (2) execution time is faster, and (3) easier to compare responses (Patton, 2002).

Data collection method - Face-to-face interviews were conducted. However, where a suitable interviewee could not physically meet the researcher, the interview was conducted telephonically. The results from the structured interviews were used to answer research questions 3, 4, 5 and 6. The

advantages of face-to-face interviews are that it offers synchronous (i.e. real-time) communication and social cues (i.e. voice and body language), which no other interview technique offers (Opdenakker, 2006). However, the disadvantage of face-to-face interviews is the time is takes to travel to the interview location and complete the interview, as well as the costs involved with the travel and possible venue costs. Telephonic interviews are synchronous in time, but asynchronous in place. This type of interview offers the following advantages: (1) wide geographical access; (2) hard to reach populations; (3) closed site access; (4) sensitive accounts; and (5) access to dangerous or sensitive locations (Opdenakker, 2006).

Data analysis - The qualitative data from the structured interviews were transcribed and stored electronically using NVIVO 10. Thematic analysis was used to analyse the qualitative data in this phase. Vaismoradi *et al.* (2013) discusses the differences between thematic and content analysis and explains how many researchers make the mistake of referring to these analysis techniques as if they were one and the same. Thematic analysis is considered a useful and flexible research tool that provides a valuable and detailed, but complex interpretation of the data, which is exactly what was required to answer research questions 4, 5 and 6 (Braun & Clarke, 2006; Vaismoradi *et al.*, 2013). Both deductive (i.e. concept-driven coding) and inductive (i.e. open coding) coding methods were used to analyse the data. Deductive coding involves using pre-defined codes and inductive coding involves creating codes based on the data.

3.6. Data quality control

Exploratory factor analysis was used to validate the subscales of the research instruments and reliability analysis was carried out to measure the internal consistency of the subscale items (Creswell & Clark, 2007). A pilot test and a pre-test was carried out on the survey for phase one, with the aim of identifying weaknesses in the items of the research instrument, and to improve its validity and reliability (Wildemuth, 2016). In the pilot test, the researcher replicated the full study, but on a much smaller scale with a small sample of the target audience (Wildemuth, 2016). The pre-test, on the other hand, involved surveying a small group of assessors, who are academics and experts in the topic.

These evaluators provided suggestions for improving the research instrument. The research instruments were pre-tested by research professionals at the University of KwaZulu-Natal, and was thereafter pilot tested with participants who are similar to this study's research population. Once all the data was collected for the actual study, exploratory factor analysis was concluded to identify data

patterns from the main constructs of the instrument. These patterns gave birth to a new framework, which is revealed in Chapter 5.

3.7. Ethical considerations

The surveys for phase one (i.e. survey of professionals from the Real Estate, Finance and Business Service sector in South Africa), received ethical clearance from the Committee for Research Ethics at UKZN *(see Appendix A*). Provisional ethical clearance was then sought for phase two (i.e. survey of final year commerce students from the top four South African universities), and the interviews for phase three (i.e. interviews with the academic leaders at the top four South African universities) *(see Appendix B*). The provisional ethical clearance was required, in order to apply for the gatekeepers' permission from all four universities, which allowed the researcher to conduct the surveys and interviews at their institutions. The gatekeeper approval letters from all four institutions *(see Appendix C*), and the research instruments for phases two and three were then sent to the Committee for Research Ethics at UKZN to obtain full ethical clearance for these two phases.

After 10 months of all the ethical procedures, ethical clearance was finally obtained for phase two and three from the Committee for Research Ethics at UKZN *(see Appendix D*). The questionnaire included the aims of the study, a section indicating that the gathered information is strictly private and confidential, and that no reference will be made to specific individuals in the study. Participants were also informed that their participation was completely voluntary and that they could choose to withdraw from the study at any point. Signatures were required by each participant, indicating their voluntary participation and informed consent. The quantitative and qualitative data was transcribed electronically to GoogleDocs, SPSS and NVivo, respectively. Once the study was completed, the surveys, in addition to the electronic data were sent to the Discipline of Information Systems and Technology for archiving (typically for a period of five years).

3.8. Chapter summary

This chapter describes and discusses the research approach adopted for this study. A mixed methods approach was necessary to achieve the desired objectives of the study, which was divided into three phases. Phase one was quantitative in nature and involved a survey of employees from the Real Estate, Finance and Business Services sector in South Africa. This phase aimed at achieving the first research objective. The second phase was also quantitative and involved the survey of final year students at the top four universities in South Africa, as identified by the Times Higher Education BRICS. Phase two attempted to achieve the second research objective, while phase three was qualitative and

comprised interviews of one academic leader of Teaching and Learning, or the equivalent, in the school/college/faculty of commerce, from each of the top four universities in South Africa. This phase attempted to achieve the remaining objectives three, four and five.

The data attained in phase one was used as a 'yardstick' to measure against the data acquired in phase two. So, the digital skills which industry indicated that they required from graduates (in phase one), was used as a measure against the digital skills that the final year commerce students claimed to possess (in phase two). This enabled the researcher to determine if graduates are adequately prepared for the Real Estate, Finance and Business Services sector. Thereafter, the data obtained from phase three was intended to have a deeper understanding of the intervening variables that influenced the relationship between the dependent and independent variables of the study (see Figure 2 for the conceptual model). Although phase three does not depend on the results from the previous two phases, the digital skills preparedness of graduates for the said industry sector (i.e. the study's overall objective) is affected by the intervening variables, which is investigated in phase three.

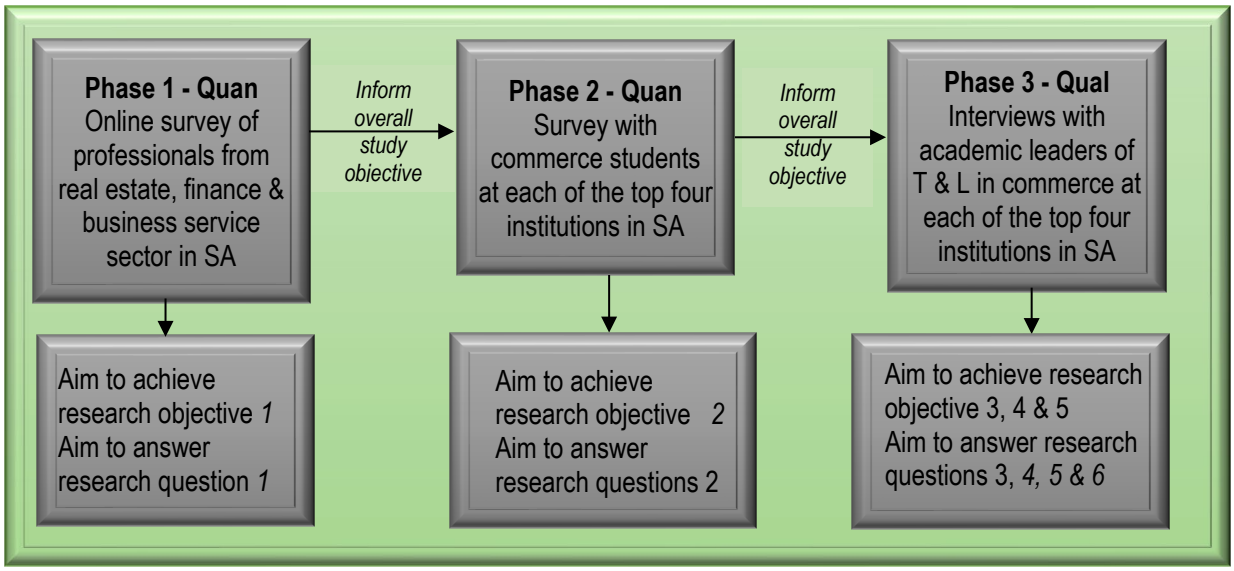

Figure 5 – Summary of the Mixed Methods Data Collection Process

Figure 5 demonstrates the three phases employed in this mixed methods study, and the alignment of each phase to the research objective(s) and the research questions, respectively. This model was necessary due to the size and nature of the study. Chapter 4 discusses the findings and analysis of phase one, Chapter 5 proposes a digital skills framework based on the analysis of the data collected in phase one, Chapter 6 discusses the findings and analysis of phase two, and Chapter 7 is the findings and analysis of phase three.

CHAPTER 4 – FINDINGS AND ANALYSIS OF PHASE 1

This chapter addresses research objective 1: *Identify the digital skills that commerce graduates are required to possess for industry*, and answer research question 1: *What are the digital skills that industry requires university graduates to have when they enter the Real Estate, Finance and Business Services Sector in South Africa?* With the aim of establishing the digital skills readiness of higher education students for the Real Estate, Finance and Business Services sector in South Africa, it was first necessary to first identify the sector's digital skills needs. According to Empirica (2019), the South African government plans to form a coordinating body (by means of structured interviews) to determine the relevant digital skills and competences required from an employee within an organisation. However, this study has already achieved this for a major sector in South Africa, which is a major GDP contributor (by means of surveys with closed and open-ended questions).

4.1. Validity

Validity refers to the degree that a questionnaire measures what it is intended to measure (Saunders, 2011). It seeks to answer if the study is really capturing the aspects of the intended research questions. Validity is divided into three categories: content validity, criterion related and construct validity. Content and construct are relevant for this study. The content validity is what is known as face validity. It is the extent to which a measurement method appears "on its face" to measure the construct of interest. In this case, the questionnaire 'asks' about various aspects of digital skills that are expected in industry as required by the study. The questions have a logical link to the objectives, hence ensuring face validity.

Content validity is the extent to which a measure "covers" the construct of interest. The questionnaire is designed, such that it covers all aspects thereby ensuring content validity. The other two types of validity make use of correlations. Criterion validity is the extent to which people's scores on a measure are correlated with other variables that one would expect them to be correlated with. The correlations of questionnaire items were expected to have strong correlations and all were measured to be positive as one would expect. The questionnaire was also developed from a pre-existing tried and tested questionnaire hence strengthening the validity.

4.2. Reliability

In order to evaluate the validity of the results of the questionnaire and hence the study itself, Cronbach Alpha was used. The Cronbach's Alpha ranges from 0 to 1. General a value of 0.7 or higher is considered to be an indication of great reliability. First of all, inter item correlations of all the 54 items were examined to see if there was any case of multi-collinearity. This occurs when we have very high correlations above 0.8. Multi-collinearity would imply that the two items are in essence measuring the same thing and hence will need to delete one of the items.

The overall questionnaire had a very high reliability given by a Cronbach Alpha of 95.8%. This indicates that all the items in the construct are measuring the same thing. The scale, when an item is deleted, did not indicate any increase of Cronbach Alpha. Therefore, no item was deleted from the questionnaire. This is not surprising as no multi-collinearity was detected from the inter item correlations. After checking overall reliability, there was a need to check for the individual sections to see of the created constructs did indeed capture the same thing. Use of digital systems and tools section gave a Cronbach Alpha of 95.5% which shows very high internal consistency. There was no increase in Cronbach Alpha value by deletion of any item.

Use of information system items had a Cronbach Alpha of 90.5% also, indicating very high internal consistency (see Table 5). Likewise, none of the items removal resulted in the increase of Cronbach Alpha. Application of security measures in digital environments scored a Cronbach Alpha of 92.5% indicating very high internal consistency, once again. None of the items caused an increase in the Cronbach Alpha. Therefore, combining the above results from the whole questionnaire and from the created constructs it can be concluded that the questionnaire for phase one achieved internal consistency and reliability. This implies that the results can be used to generalize to the entire population within the said industry sector in South Africa.

Table 5 - Cronbach Alpha of Questionnaire Constructs

Item	Number of Items	Cronbach's Alpha
Overall Questionnaire	54	95.5%
Use of software applications and Web tools	22	90.5%
Use of information systems	12	92.5%
Apply security measures in digital environments	20	94.8%

The survey consisted of four sections: (1) Background Information; (2) Use of Software Applications and Web Tools; (3) Use of Information Systems; and (4) Application of Security Measures in Digital Environments (*see Appendix E*).

4.3. Background information

A total of 389 surveys were completed by the employees in the Real Estate, Finance and Business Services sector in South Africa. Figure 6 represents the gender distribution, almost two-thirds (63.2%, n=246) of the respondents were female, roughly one-third (36.0%, n=140) were male, while 0.8% (n=3) preferred not to say.

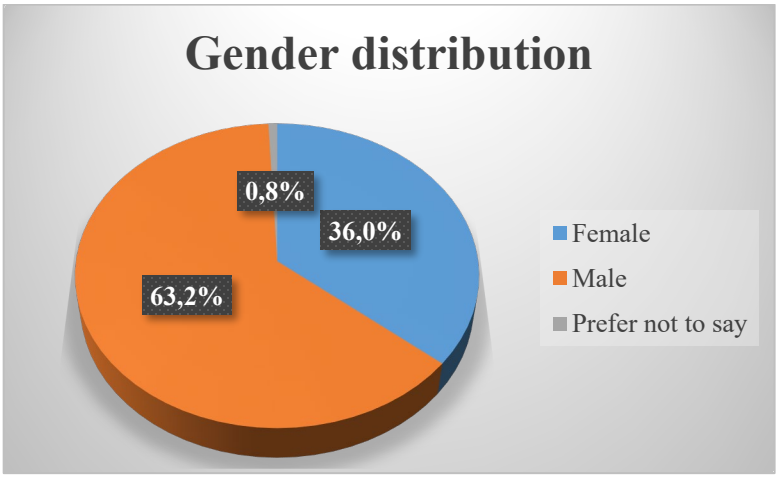

Figure 6 - Gender Distribution of Respondents

Respondents were drawn from three subsectors across South Africa. The Business Services (52.4%, n=204) sector were largely represented, 41.4% (n=161) represented the Finance sub-sector, and only 6.2% (n=24) represented the Real-Estate sub-sector (see Figure 7). This was probably due to there being generally more individuals in the Business and Finance sub-sectors, than there are in Real-Estate.

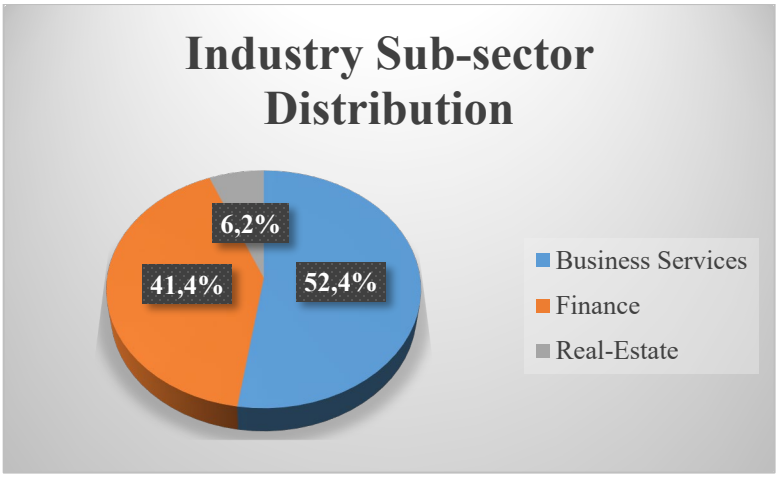

Figure 7 - Industry Sub-Sector Distribution

The respondents were also asked to indicate their current qualifications, in order to establish a general idea of their digital literacy, and to ascertain their academic qualification. A total of 387 respondents answered this question. The bar graph in Figure 8 captures the distribution of the respondents by qualification. Honours was the main qualification with 30.2% (n=117) of the respondents possessing an Honours degree. Those with an undergraduate degree were not far behind with 28.7% (n=111). Whilst postgraduate degree holders comprised 13.7% (n=53), and Master's degree holders consisted of 10.1% (n=39) respondents. However, only 2.9% (n=11) respondents did not possess any higher education qualification. One (0.2%) respondent had a PhD and 14.2% (n=55) listed their qualification as "Other", indicating their qualification was not available on the pre-set options.

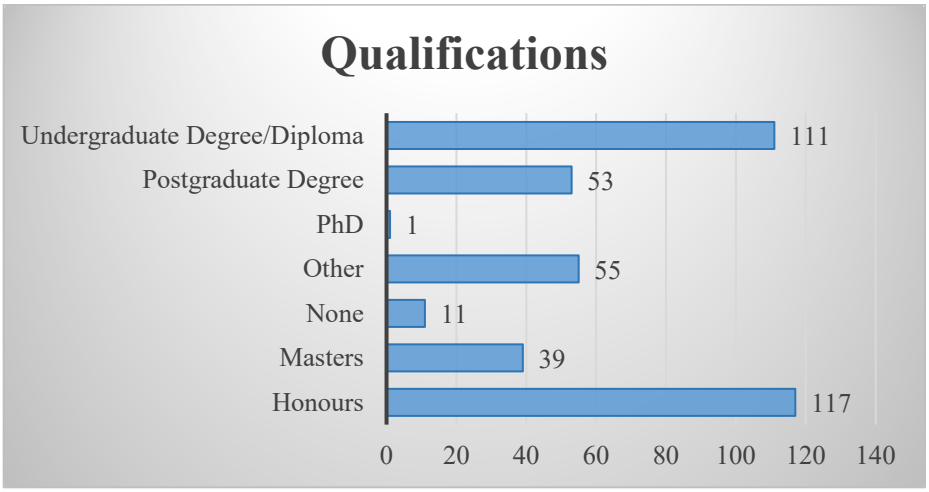

Figure 8 - Level of Qualification

The online survey for phase one was sent out to all nine provinces in South Africa, in order to ensure that there was sufficient representation of respondents from all provinces. However, Figure 9 reveals that surveys were mostly completed by respondents in KwaZulu-Natal (47.3%, n=184) and Gauteng (39.8%, n=155), following the Western Cape (6.7%, n=26).

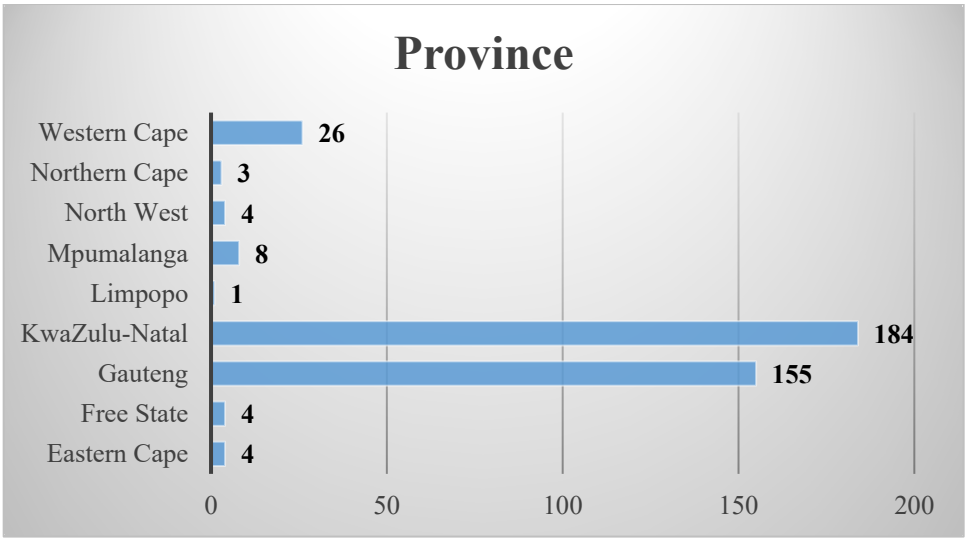

Figure 9 - Province Distribution

The cross tabulation in Table 6 below shows the sub-sector and the qualification distribution.

Table 6 - Crosstab between Sub-sector and Qualification

		Qualification							Total
		Honours	Masters	None	Other	PhD	Postgraduate Degree	Undergraduate Degree/Diploma	
Business Services	Count	62	18	5	29	1	20	68	203
	% within Subsector	30.5%	8.9%	2.5%	14.3%	0.5%	9.9%	33.5%	100.0%
Finance	Count	51	18	4	19	0	32	36	160
	% within Subsector	31.9%	11.3%	2.5%	11.9%	0.0%	20.0%	22.5%	100.0%
Real-Estate	Count	4	3	2	7	0	1	7	24
	% within Subsector	16.7%	12.5%	8.3%	29.2%	0.0%	4.2%	29.2%	100.0%
Total	Count	117	39	11	55	1	53	111	387
	% within Subsector	30.2%	10.1%	2.8%	14.2%	0.3%	13.7%	28.7%	100.0%

Of those in the business sector, 33.5% had and undergraduate/diploma, 30.5% had honours, 8.95% masters, 9.9% had a post graduate degree, 0.5% PhD and 2.5% had none, while the remaining

14.3% had other qualifications. In the finance sub-sector, 31.9% had honours, 22.5% had undergraduate degree/diploma, 20% postgraduate degree, 11.3% had masters, 2.5% had none, and no respondent had a PhD, while the remaining 11.9% had other form of qualification. Real Estate had 29.2% undergraduate degree/diploma, 16.7% Honours, 12.5% Masters, 29.2% other, 8.3% with none and none with PhD. The Monte Carlo Fisher's Exact Test[13] gave a value of 22.683 with a corresponding p-value of 0.038 (Confidence Interval - CI 0.033-0.043). Therefore, there is a relationship between sector and qualification at a 5% level of significance (see Table 7). This implies that the industry sector is associated with the qualification variable.

Table 7 - Monte Carlo Fisher's Exact Test

Chi-Square Tests						
			Asymptotic Significance (2-sided)	Monte Carlo Sig. (2-sided)		
					99% Confidence Interval	
	Value	df		Significance	Lower Bound	Upper Bound
Pearson Chi-Square	22.476[a]	12	.033	.057[b]	.051	.063
Likelihood Ratio	21.760	12	.040	.038[b]	.033	.043
Fisher's Exact Test	22.683			.019[b]	.015	.022
N of Valid Cases	387					

Given the background information of the respondents for the study, the next section tests the validity and reliability of the constructs of the research instrument. It is important to ensure that the constructs are valid and reliable, to ensure a sound study.

4.4. Factor analysis

Factor analysis was used, since it is regarded as the method of choice for analysing self-reported questionnaires (Williams *et al.*, 2010). Factor analysis is a multivariate statistical technique that: (1) reduces many variables into few sub-sets of variables (also known as factors); (2) it creates underlying factors between latent constructs and measured variables, thus permitting the creation and improvement of theory; and (3) it offers construct validity verification of self-reporting ranges (Williams *et al.*, 2010). Factor analysis was employed to try and reduce the data to a more compact form. This means, through factor analysis, items that are closely linked will be grouped together. Before extracting the factors, a few tests (i.e. Kaiser-Meyer-Olkin (KMO) Measure of Sampling

[13] Exact tests are designed to make reliable inferences from the data set. However, when the data set is too large to be processed by the exact algorithm, then Monte Carlo algorithms are used instead with the aim of estimating the p values (Mehta & Patel, 2011).

Adequacy; and Bartlett's Test of Sphericity) need to be conducted to evaluate the appropriateness of respondent data for the factor analysis statistical procedure (Williams *et al.*, 2010).

The "Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy indicates the proportion of variance in the variables that might be caused by underlying factors" that will have been obtained (Liao *et al.*, 2018, p. 7). In other words, sampling adequacy for each variable within the model and the whole model, is measured by KMO, which returns values between 0 and 1. According to Wahyudi *et al.* (2019, p. 52), general guidelines for interpreting this type of statistical values are as follows:

- KMO values between 0.6 and 1 indicate the sampling is adequate.
- KMO values less than 0.6 indicate the sampling is not adequate and that remedial action should be taken. Some authors put this value at 0.5, so use your own judgment for values between 0.5 and 0.6.
- KMO Values close to zero means that there are large partial correlations compared to the sum of correlations. In other words, there are widespread correlations which are a large problem for factor analysis.

Further to that, SPSS gives the Bartlett's test of sphericity, which tests the hypothesis that the correlation matrix is an identity matrix. If it is an identity, then it would mean that the variables are unrelated and therefore unsuitable for structure detection. Thus, the hypothesis can be rejected, since the correlation matrix is an identity matrix.

4.4.1. Use of software applications and Web tools

The second section of the questionnaire had 22 items under it. Using an eigenvalue of one, six factors were obtained (see Table 8). The KMO was obtained as 0.879 (87.9%), which means there was sampling adequacy in our data. The Bartlett's Test of Sphericity had a p-value of 0.00, hence the null hypothesis of identity matrix is rejected and factor analysis may be useful with the data. Total variance explained by the six factors was 70.48%.

Table 8 - Principal Component Analysis for Use of Software Applications and Web Tools Construct

Pattern Matrix[a]						
	Component					
	1	2	3	4	5	6
Q2.1		.771				
Q2.2		.777				
Q2.3				.760		
Q2.4		.822				
Q2.5		.700				
Q2.6				.769		
Q2.7				.607		
Q2.8	.776					
Q2.9	.770					
Q2.10	.794					
Q2.11	.743					
Q2.12					-.641	
Q2.13					-.859	
Q2.14					-.750	
Q2.15						.786
Q2.16						.775
Q2.17						.761
Q2.18						.621
Q2.19			-.828			
Q2.20			-.813			
Q2.21			-.766			
Q2.22			-.506			
Extraction Method: Principal Component Analysis.						
a. Rotation converged in 10 iterations.						

From the clustering of the items it suggests that factor one is DATA MANAGEMENT SKILLS, factor two is BASIC WINDOWS & MICROSOFT SKILLS, factor three is INTERNET & EVALUATION SKILLS, factor four is MULTI-MEDIA & PUBLISHING SKILLS, factor five is PROJECT MANAGEMENT & DESIGN SKILLS, and lastly factor six is SOFTWARE USAGE & MIGRATION SKILLS. These six factors have been used to create a model relating to the digital skills needs of the industry sector being studied, specifically relating to the use of software applications and Web tools. Two other models follow in subsequent sections, with factors relating to each section of the questionnaire, that is information systems skills and security measures in digital environments. Each model categorises and depicts the digital skills that are significant to the said sector.

Table 9 represents the frequency distribution of the first factor (i.e. Data Management Skills) of the first construct (i.e. Use of Software Applications and Web Tools).

Table 9 - Factor 1 Frequency Distribution – Data Management Skills

Graduates entering this sector should be able to:		Frequency Distribution						Descriptive	
		Not Important	Slightly Important	Moderately Important	Important	Very Important	% Important/ Very Important	Mean	Standard Dev
8. use accounting software, e.g. QuickBooks	Count	73	65	91	79	80	**41.0**	3.07	1.396
	%	18.8	16.8	23.5	20.4	20.6			
9. use database software, e.g. Microsoft Access	Count	49	64	98	81	97	**45.7**	3.29	1.340
	%	12.6	16.5	25.2	20.8	24.9			
10. use data management software, e.g. IBM Analytics	Count	67	58	104	78	82	**41.2**	3.13	1.367
	%	17.2	14.9	26.7	20.1	21.1			
11. use software for analysing Big Data, e.g. software to predict customer behaviour	Count	63	55	93	84	94	**45.8**	3.23	1.386
	%	16.2	14.1	23.9	21.6	24.2			
	Cronbach's Alpha								**0.847**

The DATA MANAGEMENT SKILLS factor has a Cronbach Alpha of 84.7% indicating high internal consistency. Respondents were asked if graduates entering this sector should be able to use: accounting software, e.g. QuickBooks (i.e. item 8), database software, e.g. Microsoft Access (i.e. item 9), data management software, e.g. IBM Analytics (i.e. item 10), and software for analysing Big Data, e.g. software to predict customer behaviour (i.e. item 11). Most respondents consider items 8, 9 and 10 for this factor as 'slightly important'. However, when the 'important' and 'very important' responses were combined on the Likert scale, then items 8, 9 and 10 are considerably important to the Real-Estate, Finance and Business Services sector.

This finding is similar to Nwosu and Amahi (2019), which showed that educators and business employers both concur that accounting software skills are required to foster the competences of accounting students to ensure employment and progress in their career. Gambo (2017) also found that 49% of organisations use accounting software. This finding suggests that the curriculum of HEIs must include some training on accounting, database and data management software, which will assist organisations in employing competent graduates, so that there is no need for further training of their new recruits. Additional training for new recruits can be costly and time consuming, so if this skill is added to the curricula, it would greatly benefit many organisations. Especially, since the said sector

mainly recruits commerce graduates. This sector has been a major contributor to the country's GDP for the last several years, therefore it is crucial to continuously upskill the students that feed into this sector. This strategy will help South Africa, and developing countries alike, to keep abreast with global economies, instead of lagging behind like South Africa's current economic climate.

Pan *et al.* (2018) found that basic data manipulation (i.e. finding and retrieving data) is regarded as a valuable analytical skill for business students irrespective of their course of study. In contrast, DBMS usage for data management is viewed as less important. This simply means that it is more essential for business students to be able to retrieve and manipulate data than to manage data. They further explain that since using a DBMS to manage data is a specialized skill and is typically the area of a firm's technical experts, instead of a skill that newly hired graduates would be expected to be familiar with (Pan *et al.*, 2018). Though, business students may not need to manage or develop database systems directly, it is imperative for them to comprehend database structures, in order to effectively communicate with information technology specialists to ensure efficient and accurate data gathering (Pan *et al.*, 2018). Systems failure sometimes occur due to key employee's lack of knowledge on the importance of data structures and other technical aspects relating to the database components of an information system. Subsequently, it is necessary for all commerce graduates to be equipped with data management skills.

Table 10 represents the frequency distribution of the second factor (i.e. Basic Windows & Microsoft Skills) of the first construct (i.e. Use of Software Applications and Web Tools).

Table 10 - Factor 2 Frequency Distribution – Basic Windows & Microsoft Skills

Graduates entering this sector should be able to:		Frequency Distribution						Descriptive	
		Not Important	Slightly Important	Moderately Important	Important	Very Important	% Important/ Very Important	Mean	Standard Dev
1. use a computer operating system, e.g. Windows 10	Count	1	3	25	75	285	**92.6**	4.65	0.660
	%	0.3	0.8	6.4	19.3	73.3			
2. use word processing software, e.g. Microsoft Word	Count	1	4	34	85	263	**90.0**	4.56	0.718
	%	0.3	1.0	8.8	22.0	68.0			
4. use spreadsheet software e.g. Microsoft Excel	Count	1	6	39	59	284	**88.2**	4.59	0.753
	%	0.3	1.5	10.0	15.2	73.0			
5. use presentation software, e.g. Microsoft PowerPoint	Count	3	19	57	101	209	**79.7**	4.27	0.937
	%	0.8	4.9	14.7	26.0	53.7			
	Cronbach's Alpha								**0.794**

The second factor, BASIC WINDOWS & MICROSOFT SKILLS, is made up of four items. A check of internal consistency amongst the selected items had a Cronbach Alpha of 79.4%, which shows high internal consistency amongst items. Respondents were then asked if graduates entering this sector should be able to use: a computer operating system, e.g. Windows (item 1), word processing software, e.g. Microsoft Word (item 2), spreadsheet software e.g. Microsoft Excel (item 4), and presentation software, e.g. Microsoft PowerPoint (item 5). Majority of the respondents signified that these particular skills are 'very important' for the Real-Estate, Finance and Business Services sector. When the 'important' and 'very important' responses were combined on the Likert scale, almost 80% and above indicated that these four items are essential skills for graduates entering their sector. These findings are in alignment with the findings of Pan *et al.* (2018).

Pan *et al.* (2018) found that undergraduate students require foundational knowledge of spreadsheets, as 86% of their respondents indicated that students should be able to: (1) perform calculations, (2) use integral functions, and (3) generate formulas. They further found that 82% agreed that students ought to correctly design a spreadsheet to analyse and manipulate the data efficiently, as well as an understanding of spreadsheet functions. These items are important, since many job descriptions require these skills to perform daily/routine administrative functions in most organisations, today. Gambo (2017) also found that a large majority of organisations use word

processing software, as well as spreadsheet software. Table 11 represents the frequency distribution of the third factor (i.e. Internet & Evaluation Skills) of the first construct (i.e. Use of Software Applications and Web Tools).

Table 11 - Factor 3 Frequency Distribution – Internet & Evaluation Skills

Graduates entering this sector should be able to:		**Frequency Distribution**						**Descriptive**	
		Not Important	Slightly Important	Moderately Important	Important	Very Important	**% Important/ Very Important**	Mean	Standard Dev
19. use social media and online collaboration tools, e.g. Facebook	Count	66	67	79	79	98	**45.5**	3.20	1.424
	%	17.0	17.2	20.3	20.3	25.2			
20. use Web 2.0 tools, e.g. Google/YouTube	Count	30	51	78	99	130	**59.0**	3.64	1.277
	%	7.7	13.1	20.1	25.5	33.5			
21. use of cloud computing applications, e.g. Google Docs	Count	27	36	76	110	139	**64.2**	3.77	1.225
	%	7.0	9.3	19.6	28.4	35.8			
22. critically evaluate software applications to determine its effectiveness in enhancing work performance	Count	36	37	85	109	122	**59.4**	3.63	1.269
	%	9.3	9.5	21.9	28.0	31.4			
	Cronbach's Alpha								**0.799**

The third factor, INTERNET & EVALUATION SKILLS, is made up of four items and the Cronbach Alpha obtained was 79.9%, which shows high internal consistency. When asked if graduates entering this sector should be able to use social media and online collaboration tools, e.g. Facebook, 17.0% of the respondents indicated that it is not important, 17.2% slightly important, 20.3% moderately important, 20.3% pointed out that it is important and 25.2% consider it as very important. This is mainly due to the fact that many businesses are turning to social media for advertising and customer relationship management. So, business professionals may need to respond to customer queries and/or continuously update the Facebook page. Many businesses also conduct business by means of provincial or national team efforts, therefore online collaboration tools are a skill considered significantly important. Social networks behave as a natural medium for network outcomes and as a strategic area for community development that is able to boost a project's appeal (Shuen, 2018). Furthermore, social networks helps businesses reach a greater audience, as well as establish stronger relations with the project's user population (Shuen, 2018).

Although social media and online collaboration tools are Web 2.0 tools, when respondents were questioned if graduates entering this sector should be able to use Web 2.0 tools, such as Google/YouTube their responses differed significantly from the results above, as 7.7% indicated that it is not important, 13.1% slightly important, 20.1% moderately important, 25.5% pointed out that it is important and 33.5% consider it as very important. This means that not all Web 2.0 tools are considered on the same level of importance. Web 2.0 tools are regard as the mainstay of many successful organisations. For example, Procter and Gamble's CEO, A.G. Lafley, raised his new product development to 80%, whereas the industry average was 30% as a result of adopting Web 2.0 tools (Shuen, 2018). She claims that social networking has the ability to enrich and infuse Web 2.0 projects even though they may not be the main focus.

Table 12 represents the frequency distribution of the fourth factor (i.e. Multi-Media & Publishing Skills) of the first construct (i.e. Use of Software Applications and Web Tools).

Table 12 - Factor 4 Frequency Distribution - Multi-Media & Publishing Skills

Graduates entering this sector should be able to:		**Frequency Distribution**						**Descriptive**	
		Not Important	Slightly Important	Moderately Important	Important	Very Important	**% Important/ Very Important**	Mean	Standard Deviation
3. use audio and video software, e.g. Windows Movie Maker	Count	102	83	103	50	51	**26.0**	2.65	1.341
	%	26.2	21.3	26.5	12.9	13.1			
6. use multimedia software, e.g. Windows Media Player	Count	75	90	98	63	63	**32.4**	2.87	1.342
	%	19.3	23.1	25.2	16.2	16.2			
7. use desktop publishing software, e.g. Microsoft Publisher	Count	80	88	102	66	53	**30.6**	2.80	1.315
	%	20.6	22.6	26.2	17.0	13.6			
	Cronbach's Alpha								**0.831**

The fourth factor, MULTI-MEDIA & PUBLISHING SKILLS, is made up of three items. The Cronbach Alpha obtained was 83.1%, which once again shows high internal consistency. The respondents were required to indicate if graduates entering this sector should be able to use: audio and video software, e.g. Windows Movie Maker, multimedia software, e.g. Windows Media Player, and use desktop publishing software, e.g. Microsoft Publisher. The results show that 26.2% of the respondents indicated that ability to use audio and video software, e.g. Windows Movie Maker was

not important, 21.3% feel that it is slightly important, 26.5% moderately important, 12.9% important and lastly 13.1% said it is very important. This digital skill may not be as important to the said sector, but in a few other industry sectors it is considered a key component. This factor contained skills that was the least important from all other factors in this study.

With regard to the use of multimedia software, e.g. Windows Media Player, it is considered not important by 19.3% of the respondents, whilst 23.1% reported it is slightly important, 25.2% moderately important, 16.2% indicated important and 16.2% very important. Although multimedia software is largely regard as moderately important to the said industry sector, with the advent of computer networking, it is believed that multimedia training will have a vast influence in the domain of training and education (J. Wang & Wang, 2018). Multimedia software is found to greatly influence other industries, such as the creative industries (i.e. dance, design, music, etc.), which have a big impact on improving the economies of scale in EU countries like the UK (J. Wang & Wang, 2018).

Desktop publishing software are typically used to produce documents with graphical designs and typographic quality images and text, such as newspapers, books, magazines, flyers, posters and brochures (Manuja & Duggal, 2017). When questioned if graduates should be able to use desktop publishing software, 20.6% of the respondents indicated it is not important, 22.6% slightly important, 26.2% moderately important, 17% important and 13.6% consider it as very important. This skill is considered moderately important by most of the respondents, nevertheless it is a skill that is required by the said sector and therefore students need to be knowledgeable in this software. Desktop publishing can prove to be highly beneficial to the marketing and advertising of any organisation, locally and globally. Surely, if a company is well marketed, it increases the chances of improved revenue for the organisation and consequently the economy. It can thus be deduced that even though these three items are used by the Real-Estate, Finance and Business Services sector in South Africa, most respondents claim that they are moderately important. Nonetheless, these skills may feature in the curricula of training programmes, but may not necessarily be covered at length, since this sector does not place too much emphasis on them. Table 13 represents the frequency distribution of the fifth factor (i.e. Project Management & Design Skills) of the first construct (i.e. Use of Software Applications and Web Tools).

Table 13 - Factor 5 Frequency Distribution - Project Management & Design Skills

Graduates entering this sector should be able to:		Frequency Distribution						Descriptive	
		Not Important	Slightly Important	Moderately Important	Important	Very Important	% Important/ Very Important	Mean	Standard Deviation
12. use project management software, e.g. Microsoft Project	Count	55	72	88	97	77	**44.7**	3.18	1.328
	%	14.1	18.5	22.6	24.9	19.8			
13. use design software, e.g. Microsoft Visio	Count	94	53	74	86	82	**43.2**	3.02	1.474
	%	24.2	13.6	19.0	22.1	21.1			
14. use drawing and planning software, e.g. Corel Draw	Count	143	74	90	44	38	**21.1**	2.38	1.337
	%	36.8	19.0	23.1	11.3	9.8			
	Cronbach's Alpha								**0.858**

The fifth factor, PROJECT MANAGEMENT & DESIGN SKILLS, is made up of three items. The Cronbach Alpha obtained was 85.8%, which also shows high internal consistency. Respondents thereafter needed to indicate if graduates should be able to use: project management software, e.g. Microsoft Project, use design software, e.g. Microsoft Visio, and drawing and planning software, e.g. Corel Draw. The frequency distributions show that 14.1% of the respondents indicated that it is not important for graduates to possess the ability to use project management software, e.g. Microsoft Project, while 18.5% pointed out that it is slightly important, 22.6% moderately important, 24.9% important and lastly 19.8% very important. Project success is dependent on the outcomes it is meant to achieve, but achieving successful results is subject to how meticulously businesses manage the risks that threaten their projects (Kliem & Ludin, 2019). Consequently, project management software plays a pivotal role for managing risks, and for that reason it is important for graduates to be skilled in such software.

Furthermore, industry's expectations from graduates with regards to the use of design software, e.g. Microsoft Visio is considered not important by 24.2% of the respondents, whilst 13.6% indicated it is slightly important, 19.0% moderately important, 22.1% said it is important and 21.1% very important. Owing to current economic globalization trends, digital product design software predominantly, includes Microsoft Visio and Microsoft Project (H. J. Wang, 2016). Foreign and domestic enterprises, in the field of digital design mainly these two software (H. J. Wang, 2016). Design software is typically used in the software development lifecycle to establish the design of the

user/ system requirements. From the design of databases, dataflow diagrams, flowcharts, network designs, UML class diagrams to Gantt charts, only to name a few. It will be advantageous to students to be skilled in a versatile design software like Microsoft Visio. For example, the calendar and organisational chart features will assist even graduates that take on even an administrator role in the said sector.

When questioned if graduates should be able to use drawing and planning software, e.g. Corel Draw, a large portion of the respondents (i.e. 36.8%) indicated that it is not important, 19.0% slightly important, 23.1% moderately important, 11.3% pointed out that it is important and 9.8% consider it as very important. This particular skill is not primarily viewed as a 'must have' for the said sector. Therefore, a general digital skills training program should cover this skill on the surface only, so that graduates are aware of the various drawing and planning software, in the event that they may need to use it in the future. However, this skill is still considered important for some occupations, hence it should be covered in detail in a specialised program that requires such skills, such as architecture.

Table 14 represents the frequency distribution of the sixth factor (i.e. Software Usage & Migration Skills) of the first construct (i.e. Use of Software Applications and Web Tools).

Table 14 - Factor 6 Frequency Distribution - Software Usage & Migration Skills

Graduates entering this sector should be able to:		**Frequency Distribution**						**Descriptive**	
		Not Important	Slightly Important	Moderately Important	Important	Very Important	**% Important/ Very Important**	Mean	Standard Dev
15. use custom-designed software, e.g. in-house software	Count	62	52	63	98	114	**54.5**	3.39	1.432
	%	15.9	13.4	16.2	25.2	29.3			
16. comply with legal copyright provisions	Count	21	23	40	89	214	**78.3**	4.17	1.165
	%	5.4	5.9	10.3	23.0	55.3			
17. use software applications to access information	Count	13	18	56	131	169	**77.6**	4.10	1.031
	%	3.4	4.7	14.5	33.9	43.7			
18. migrate to new software applications	Count	22	34	85	132	115	**63.6**	3.73	1.144
	%	5.7	8.8	21.9	34.0	29.6			
	Cronbach's Alpha								**0.775**

The final factor, SOFTWARE USAGE & MIGRATION SKILLS, has a Cronbach Alpha of 77.5% indicating high internal consistency. Respondents then denoted the graduates' ability to: use custom-designed software, e.g. in-house software, comply with legal copyright provisions, comply with legal copyright provisions, and migrate to new software applications. The items in this factor, were rated the second highest from all other factors in this construct, in terms of importance to the said sector.

When asked if graduates entering this sector should be able use custom-designed software, e.g. in-house software, 15.9% of the respondents declared that it is not important, 13.4% indicated slightly important, 16.2% moderately important, 25.2% pointed out it is important and 29.3% said it is very important. Many organisations are seeing the benefits of deploying custom-designed software to meet the goals and objectives of their business. Given that hundreds of thousands of rand, and in some cases millions, is spend on software/systems development, it is imperative that graduates should be comfortable and familiar with the requisite of being able to use custom-designed software. While it is obvious that not all organisations will use similar custom-designed software, graduates should have the experience of using a few custom-designed software, which will augment their inclination to efficiently and effectively use custom-designed software after they have being trained on the specific custom-designed software. Some employees are afraid to use custom-designed software, as there are several fears that they possess, which hinders their willingness to productively use custom-designed software.

The Real-Estate, Finance and Business Services sector require graduates to be able comply with legal copyright provisions, as 55.3% considers it very important and 23.0% indicated it is important, whilst 10.3% feel it is moderately important, 5.9% slightly important, and only 5.4% considers it not important. Ensuring that employees are able to comply with legal copyright provisions are critical for an organisation, as failure to comply with these copyright laws will most probably lead to unpleasant legal battles and unnecessary legal costs. Moreover, a copyright infringement may also put the company's reputation at risk. Owing to this, it is imperative that graduates are educated on the implications of non-compliance. Even large conglomerates, such as Samsung were sued for copyright infringement by Apple, when Samsung replicated the iPad with their tablet computers. Apart from the hefty legal costs that Samsung Electronics had to fork out, the jury stated that Samsung must pay $539 million to Apple, since they replicated Apple's patented smartphone and tablet features (Reuters, 2018). Furthermore, some businesses go beyond the contentions of its contribution to the growth of the economy, which necessitates stringent copyright protection to guarantee its

development (Ncube, 2018). It is also argued that a vital first stage is to enhance present copyright frameworks by addressing its intrinsic entrepreneurial challenges to better empower creators to garner economic returns (Ncube, 2018).

Information is vital in every organisation, and is considered the heart of an organisation. Graduates have to be able to use software applications and Web tools to access information if they want to survive the 21st century workplace. As such, only 3.4% of the industry respondents regards the use of software applications and Web tools to access information as not important, 4.7% slightly important, 14.5% moderately important, while the majority feel that it is of utmost importance from all other digital skills in this construct (i.e. use of software applications and Web tools), since 33.9% of respondents considers it is important and 43.7% as very important. Variations of 21st century skills framework have been progressively adopted by more universities to guarantee that their graduates acquire the expertise required to function in a knowledge-based society (Travis, 2011). This finding confirms that even after almost a decade, organisations still believe that graduates' ability to use software applications to access information is very important. Further to that, many employees claim that accessing information is a fundamental part of their work, which indicates the value that information literacy skills hold in the workplace and is recognised as such by businesses as it is by graduates (Travis, 2011).

The importance of continuous learning and the significance that information literacy has in all work sectors and not only knowledge management, have been understated (Travis, 2011). According to Moore's Law, the processing speed of computers will double every two years. As a result, businesses' find the need to upgrade their information systems every few years, so that they can keep abreast of technology advancements, in order to gain a competitive advantage. It is therefore imperative that their employees are knowledgeable in migrating to new software applications. Hence, 29.6% of respondents consider the ability to migrate to new software applications as very important, 34% as important, 21.9% as moderately important, whilst only 5.7% not important, the remaining 8.8% as slightly important.

Figure 10 is a model that was derived from the principal component analysis that was performed for the first construct: Use of software applications and Web tools. This model deals specifically with the skills required from graduates entering the Real Estate, Finance and Business Services industry sector. While the digital skills model for software applications usage is a result of the data collected for the said sector, it may also be tested in other sectors to determine if the

requirements in this sector is also applicable to other sectors. If the model is applicable to other sectors, then it may be used as a generic model that HEIs should use as a framework for their curriculum development, to ensure curricula alignment to industry. If it is not applicable to other sectors, then only the commerce faculty should use the model as a guide to align their digital skills offering to what the said sector needs.

Chapter 2 discussed that South Africa, like other developing countries, possesses a mis-alignment between the digital skills being taught at tertiary institutions and the digital skills that industry actually requires, which research indicates is indirectly affecting the economy. However, this study reveals the exact digital skills that students are lacking and proposes a framework to bridge the digital skills gap in the South African context. A framework used by any first-world country may not be applicable to a developing country, since there are several factors that differ between a first-world and a developing country. For example, when searching a recruitment website, the job responsibilities for a typical administrator required much more digital skills in a first-world country than a developing country. Hence, the Digital Skills Model for Software Applications Usage is particularly applicable to developing countries, such as South Africa. The model below (Figure 10) provides a bird's-eye view of the skills categories, with regard to the construct called "Use of Software Applications and Web Tools", where each block in the model represents a factor.

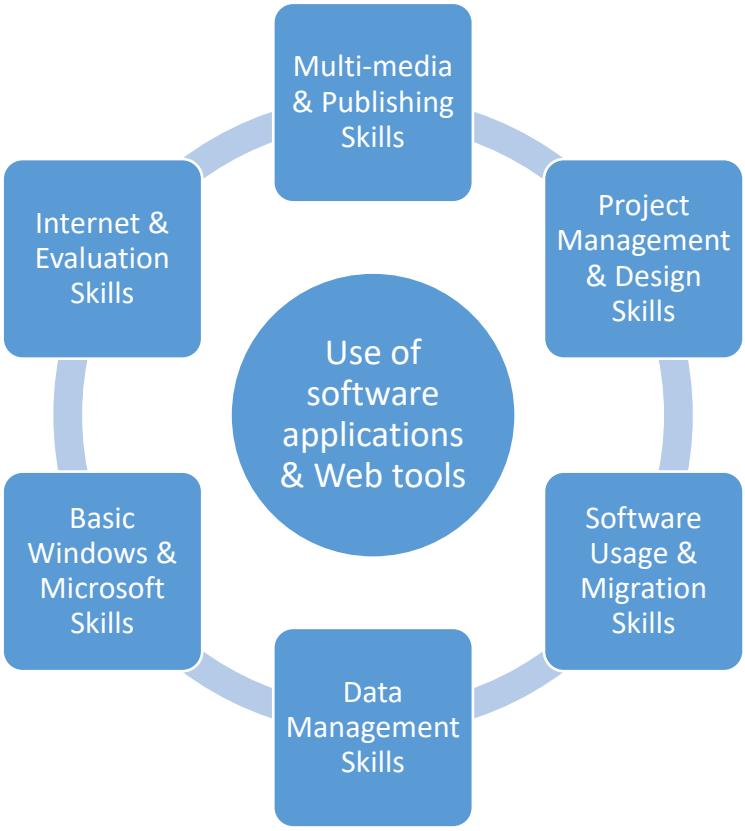

Figure 10 - Digital Skills Model for Software Applications Usage

The next section unfolds the second construct of the questionnaire, which is the *use of information systems*. Towards the end of the late 20th century, many organisations have moved from manual information systems to electronic information systems (Haigh, 2001). This transformation has provided these organisations with numerous benefits that far outweigh its drawback. As a result, every so often organisations invest a large outlay of funds into the maintenance and upgrade of their information systems. These investments are necessary, in order to: keep up with technological advancements, gain a competitive advantage, attract and maintain clientele and most importantly, increase their profit margins, only to list a few.

Due to industry's large investment in information systems, it was necessary to observe the *use of information systems* as a separate construct. This enabled the researcher to investigate if HEIs in South Africa are adequately preparing graduates with the necessary digital skills to efficiently and effectively use information systems, to achieve the goals of the organisation. Understandably so, there

is no ‘one-size fits all’ information system, but most information systems possess a number if similar characteristics/features, although they differ in others.

4.4.2. Use of information systems

Phase one comprises three constructs with the *use of information systems* being the second construct. This construct constituted 12 items and once the exploratory factor analysis was run with SPSS, two factors based on eigenvalue of one were obtained (see Table 15). The eigenvalue is the degree to which a factor explains the variance of the observed variables (Beavers *et al.*, 2013). In other words, the eigenvalue is the value that is used to determine the number of factors to extract for each construct.

Table 15 - Principal Component Analysis for Use of Information Systems

Pattern Matrix[a]		
	Component	
	1	2
Q3.1	.557	
Q3.2	.769	
Q3.3	.898	
Q3.4	.864	
Q3.5	.903	
Q3.6	.782	
Q3.7	.846	
Q3.8		.724
Q3.9		.878
Q3.10		.870
Q3.11		.845
Q3.12		.503
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.		
a. Rotation converged in 5 iterations.		

The KMO obtained was 0.914 (91.4%), which denotes that there was sampling adequacy in the data obtained (see Table 16). The Bartlett's Test of Sphericity had a p-value < 0.001, hence the null hypothesis of the identity matrix can be rejected and it can be concluded that factor analysis may be useful with the data. Total variance explained by the two factors was 68.97%.

Table 16 - Measure of sampling adequacy – Use of information systems construct

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.914
Bartlett's Test of Sphericity	Approx. Chi-Square	3415.893
	df	66
	Sig.	.000

From the clustering of the items it suggests that factor one is SYSTEM DEVELOPMENT & TROUBLESHOOTING SKILLS, and factor two is DIGITAL DEVICE USAGE, INFORMATION SYSTEMS USAGE & MIGRATION SKILLS. These two factors have been used to create a model relating to the digital skills needs of the sector under study, specifically relating to the use of information systems (see Figure 12). Since many organisations are utilizing information systems, it is necessary for them to review and/or upgrade their system to keep abreast with technology. In doing so, it is essential for key employees to be involved at the various stages of the systems development lifecycle (SDLC). Even though some employees may not have the technical knowledge of building an information system, their vast knowledge of the workings of the organisation in question, will assist in the development and implementation of a successful information system. Therefore, it is important to educate all graduates on the SDLC, even those students in the social and business sciences.

These days many organisations use information systems to conduct vital business functions, as well as to keep a record of their clients. In some instances, a knowledge base is needed for the information system, and business professionals are required to provide information for the knowledge base and input for other components of the information system. There is much communication between the IT experts and business professionals, in order to develop a successful system. At times, the development of the information systems takes longer and invariably costs more due to the digital skills deficiency by the business professionals on the SDLC, and sometimes vice versa. Some basic knowledge of the SDLC within the business domain could help mitigate this kind of issue.

Table 17 represents the frequency distribution of the first factor (i.e. System Development & Troubleshooting Skills) of the second construct (i.e. Use of Information Systems).

Table 17 - Factor 1 Frequency Distribution - System Development & Troubleshooting Skills

Graduates entering this sector should be able to:		**Frequency Distribution**						**Descriptive**	
		Not Important	Slightly Important	Moderately Important	Important	Very Important	**% Important/ Very Important**	Mean	Standard Deviation
1. assist in the analysis of an information system	Count	33	37	89	118	112	**59.2**	3.61	1.231
	%	8.5	9.5	22.9	30.3	28.8			
2. assist in the design of an information systems	Count	75	58	88	100	68	**43.2**	3.07	1.370
	%	19.3	14.9	22.6	25.7	17.5			
3. write software development code	Count	145	58	69	62	55	**30.0**	2.55	1.472
	%	37.3	14.9	17.7	15.9	14.1			
4. install software applications	Count	86	58	86	80	79	**40.9**	3.02	1.434
	%	22.1	14.9	22.1	20.6	20.3			
5. ensure smooth functioning of the information system	Count	75	52	77	96	89	**47.6**	3.19	1.428
	%	19.3	13.4	19.8	24.7	22.9			
6. connect information systems to the Internet	Count	64	64	76	88	97	**47.5**	3.23	1.413
	%	16.5	16.5	19.5	22.6	24.9			
7. troubleshoot information systems	Count	72	60	80	86	91	**45.5**	3.16	1.425
	%	18.5	15.4	20.6	22.1	23.4			
	Cronbach's Alpha								**0.920**

This factor, SYSTEM DEVELOPMENT & TROUBLESHOOTING SKILLS, had a Cronbach Alpha of 92% indicating high internal consistency. Respondents were asked to indicate if graduates should be able to assist in the 'analysis' of an information system, 8.5% of the them indicated it is not important, 9.5% slightly important, 22.9% moderately important, 30.3% important and 28.8% denoted it as very important. This item scored the highest percentage for this construct, in terms of its importance to the said sector. Additionally, when asked if graduates entering the sector should be able to assist in the 'design' of an information system, 19.3% pointed out that it is not important, 14.9% slightly important, 22.6% moderately important, 25.7% important, whilst the remaining 17.5% considered it very important. Most frequently, IT organizations engage in supporting non-IT organizations, which affects the development effort and overall outcome of the information system (Kobus *et al.*, 2018).

Typically, when systems development tasks are newly assigned, big differences amid individual's skills are presented by the employees of the non-IT organizations (Kobus *et al.*, 2018). Those employees from the non-IT organizations, who possess little or no technical knowledge of systems development, require substantially more time and effort to articulate the necessary information required by the IT professionals in the development effort. For any business, 'time is money', so this extra time required for the analysis and design stages of the SDLC will substantially escalate client costs, and subsequently delay the production of the deliverables for these two stages of the SDLC. Since, every organisation wants maximise profits and reduce operating costs, it is important to educate all commerce students that feed into the said sector, not only with the digital skills that is required to perform their daily job responsibilities, but the skills required for a systems development initiative. In turn, this has the potential to benefit organisations, as their employees will have sufficient knowledge to cooperate with IT professionals when the need arises for systems upgrade or renewals, thereby reducing the system development costs.

With regard to the graduate's ability to write software development code, 37.3% of the respondents consider it not important, 14.9% slightly important, 17.7% moderately important, 15.9% important and 14.1% consider it as very important. From these results, most South African organisations in the said sector do not believe that the ability for a graduate to write code is important. These results are expected, since this specific digital skill is largely a core skill for computer engineers and most IT professionals, therefore it should undoubtedly feature in curricula for students that want to major in IS and/or computer science (CS). However, it will be beneficial to commerce students to have a few weeks of programming covered in their IT curriculum, as it is done at UKZN. This not only benefits the organisation that the student will feed into, but it also benefits the student in a few ways. For instance, students become more employable, and this also keeps the student's options open if s/he decides to change from say an accounting to an IS major. Research suggests that coding is particularly important even at primary school level, therefore many first-world countries have already introduced coding as a valuable component of their curricula.

In view of the fact that there is ample coding tools and online technical support to coding even in early childhood, surely institutions of higher education can find the ways and means of ensuring that all graduates have some coding knowledge pertaining to his/her degree structure. So, the main question is: 'Why has the South African Qualifications Authority (SAQA) not made any efforts to make coding compulsory at tertiary level, as a start?' Understandably so, South Africa does not have enough funding to roll out the infrastructure required to make coding compulsory at high schools, let

alone primary schools. Surely, seeing as institutions of higher education already have the technical infrastructure, SAQA should outline a strategy to ensure that all degree structures have IT infused within the curricula.

Currently, there are thousands of software applications that are available to carry out various tasks of an organisation. It is also necessary for an organisation to regularly update the software that it utilises. When asked if graduates entering the sector should be able to install software programs, 22.1% felt that it is not important, 14.9% indicated slightly important, 22.1% as moderately important, 20.6% as important, whilst the remaining 20.3% consider it very important. While this may be a cost-effective approach for an organisation to save on hiring IT professionals, allowing non-IT professionals to install software on a company's hardware devices could potentially pose a security risk for the organisation. There are many Trojan horse[14] software available online, and not to mention other cyber-threats, like ransomware. This particular digital skill is a 'nice to have' skill for personal growth and development, but could be harmful to an organisation. Additionally, there are guidelines and/or company policies that would need to be followed when installing a software application, even though it may be a simple, yet straightforward task.

The ability of graduates, entering the sector, to ensure smooth functioning of the information system is considered not important by 19.3% of the respondents. 13.4% consider it slightly impossible. 19.8% as moderately important, 24.7% and 22.9% consider it important and very important, respectively. This skill is the second most important skill in this factor for a graduate to possess. An information system is the heart of most organisations today, and if it does not function smoothly, the result is a ripple effect: a drop-in productivity, hence a drop-in profit margin. Some organisations, and mostly larger ones, have an ICT department which typically handles the smooth functioning of their information system. In some cases, smaller organisations train their employees to handle issues that may arise when performing daily tasks. In such a case, this skill will be crucial to the job requirements. And of course, the IT professionals would definitely require this skill if they are to be successful in their career, and to keep the client happy. Although this skill sounds simple, it is far from straightforward. This skill is linked to the last skill in this factor, which is troubleshooting an information system.

[14] A software application that camouflages its true malicious intent. The user trusts that once the application is installed, it will perform as indicated by the developer, but this is not the case, as it is a virus (Jaiswal, 2017).

When it came to the ability to connect information systems to the Internet 16.5% consider it not important. An equal percentage consider it slightly important, 19.5% of the respondents consider it moderately important, and 22.6% indicated it is important. The remaining 24.9% felt that it is very important. Once again, this skill is considered very important to most organisations. A contributing factor for this result is that many organisations run their information systems via the Internet or an Intranet[15], therefore it is imperative for their information systems to be connected to the Internet. No Internet means system downtime, which ultimately results in a loss in profit. Graduates having this skill could help to easily mitigate these negative effects in the event that the Internet connection drops for reasons within one's control. Respondents who indicated that this skill is not important possibly do not use an information system, or they have IT specialists in close proximity to rectify issues when Internet connectivity is lost by the information system.

A graduate's ability to troubleshoot information systems, was considered it not important by 18.5% of the respondents, slightly important by 15.4%, 20.6% rated it moderately important, 22.1% indicated it is important and 23.4% consider it very important. This skill is linked to the skill discussed earlier on ensuring the smooth functioning of the information system. In order to ensure the smooth functioning of an information system, one would need to have good troubleshooting skills. The information system users will need to be trained for custom information systems developed in-house by the organisation. However, there are some fundamental trouble shooting skills that can be taught to students before they enter the job market. For example, the DECSAR Method developed by Ross (2004) in an attempt to address troubleshooting issues.

The DECSAR Method is a six-step troubleshooting approach designed to display effective troubleshooting techniques (see Figure 11). The figure below illustrates the DECSAR Method, which is one strategy that can be taught to students, with regard to troubleshooting information systems.

[15] A computer network used by an organisation to share information and resources with its employees.

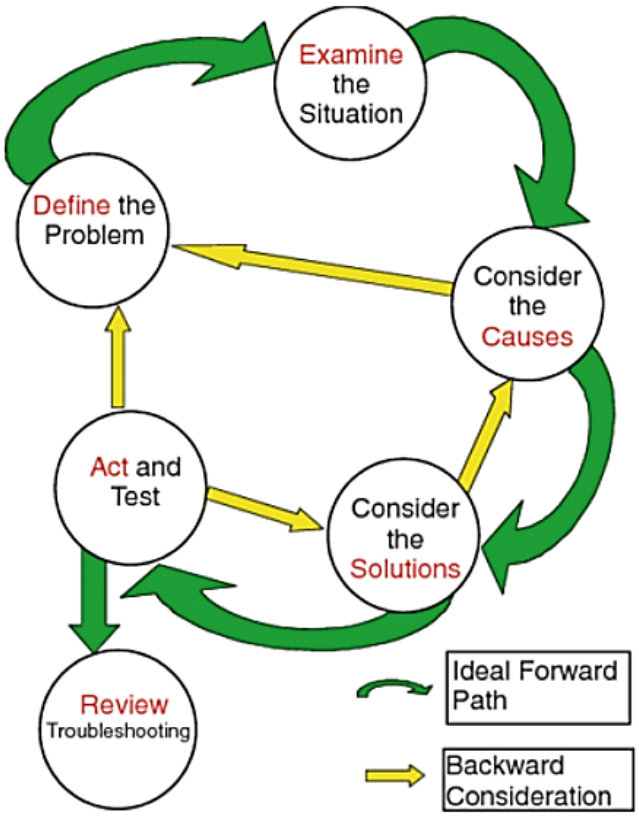

Figure 11 - The DECSAR Method (Ross, 2004)

It should be noted that items three and four of this factor are skills mainly required by the IT industry of this sector, therefore the most respondents considered these skills to be not important. However, as discusses, research suggests that these skills have numerous benefits. Table 18 represents the frequency distribution of the second factor (i.e. Digital Device Usage, Information Systems Usage & Migration Skills) of the second construct (i.e. Use of Information Systems).

Table 18 - Factor 2 Frequency Distribution – Digital Device Usage, Information Systems Usage & Migration Skills

		Frequency Distribution						**Descriptive**	
		Not Important	Slightly Important	Moderately Important	Important	Very Important	**% Important/ Very Important**	Mean	Standard Deviation
8. use mobile digital devices, e.g. smartphones	Count	16	20	59	94	199	**75.5**	4.13	1.108
	%	4.1	5.2	15.2	24.2	51.3			
9. use information systems to process information	Count	14	21	64	113	177	**74.5**	4.07	1.076
	%	3.6	5.4	16.5	29.0	45.5			
10. use information systems for collaborating	Count	22	29	62	109	167	**70.9**	3.95	1.182
	%	5.7	7.5	15.9	28.0	42.9			
11. use information systems for solving problems	Count	16	17	69	109	177	**73.7**	4.07	1.086
	%	4.1	4.4	17.8	28.1	45.6			
12. migrate to new information systems	Count	27	40	99	110	112	**57.3**	3.62	1.200
	%	7.0	10.3	25.5	28.4	28.9			
	Cronbach's Alpha								**0.880**

This factor, DIGITAL DEVICE USAGE, INFORMATION SYSTEMS USAGE & MIGRATION SKILLS, had a Cronbach's Alpha of 88%, hence a very high internal consistency. For the frequency distribution regarding the graduate's ability to use mobile digital devices, e.g. smartphones [16], 4.1% consider it as not important, 5.2% believe it slightly important, 15.2% moderately important, 24.2% important and the vast majority of 51.3% consider it very important. Mobile devices are no longer used for just phone calls and text messages. The evolution of digital devices, like the cellular telephones (i.e. cell phones), as well as the advent of the tablet computers and other mobile devices have created a paradigm shift for numerous industries (Lee & Shin, 2018). Consequently, many businesses' have gone digital, whereby orders are placed online, confirmation receipts are delivered via e-mail and payment are done electronically (via the banking app), all from the comfort of one's mobile device (Lee & Shin, 2018).

[16] A mobile device that has an operating system, Internet access, and where users can download numerous applications that can be used for entertainment purposes and carry out daily business activities, such as e-mail.

Lee and Shin (2018) explain that retail and consumer payment options include: peer-to-peer (P2P) mobile payments, real-time payments, mobile wallets, foreign exchange and remittances, and digital currency solutions. These services are designed to enhance the customer experience for who desire an efficient payments experience with regard to convenience, speed and multi-channel accessibility (Lee & Shin, 2018). Additionally, they agree mobile payment facilities that are securely and conveniently implemented via mobile devices have become a popular business model. Mobile commerce[17] (m-commerce) promises a bright future, as a prominent trend is its own growth, which seems as it is getting brighter (Baby, 2019). Furthermore, m-commerce is universally recognized as a prominent technique to enhance business brands, boost sales and keep abreast of competitors (Baby, 2019). Another trend that Baby (2019) points out in m-commerce is that customers want more information via mobile websites, and that 80% of smartphone users desire more product information when doing online shopping via their mobile devices. All these are contributing factors to this finding, where 51.3% consider the use of mobile digital devices very important.

Concerning the graduate's ability to use information systems to process information, 3.6% of the respondents consider it not important, 5.4% indicated it is slightly important, 16.5% felt it is moderately important, 29% and 45.5% consider it important and very important, respectively. Many organisations, even small-to-medium enterprises (SMEs), utilise information systems to conduct business undertakings, therefore the said sector strongly believe that this is an essential skill for graduates. Information is a critical success factor (CSF) for every organisation, so inaccurate, inconsistent or untimely information could have serious consequences for an organisation. The main reason that organisations use information systems, specifically ICT, as a tactical tool is to enhance their competitive advantages (da Anunciação *et al.*, 2018). However, more importantly 'information', is the core economic resource that management uses to derive the competitive advantages, since information alone can make competitive advantage possible (da Anunciação *et al.*, 2018).

Consequently, it is imperative for management to ensure that information systems and technology investments yield economic value for the organization (da Anunciação *et al.*, 2018). A key component of any information system are its users, and they can be considered an investment in the information system, since they are part of the system. Without users, many systems are not fully functional, therefore a graduate should be proficient in using information systems to process information, effectively and efficiently. Organisations invest extensively in graduate training

[17] The use of mobile devices, such as tablets and smartphones, to conduct business-related transactions.

programs once they employ new graduates. This is done to ensure that their junior employees use the information systems well, to achieve organisational goals and objectives. Graduates entering the said sector should be able to comfortably process information via an information system, with minimal or no issues. Therefore, generic information systems skills can be taught to students on how to efficiently and effectively process information, seeing as this is a job requirement of most graduates.

The use of information systems for collaborating is rated not important by 5.7% of the respondents, slightly important by 7.5%, moderately important by 15.9%, important by 28%, and 42.9% consider it very important. It is no secret that the people have transformed into an information society, from checking the weather online to collaborating with co-workers. In some cases, much of the collaboration is possible via an information system. These collaboration features are built into the information systems, such as the group support system and enterprise systems, to ensure that team efforts progress smoothly and resourcefully. Collaboration is a highly valuable technique for enterprise systems, especially within Enterprise 2.0 and Web 2.0 (Prakash *et al.*, 2020). The collaboration offers support in the enterprise collaboration system (ECS) to attain anticipated goals by amalgamating tasks of people or employees working on a related or identical task (Prakash *et al.*, 2020). As a result, collaboration information systems have received significant attention, which is why this skill is largely considered very important (Prakash *et al.*, 2020).

The use information systems for solving problems is regarded as not important by 4.1% of the respondents, slightly important by 4.4%, moderately important by 17.8%, important by 28.1%, and 45.6% regarded it as very important. In addition to achieving the goals and objectives of an organisation, an information system is also used for problem solving. However, not much attention is dedicated to how people use and respond to information systems for "problem solving or self-regulating performance (behavioural factors), nor organizational processes" (Nkanata *et al.*, 2018, p. 9). This particular skill is highly important to industry, yet no recent research was found regarding the use of information systems for problem-solving. Accordingly, more research is required in this area, which may contribute to curriculum development around this crucial skill. Moreover, this skill can be included in curriculum by means of covering George Huber's model of the 'Problem-Solving Process' consisting of five stages: Intelligence, Design, Choice, Implementation and Monitoring.

The ability to migrate to new information systems is considered as not important by 7% respondents, 10.3% consider it slightly important, 25.5% moderately important, 28.4% important and the remaining 28.9% consider it very important. In 1965, Gordon Moore predicted that the "number

of transistors on a microprocessor chip will double every two years or so — which has generally meant that the chip's performance will, too" (Waldrop, 2016, p. 144). Since then, Moore's Law has greatly influenced technology advancements. Further to that, industry has a perpetual need for greater processing power, owing to increasing volumes of data demanding processing. So, technological advancements together with the changing business needs are a few reasons that necessitate the upgrade/renewal of existing information systems and infrastructure. This means that the users of the existing systems need to be able to migrate to new information systems. While not all information systems function in the same manner, graduates need to be enlightened on these imminent upgrades and how to deal with the migration process. IT graduates should possess change management skills to lessen the resistance to change by the information system users.

Figure 12 below provides a summary of the skills categories, with reference to the use of information systems.

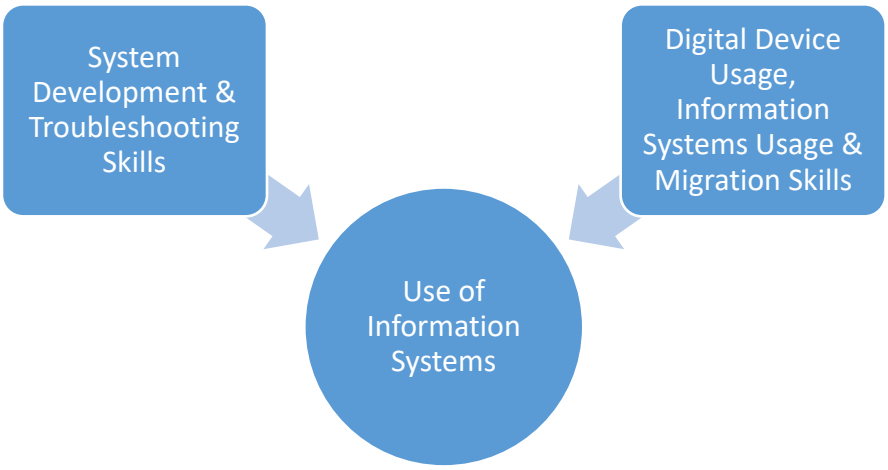

Figure 12 - Digital Skills Model for Information Systems Usage

The next section deals with the third construct of the questionnaire, which is the *application of security measures in digital environments*. It was important to add security as a separate construct, since organisations spend a significant amount of money each year to ensure that their information is safe, and that their network/information systems do not get hacked or infected with viruses.

4.4.3. Apply security measures in digital environments

Using an eigenvalue of one, three factors were obtained. The KMO was obtained as 0.945 (94.5%), which means there was sampling adequacy in the data (see Table 19). The Bartlett's Test of Sphericity

had a p-value of 0.00, hence we reject the null hypothesis of identity matrix and conclude that factor analysis may be useful with the data. Total variance explained by the four factors was 69.7%.

Table 19 - Measure of Sampling Adequacy – Application of Security Measures Construct

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.945
Bartlett's Test of Sphericity	Approx. Chi-Square	5966.150
	df	190
	Sig.	.000

Table 20 shows the principal component analysis of all 20 items in the construct *Apply Security Measures in Digital Environments.* The first factor relates to the security of digital content, the second to high-level technical security, and the third to personal security measures.

Table 20 - Principal Component Analysis–Application of Security Measures in Digital Environments

Pattern Matrix[a]			
	Component		
	1	2	3
Q4.12	.899		
Q4.13	.876		
Q4.11	.867		
Q4.10	.696		
Q4.9	.677		
Q4.14	.640		
Q4.8	.478		
Q4.16		.917	
Q4.15		.884	
Q4.18		.808	
Q4.17		.804	
Q4.19		.786	
Q4.20		.770	
Q4.2			.932
Q4.1			.840
Q4.4			.665
Q4.5			.626
Q4.3			.617
Q4.6			.528
Q4.7			.486

From the clustering of the 20 items it suggests that factor one is DIGITAL CONTENT SECURITY SKILLS, factor two is HIGH-LEVEL TECHNICAL SKILLS, factor three is PERSONAL IT SECURITY SKILLS. These three factors have been used to create a model relating

to the digital skills needs of the said sector, specifically relating to the application of security measures in digital environments. From all three constructs in the questionnaire, the application of security measures in digital environments seems to be the most important construct to the Real-Estate, Finance and Business Services sector in South Africa. As the frequency of cyber-attacks continues to rise, particularly against small-to-medium organizations, companies are starting to acknowledge that a crucial technique of lessening security breaches is continuous user education (Lipsman, April 26, 2019).

Table 21 represents the frequency distribution of the first factor (i.e. Digital Content Security Skills) of the third construct (i.e. Application of Security Measures in Digital Environments).

Table 21 - Factor 1 Frequency Distribution – Digital Content Security Skills

		Frequency Distribution						**Descriptive**	
		Not Important	Slightly Important	Moderately Important	Important	Very Important	**% Important/ Very Important**	Mean	Standard Deviation
8. delete sensitive digital content	Count	22	31	56	87	193	**72.0**	4.02	1.213
	%	5.7	8.0	14.4	22.4	49.6			
9. maintain secure user id and passwords	Count	7	9	27	42	304	**88.9**	4.61	0.856
	%	1.8	2.3	6.9	10.8	78.1			
10. protect digital content against accidental damage	Count	12	20	39	67	251	**81.7**	4.35	1.053
	%	3.1	5.1	10.0	17.2	64.5			
11. protect unauthorized use and modification of digital content	Count	16	14	35	68	255	**83.2**	4.37	1.062
	%	4.1	3.6	9.0	17.5	65.7			
12. comply with legal issues regarding digital content	Count	13	15	30	69	259	**85.0**	4.41	1.019
	%	3.4	3.9	7.8	17.9	67.1			
13. determine the trustworthiness of digital sources	Count	11	15	40	74	249	**83.0**	4.38	1.007
	%	2.8	3.9	10.3	19.0	64.0			
14. identify digital frauds, suspicious activity and cyber crimes	Count	14	19	35	70	250	**82.4**	4.35	1.066
	%	3.6	4.9	9.0	18.0	64.4			
	Cronbach's Alpha								**0.927**

The DIGITAL CONTENT SECURITY SKILLS factor had a Cronbach Alpha of 92.7% indicating high internal consistency. When respondents were asked if graduates entering the sector should be able to delete sensitive digital content, 5.7% of the respondents indicated it is not important, 8% slightly important, 14.4% moderately important, 22.4% believe it is important and 49.6% consider it very important. Cherel *et al.* (2017) explain that Personally Identifiable Information (PII), such as performance reviews, salary information, and confidential product plans, are warehoused in numerous commercial information systems. While traditional systems can protect PII by means of access restrictions (i.e. authentication and authorizations) and encryption, once the information is no longer required, it should be destroyed (Cherel *et al.*, 2017). Many organisations have policies with regards to the deletion of sensitive information, so graduates should be able to comply with such policies, in order to securely delete sensitive information. This skill will ensure that graduates know what processes to follow when deleting sensitive digital content, so that the deletion occurs when necessary and in a secure manner. South Africa has established the Protection of Personal Information (POPI) Act to ensure that institutions act responsibly when gathering, processing, storing and disseminating an individual's personal information by assigning accountability to them in the event of abuse or compromise one's personal information (Kandeh *et al.*, 2018).

With reference to the graduate's ability to maintain secure user IDs and passwords, 1.8% indicated it is not important, 2.3% slightly important, 6.9% moderately important, 10.8% believe it is important, whilst the remaining 78.1% consider it very important. Although ICT makes life convenient, there are numerous adverse effects attached. Virus attacks that spread malicious code by enticing users to bogus websites via e-mail or SMS, and using social engineering is a common occurrence (Mun & Han, 2016). Most websites authenticate its users by simply processing a user ID and password, however this is the basis for attack methods to constantly change (Mun & Han, 2016). Furthermore, Internet users are susceptible in the authentication process, since they typically set a similar ID and identical password on various websites (Mun & Han, 2016). Graduates need to understand the user ID and password vulnerabilities, as well as how to improve password strengths to prevent various attacks that could put an organisation's information system at risk. For this reason, industry places very high importance on this particular skill.

The ability of a graduate to protect digital content against accidental damage was considered, not important by 3.1% of the respondents, slightly important by 5.1%, moderately important by 10.0%, important by 17.2%, and 64.5% consider it as very important. Organisations not only store information, but other digital content like videos and podcasts as well, which are essential to their

business. Research suggests that many data breaches are a result of intentional, accidental, or malicious factors, which often leads to data and financial loss (Aslam *et al.*, 2019). Although organisations employ technical solutions to protect digital content, at times these solutions are insufficient. Much money is being spent on protecting their digital content, therefore graduates should be educated on the various policies around the protection of digital content against accidental/deliberate damage, the consequences of non-compliance, and ways in which to prevent the damage of digital content. Aslam *et al.* (2019) advise on one approach to improve user behaviour and culture is through continuous awareness, training and activities among users. Collectively, this awareness will contribute to the overall security of digital content.

The ability of a graduate to protect unauthorized use and modification of digital content was rated as follows: 4.1% of the respondents indicated it is not important, 3.6% slightly important, 9.0% moderately important, 17.5% believe it is important, whilst the remaining 65.7% consider it very important. Even though there is software available to protect unauthorised use and modification of digital content, at times this may be insufficient. Furthermore, content providers are always concerned that as soon as their protected digital content is accessible via the Internet, hackers will circumvent security mechanisms and freely disseminate the content thereafter (Hodzic *et al.*, 2019). Graduates need to be aware of techniques that can be used to circumvent unauthorised use and modification of digital content. For example, one method that can be used in protecting digital content is the digital watermarking technique. Dixit and Dixit (2017) explain that with digital watermarking, confidential information is embedded with original data with the intention of maintaining proprietorship of the digital content. Password protecting digital content can ensure that unauthorized users cannot view the content, while others cannot modify it.

The ability to comply with legal issues regarding digital content is considered as not important by 3.4% of the respondents, slightly important by 3.9%, moderately important by 7.8%, while 17.9% consider this skill to be important, and 67.1% consider it very important. When addressing legal compliance, there are a few issues to take into consideration. The prominent one is that different social groups have different compliance behaviour. For instance, Van Rooij *et al.* (2017) found that Chinese students' were inclined to engage in digital piracy primarily due to the approval and perceived behaviour of others, although there was an explicit restriction message of enforcement. However, this finding was contrary to their US sample in the same study, where the decision-making processes were affected by social norms, together with an apparent obligation to obey the law (without an explicit clampdown) or with perceived deterrence (in the course of an explicit clampdown). This

is an important issue to consider, since the transfer of this skill may require a different approach, depending on the social norms of South African students.

The trustworthiness of digital sources is considered not important by 2.8% of respondents, slightly important by 3.9%, moderately important by 10.3%, 19.0% believe it is important, and the remaining 64.0% indicated it is very important. Data transparency and authenticity are highly important to many organisations, as does this study confirm. As a result, organisations employ policy guidelines that govern which sources of data are acceptable and the origin of the data sourced (Tang *et al.*, 2018). As pointed out by Tang *et al.* (2018, p. 2), numerous experts recognise the "breakdown of trusted information sources as one of the grand challenges we face in the 21st century". Frameworks and guidelines which can be used to determine the trustworthiness of digital sources need to be included in curricula for all students. This skill type is one that is needed by all graduates entering the said sector and is not confined to IT graduates. Additionally, graduates need to be aware of the consequences associated with using unreliable/untrusted information sources for business purposes.

On the graduate's ability to identify digital frauds, suspicious activity and cyber-crimes, 3.6% consider it not important, 4.9% slightly important, 9.0% moderately important, 18.0% rated it as important, and 64.4% consider it very important. The most common cyber-crimes include: identity theft, theft of intellectual property and fraud. Cyber-criminals use various techniques to conduct these types of crime, which range from spam e-mails to the hacking of social networks and personal databases (Collins & McGuirk, 2018). The Internet has enabled cyber-criminals to engage in an extensive array of new-found crimes, and online fraud comprises an wide range of activities (Collins & McGuirk, 2018). Criminals may impersonate a legitimate business professional with the intent to acquire a personal gain from the victim. For example, a criminal may want to target their victims by impersonating an employee of their bank, to obtain sufficient their personal details about their victim with the aim of making a financial gain (Collins & McGuirk, 2018). The only way graduates will be able to identify these types of suspicious activities is if they have been enlightened on the various cyber-crimes, how to identify them and how to prevent them.

The next factor entails high-level technical skills in relation to digital security skills. This set of skills requires a little more technical knowledge around security. Numerous organisations employ some form of technology for the running of their business', from smartphones to workstations. However, malware attacks are a global phenomenon that is growing exponentially and has serious

consequences for any organisation that falls victim to it. In South Africa, these attacks increased by 22% in 2019 when compared to 2018, according to Kaspersky Lab, a global cyber-security company (Smith, Apr 29, 2019). “Kaspersky’s head of global research and analysis in the Middle East, Turkey and Africa” explained that about 13,842 attempted cyber-attacks occurred in South Africa per day in the first quarter of 2019, which translates to 577 attempted attacks per hour (Smith, Apr 29, 2019, p. 1). Another disturbing statistic is that South Africa’s Android mobile phones are the second most targeted, with regard to banking malware, with Russia being the first (Smith, Apr 29, 2019). Table 22 represents the frequency distribution of the second factor (i.e. High-Level Technical Security Skills) of the third construct (i.e. Application of Security Measures in Digital Environments).

Table 22 - Factor 2 Frequency Distribution – High-Level Technical Security Skills

		Frequency Distribution						**Descriptive**	
		Not Important	Slightly Important	Moderately Important	Important	Very Important	**% Important/ Very Important**	Mean	Standard Deviation
1. use anti-virus software to protect against a cyber-attack	Count	22	30	42	79	216	**75.8**	4.12	1.212
	%	5.7	7.7	10.8	20.3	55.5			
2. install local firewall on computers	Count	65	44	62	74	142	**55.8**	3.48	1.491
	%	16.8	11.4	16.0	19.1	36.7			
3. securely send and open digital messages and content	Count	16	18	59	98	198	**76.1**	4.14	1.095
	%	4.1	4.6	15.2	25.2	50.9			
4. securely connect to networks	Count	17	16	45	83	228	**79.9**	4.26	1.094
	%	4.4	4.1	11.6	21.3	58.6			
5. encrypt sensitive information	Count	28	28	66	85	181	**68.5**	3.94	1.255
	%	7.2	7.2	17.0	21.9	46.6			
6. backup and store digital content on your local computer network	Count	17	18	46	76	232	**79.1**	4.25	1.110
	%	4.4	4.6	11.8	19.5	59.6			
7. backup and store digital content on the Cloud, e.g. Google Drive and DropBox	Count	21	21	55	84	208	**75.1**	4.12	1.169
	%	5.4	5.4	14.1	21.6	53.5			
	Cronbach’s Alpha								**0.896**

The HIGH-LEVEL TECHNICAL SKILLS factor had a Cronbach Alpha of 89.6% indicating high internal consistency. Cyber-attacks are a common cause for concern in many organisations, due

to its constantly evolving nature that threatens computers or computer networks (Biju *et al.*, 2019). There are numerous hacking techniques that one needs to be aware of, which makes individuals and organisations more susceptible to cyber-security issues. When tackling these cyber-security issues, various preventative methods are necessary. For example, the use of a firewall, an anti-virus software, encryption, a virtual private network and circumventing public networks when transmitting sensitive data aids the deterrence of cyber-attacks, such as the eavesdropping attack (Biju *et al.*, 2019). The results from this construct shows that the targeted industry sector holds digital security in high regard.

With reference to the use of anti-virus software to protect against a cyber-attack, 5.7% of the respondents indicated it is not important, 7.7% slightly important, 10.8% moderately important, 20.3% believe it is important, and 55.5% consider it is very important. Kaspersky (2019) further explains that a company generally implements anti-virus software as a preventative measure, but some companies leave the task of updating the anti-virus software to their employees. These employees are prompted to run the updates and they decide if the updates should occur. Employees are prone to decline updates, especially when in the midst of a project, as most updates require their machines to be shut down and restarted. Seeing as most organisations consider use anti-virus software to protect against a cyber-attack as very important, anti-virus updates are just as important, and should be updated promptly and must not be assigned to employees.

Regarding a graduate's ability to install a local firewall on computers, 16.8% indicated it is not important, 11.4% slightly important, 16.0% moderately important, 19.1% believe it is important, whilst the remaining 36.7% consider it very important. "Bring your own device (BYOD)" is a policy that allows employees to bring their mobile devices to the workplace and their devices to access privileged company applications and information (Gupta *et al.*, 2019, p. 1). BYOD provides organisations with many benefits, such as improved productivity, increases employee morale, more convenient for the employee, makes the company look like an attractive employer, and even attracts new hires in some cases (Gupta *et al.*, 2019). Organisations use a firewall, which has been designed to improve the security of a network by permitting the usage of dynamic objects in rules of the firewall, where these dynamic objects evaluate to a capricious number of devices (Gupta *et al.*, 2019). However, BYOD environments introduces considerable security issues, such as data breaches and exposure of company data on devices of employees (Gupta *et al.*, 2019). For these reasons, it is necessary for graduates to be able to install a local firewall, especially when exercising BYOD for employment purposes.

Pertaining to a graduate's ability to securely send and open digital messages and content, 4.1% indicated it is not important, 4.6% slightly important, 15.2% moderately important, 25.2% believe it is important and 50.9% consider it as very important. An increasing number of organisations are using digital mobile platforms to enhance the customer experience (Karpeh & Bryczkowski, 2017). Some companies are taking to social media platforms to communicate information to their customers, but they need to do so responsibly, as these are public platforms. Even though some platforms, like WhatsApp, use sophisticated encryption, companies still need to have policies in place, governing social media sites and e-mails for the dissemination of confidential information (Karpeh & Bryczkowski, 2017). POPIA is a contributing factor to the reason for industry placing high importance on graduates' ability to send and open digital messages and content, securely. It is also imperative that employees are aware of the laws, as well as the laws on e-mail privacy (O'Connor & Schmidt, 2018).

The ability of a graduate to securely connect to networks is regarded as not important by 4.4%, slightly important by 4.1%, moderately important by 11.6%, 21.3% believe it is important, whilst the remaining 58.6% consider it very important. Organisations usually have IT professionals to secure their network connections when employees are connected to the company's network. But in cases where organisations employ BYOD, business information is could be stored or distributed with inadequate security on a BYOD, hence exposing the company to potential data breaches, especially when connected to an unsecure network (Tu *et al.*, 2019). Furthermore, when an employee is connected to an unsecure network outside the organisation, e-mail systems may be hacked, their personal files from the BYOD may become virus-infected or they may download malware, which will possibly migrate to business file servers, as well as other assets over the company's networks (Tu *et al.*, 2019). These organizations have reduced control over their employees who are connected to networks afterhours, most BYODs lack antivirus software, and Web traffic and e-mail accessed remotely often bypass firewalls and gateway inspection (Tu *et al.*, 2019). Consequently, industry believes it is very important for graduates to be able to securely connect to networks.

Respondents then needed to indicate if graduates entering the sector should be able to encrypt sensitive information, 7.2% consider it not important, 7.2% slightly impossible, 17.0% moderately important, 21.9% believe it to be important, and 46.6% consider it very important. Most enterprises and vendors use cryptographic algorithms to encrypt sensitive data, but there are times when employees need to share sensitive information external to the organisation. In such cases, the employee may send the said information via e-mail, which is susceptible to hacking and is therefore

still considered precarious. One method of encrypting sensitive information is by means of password protection. The contents of sensitive information are then encrypted and can only be decrypted by the receiver by using the correct password. This means that password strength plays an important role in the encryption of sensitive information. Many organisations store and share sensitive information electronically, therefore all graduates need to be knowledgeable on the various online threats and cyber-crime prevention methods, such as encryption.

Relating to the graduate's ability to backup and store digital content on their local computer network, 4.4% consider it not important, 4.6% slightly important, 11.8% moderately important, 19.5% believe it is important, and the remaining 59.6% consider it very important. Some organisations set up their systems to do automatic backups of business data to external servers, without the employees having to manually perform this activity. Nevertheless, there are instances that require manual backups of other data. Due to convenience, an employee may occasionally decide to work on his/her local machine to perform business activities. In these instances, the employees need to know how to store and backup on the company's local computer network. Once again, the Real-Estate, Finance and Business Services sector places high importance on this skill, since data loss can be a costly 'affair' and could even be detrimental to the organisation. For example, data loss of customer order information could lead to hefty lawsuits, especially when upfront payments are made. This skill could save a company thousands of rand on unnecessary legal costs and customer pay-outs in the event of data loss.

Pertaining to the ability of a graduate entering the sector to be able to backup and store digital content on the Cloud, e.g. Google Drive and DropBox, 5.4% consider it not important, 5.4% slightly important, 5.4% moderately important, 21.6% rated it as important, and 53.5% consider it very important. Increasingly, organisations have decided to back up their valuable data via cloud based storage (Whitmer & Russo, 2019). This backup approach is appealing, as it can minimise or eradicate the need for an organisation to procure and maintain its private backup hardware (Whitmer & Russo, 2019). Data integrity and security can be assured by this backup approach, as all data stored in the cloud datacentre is encrypted via sophisticated encryption algorithms (Whitmer & Russo, 2019). Cloud backups offer data protection in the event of a disaster occurrence at the organisation's site, since the data is stored in a remote location in the cloud data centre, and users can access the cloud datacentre, from anywhere in the world (Whitmer & Russo, 2019). Table 23 represents the frequency distribution of the third factor (i.e. Personal IT Security Skills) of the third construct (i.e. Application of Security Measures in Digital Environments).

Table 23 - Factor 3 Frequency Distribution – Personal IT Security Skills

		Frequency Distribution						Descriptive	
		Not Important	Slightly Important	Moderately Important	Important	Very Important	**% Important/ Very Important**	Mean	Standard Deviation
15. practice safe online behaviour	Count	2	5	29	46	306	**90.8**	4.67	0.714
	%	0.5	1.3	7.5	11.9	78.9			
16. secure personal information against identity threats	Count	2	4	27	54	302	**91.5**	4.67	0.696
	%	0.5	1.0	6.9	13.9	77.6			
17. maintain a secure digital footprint	Count	4	3	36	78	268	**89**	4.55	0.777
	%	1.0	0.8	9.3	20.1	68.9			
18. report suspicious online activity	Count	3	7	30	58	291	**89.7**	4.61	0.771
	%	0.8	1.8	7.7	14.9	74.8			
19. report breaches in security	Count	4	3	29	45	308	**90.8**	4.67	0.735
	%	1.0	0.8	7.5	11.6	79.2			
20. comply with employer's digital policy	Count	2	2	13	36	335	**95.6**	4.80	0.564
	%	0.5	0.5	3.4	9.3	86.3			
	Cronbach's Alpha								**0.919**

The PERSONAL IT SECURTY SKILLS factor had a Cronbach Alpha of 91.9% indicating high internal consistency. Kaspersky's head of global research and analysis, Amin Hasbini, emphasised that many organisations are victims of malware attacks, and that most of these attacks are due to employees' inappropriate usage of company property, such as mobile devices (Smith, Apr 29, 2019). Consequently, the application of security measures in digital environments have been rated much higher than the other two constructs. There are many forms of cyber-crimes and not as many laws to deal with them, locally. It is, therefore, important for graduates to be able to employ techniques to prevent or minimize the effects of cyber-crimes. The results infer that additional time should be spent on educating students on the application of security measures in digital environments, over other digital skills.

In relation to a graduate's ability to practice safe online behaviour, 0.5% indicated it is not important, 1.3% slightly important, 7.5% moderately important, 11.9% believe it is important whilst

the remaining 78.9% consider it very important. According to Jansen and van Schaik (2019), technology alone is unable to offer a comprehensive security solution, thus end user aspects are vital to address. They also suggest that end users should practice precautionary online behaviour, as this is important in protecting the online domain and end users play a key role in attaining online security. Jansen and van Schaik (2019) found that 81.2% of participants agreed that they themselves are predominantly responsible for their online safety. They further found that fear needs to be invoked in end users to some degree in order for them to take some precautionary action. In an eye-tracking experiment by Alsharnouby (2015), their participants spent 85% of the time reviewing the webpage content when determining if a website is authentic or not, and just 6% examining its security indicators. Graduates entering the said sector must be knowledgeable on the techniques/guidelines regarding safe online behaviour. For example, e-mail attachments should only be opened from a trusted source, as it could contain a virus.

Regarding the ability to secure personal information against identity threats, 0.5% of the respondents indicated it is not important, 1.0% slightly important, 6.9% moderately important, 13.9% believe it is important and 77.6% consider it very important. Cybercrime is a brutal reality worldwide and has even surpassed criminal drug trafficking (Sousa, 2019). A disturbing statistic is that every three seconds, an individual is robbed of their identity, and if devoid of high-tech security measures, a computing device may be virus infected shortly after connecting to the Internet (Sousa, 2019). According to (Ahmed, 2020, p. 5), "Identity crime, which encompasses both identity theft and identity fraud, is one of the fastest growing crimes around the world, yet it lacks its own identity: there is no universally accepted definition, little understanding of what the crime is or should be, and no legal framework placing the crime into a coherent and effective grouping of criminal sanctions". It is no wonder that the target sector places much importance on a graduate's ability to secure personal information against identity threats.

When respondents were asked if graduates entering the sector should be able to maintain a secure digital footprint, 1.0% indicated that it is not important, 0.8% slightly important, 9.3% moderately important, 20.1% believe it is important, whilst the remaining 68.9% consider it very important. A digital footprint is a trace of prior digital data in relation to a user, and illustrates a pattern of user activities (Bender *et al.*, 2019). Some computers are designed to provide the data of a user's digital footprint to the public (Bender *et al.*, 2019). Many end-users are unaware of the existence of their digital footprint, let alone the threats that their digital footprint poses to them.

According to the CEO of TitanGrid, Aleks Koha, hackers spend 90% of the time collecting personal information about users, which they utilize to commit cyber-crimes (Keren, 2020).

Keren (2020) advises that their systems found IT and security professionals to hold the largest digital footprints, and roughly half of them have not changed their passwords in the last 12 months. Other users have never changed them whatsoever and lots of them apply the same password on several websites. It's all about awareness. She further maintains that when end-users are aware of the kind of attacks in existence, it can be better anticipated and circumvented. End-users with a vast digital footprint, such as online marketers, must be cognisant of the information they put online, since it may be used in a cyber-attack against them (Keren, 2020). On the other hand, the information that is used to hack end-users frequently comes from factors s/he is unaware of, for example, old MySpace accounts that you s/he forgot even existed (Keren, 2020). Similarly, since many end-users employ the same passwords time and again, one data leak is sufficient to cause the exposure of all of their accounts (Keren, 2020). It is for these reasons that this digital skill, the ability to maintain a secure digital footprint, is rated has highly important by industry.

Concerning the ability to report suspicious online activity, 0.8% of the respondents indicated it is not important, 1.8% slightly important, 7.7% moderately important, 14.9% believe it is important and 74.8% consider it very important. Reporting suspicious online activity enables law enforcement officials to start investigations, since they cannot review every single social media post. International detectives have been inspecting more social media activity in recent years, and many leads originate from Twitter followers or Facebook friends who report suspicious behaviour (WTOL Newsroom, 2018). So too can industry professionals employ the same mechanisms to prevent cyber-attacks, expose a probable threat to employee safety, reveal mental health issues of an employee, as well as fraudulent activities by disgruntled employees (WTOL Newsroom, 2018).

Although, some organisations use sophisticated technology, such as Office 365 Security Dashboard, to monitor suspicious activity some employees find ways to work around the technology. For example, a company has a policy that prohibits the printing of confidential documents, but a displeased employee wants to make money by selling the company's confidential data. If e-mailed, there is likely to be a security alert from Security Dashboard, therefore this employee copies the data to a flash drive and sends it to the recipient via post. Security breaches could result in productivity and revenue loss, the outlay of hardware and software of repair and/or replacement, the loss of customer trust and loyalty, reduced competitive advantage and investor confidence in one's industry

among others (Chatterjee & Sokol, 2019). Therefore, it is crucial for every employee to report suspicious online activity. Graduates need to understand the seriousness of not reporting suspicious online activity, as well as its consequences. Furthermore, if an employee is aware of such suspicious activity and chooses not to report it, s/he could be held in contempt of withholding information should the culprit be caught.

In regard to the ability to report breaches in security, 1.0% indicated it is not important, 0.8% slightly important, 7.5% moderately important, 11.6% believe it is important, whilst the remaining 79.2% consider it very important. According to a Gartner (2019) forecast report, global spending on IT security was anticipated to increase in 2019 by 8.7% to $124 billion, which was greater than the general IT expenditure growth that was projected to be about 3.2%. Yet regardless of all the efforts associated with information security, data breaches are progressively more frequent (Chatterjee & Sokol, 2019). IT professionals were also surveyed and they indicated that majority of financial services firms in the United Sattes implement new technologies, before creating the compliance mechanisms needed to ensure data security (Thales, 2017). The reporting of data breaches by employees is therefore considered highly important by industry, since the breaches impact compliance and corporate governance, and the disclosure makes it easier to manage risk appropriately (Chatterjee & Sokol, 2019). This digital skill is linked to the next one on the graduate's ability to comply with their employer's digital policy.

On the ability to comply with their employer's digital policy, 0.5% of the respondents indicated it is not important, 0.5% slightly important, 3.4% rated it moderately important, 9.3% believe it is important and the remaining 86.3% consider it very important. Chatterjee and Sokol (2019) highlight that progressively more corporate boards are concentrating on cybersecurity risks, as 89% of executives in public companies note that board meetings frequently comprise a cybersecurity discussion (Chatterjee & Sokol, 2019). However, compliance protocols and practices are not given the same level of importance for data breaches, as done for traditional compliance concerns, for instance audit fraud and anti-bribery (Chatterjee & Sokol, 2019). They further suggest that the compliance spending related to data breaches by companies remains considerably smaller when compared to other areas of compliance.

From a compliance perspective, if a user does not address a security weakness the whole network becomes less secure. Sombatruang *et al.* (2019) emphasizes that humans are the 'weakest link' with regard to Wi-Fi access, because most users do not appear to worry about Wi-Fi security.

Moreover, Beautement *et al.* (2016) conducted a survey and found that security policies are frequently composed without essentially taking into consideration employees' goals and capabilities that must abide by such policies. So, organisations implement systems prior to composing a compliance policy, and when they do compile the compliance policy, they fail to consider employees' goals and capabilities. These are some of the reasons for non-compliance by employees, so if organisations consider this skill so highly important, they need to rectify the above issues. Similarly, graduates need to be trained such that they comply with their employer's digital policy.

Figure 13 below provides a summary of the skills categories, with reference to the application of security measures in digital environments.

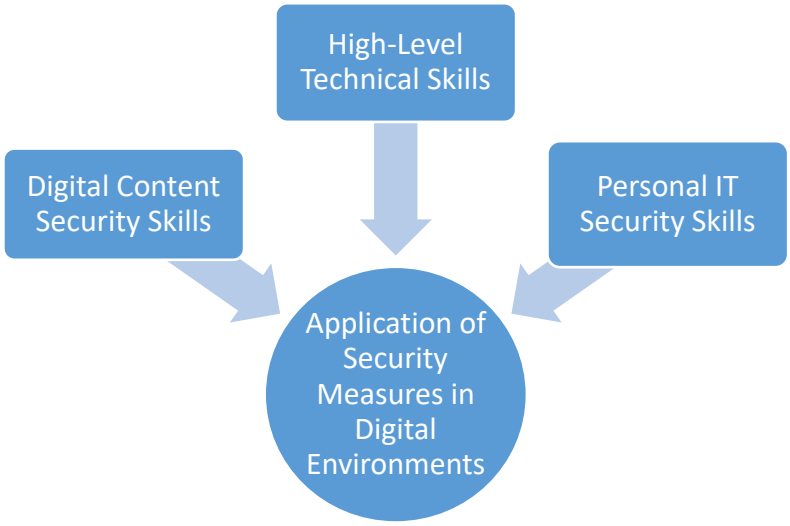

Figure 13 - Digital Skills Model for Application of Security Measures in Digital Environments

Some stakeholders and vendors trust that the key to educating users on cyber-security is by administering quarterly or annual newsletters in an attempt to enlighten their employees on secure online conduct (Lipsman, April 26, 2019). However, these exercises are essentially ineffective, as leaders fail to understand the fundamental root cause of their employees' meagre understanding, in addition to the absence of prioritizing cybersecurity at management level (Lipsman, April 26, 2019). The cyber-security knowledge gap continues to expand with the growing intricacies of cyber-security threats, but leaders prefer their employees to "stick to their day job and master their own domains" (Lipsman, April 26, 2019, p. 1). In spite of this, more than 50% of small-to-medium organizations would have experienced a cyber-attack, and negligent employees happen to be the number one root

cause of data breaches (Lipsman, April 26, 2019). “The mere existence of a cybersecurity knowledge gap is no longer an acceptable excuse for organizations who experience a data security breach” (Lipsman, April 26, 2019, p. 1).

4.5. Chapter summary

Security and compliance should be an organisation’s regime as the company becomes more digital (Katzer, 2019). Reducing security risks has much to do with education and training, since some security professionals still fall victims to cybercrimes, so regular users are certain to get hacked (Keren, 2020). Consequently, this type of knowledge should be provided via the schooling system. If South Africa does not possess a workforce that is competent in employing Web 2.0 tools in their daily corporate activities, they will struggle to sustain an economy that is globally competitive. These tools may be employed in other industry sectors, but to varying degrees, not only to the sector under study. Web 2.0 tools has numerous advantages that can help grow South Africa’s struggling economy. There are literally hundreds to Web 2.0 tools available to assist organisations in achieving their business goals, but some organisations are unaware of the benefits, while others are under skilled in this area. HEIs should enlighten students on the availability of such tools and its benefits, as well as train them to ensure that they become an asset to the South African workforce.

This chapter discussed the findings and analysis of phase one, which attempted to achieve the first research objective and answer the first research question. The validity and reliability of the research instrument was statically tested and the three constructs of the questionnaire were analysed by means of factor analysis to reduce the data items into factors or groups that were more closely linked. Frequency distributions were then provided for all factors, in order to understand the digital skills that industry deems as important. The next chapter is based on a proposed theoretical framework that is centred on the findings of phase one.

CHAPTER 5 – PROPOSED THEORETICAL FRAMEWORK

Higher education institutions (HEIs) have the potential to provide industry with the best graduates that can effectively exploit the various advantages digital technologies has to offer. The South African Government has policies in place to digitally skill their workforce, so that they are competent enough to employ digital technologies in the workplace, with the aim of improving the economy to surpass international competitors. Figure 14 below represents the ripple effect that digital skills training will have on the economy, which is a crucial intervention required to boost the South African economic landscape. Digital competence is multi-dimensional and cannot be viewed in the same light as Internet skills, as it encompasses a wide array of elements that collectively attributes to digital intelligence.

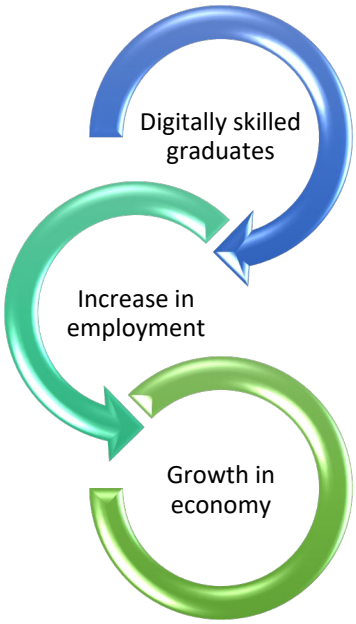

Figure 14 - Ripple effect of digital skills training

Gekara et al. (2017, p. 6) define digital skills as "a combination of a digital mindset (hardware, software, information, systems, security and innovation), knowledge (theoretical comprehension and understanding), competence (cognitive and practical knowhow) and attitude (value and beliefs)", since the concept of 'digital skills', as opposed to digital competence/literacy is the focal point of this study. The digital skills model below is a proposed framework that will be tested in a subsequent study, either in another country using a similar sector or in South Africa using a different sector. The model is a 'snapshot' of all the digital skills discussed in the previous chapter of this study. There were three constructs that is the use of software systems and Web tools, the use of information

systems, and the application of security measures in digital environments. These three constructs consisted of 54 items in the questionnaire (*see Appendix E*).

The digital skills framework was created to act as a catalyst for HEIs to inculcate these skills in every graduate leaving their commerce faculty. This digital skills framework has been developed through surveying participants from the Real Estate, Finance and Business Service sector in South Africa. The survey was disseminated to all nine provinces in South Africa and participants were positioned at various organisational levels across this sector. The framework is proposed as a training and support mechanism and has the potential to help tertiary institutions provide digitally skilled graduates to industry and thereby empower the labour force in this sector. The framework may also be used by anyone wishing to expand their digital skill-set, in that way upskilling oneself to provide better services to one's employer in this digitally economy. The framework may also be used by researchers to test its pertinence to other industry sectors in South Africa, and possibly internationally.

The framework is comprised of a dynamic set of conventional skills needed to support the technological advancement of individuals and organisations. Owing to its dynamic nature, the framework may be used by future researchers as a basis of their study to determine the changing digital skills requirements of industry. There is a need for people to digitally upskill to what their organisation requires, so this model may be used as a guide by individuals to achieve this, and for employees working in this sector to perform a self-assessment to measure their digital intelligence against the framework. The framework in Figure 15 may be used by educational institutions to identify the digital skills lacking in their present curriculum, to guide professional and personal development, to support formal and informal training initiatives, and as an organisation's digital transformation strategy. These digital skills have been recognised as essential by the Real Estate, Finance and Business Services sector in South Africa.

Figure 15 - Proposed Digital Skills Framework

5.1. Use of software applications and Web tools domain

Data Management Skills Domain

a) The ability to use accounting software, such as QuickBooks and Enterprise Resource Planning (ERP) software, to keep records of corporate transactions and handle financial aspects of a company.
b) The ability to use database software, such as Microsoft Access or SQL Server, to input, store, manipulate and output data, create tables, forms, queries and reports, in addition to creating input masks and validation rules.
c) The ability to use data management software, such as IBM Analytics and Database Management Systems (DBMS), to create, manipulate and manage databases in a systematic way.
d) The ability to use software, such as Knime and OpenRefine, for analysing Big Data by predicting customer behaviour for instance.

Basic Windows & Microsoft[18] Skills

a) The ability to use a computer operating system, such as Windows 10, to access applications and run utilities to configure, analyse, optimize and/or maintain a computer system.
b) The ability to use word processing software, such as Microsoft Word, to manipulate a text document by capturing, copying, deleting and formatting text, and applying various other features to successfully create a professional document.
c) The ability to use spreadsheet software e.g. Microsoft Excel, to create templates, graphs and charts, store and sort data, perform common calculations using functions, use macros and data validation, format and protect a worksheet, Lookup functions, import data into a spreadsheet, create Pivot Tables and Pivot Charts, forecast future values, and link data between a worksheet and a workbook.
d) The ability to use presentation software, such as Microsoft PowerPoint, to design, create, format and preview presentations, add transitions and animations, modify various slide masters, insert objects (i.e. sound pictures and tables, etc.) and print the presentation using different layouts.

Internet & Evaluation Skills

a) The ability to use social media (e.g. Facebook) and online collaboration tools (e.g. DropBox) to manage projects, tasks, and social networks for personal and professional purposes.

[18] This particular operating system (OS) was specified, since it is the most commonly used OS in South Africa.

b) The ability to use Web 2.0 tools, e.g. Google/YouTube to improve relations with customers, suppliers and third parties external to the organisation, as well as internal business operations.
c) The ability to use cloud computing applications, such as Google Docs to create, store, delete, edit, arrange, calculate, manage, publish, share, host, and manipulate cloud software and data via the Internet.
d) The ability to use techniques to critically evaluate software applications in terms of usability, sustainability, and maintainability, and to determine its effectiveness in enhancing productivity.

Multi-Media & Publishing Skills

a) The ability to use multimedia software, such as Windows Movie Maker and Adobe Photoshop, to create, edit, publish and share professional images, audio and video files.
b) The ability to use desktop publishing software, such as Microsoft Publisher to create page layouts for documents and visual communications in the form of business cards, brochures, posters, and online electronic publishing.

Project Management & Design Skills

a) The ability to use project management software, such as Microsoft Project to plan and schedule projects, allocate project resources, and manage change, costs and budgets.
b) The ability to use design software, such as Microsoft Visio to design organograms, floor and building plans, process flow diagrams, business process modelling, and a brainstorming diagram.
c) The ability to use vector-based drawing software, such as Corel Draw to create logos, flexes, banners, invitation cards and other vector designs.

Software Usage & Migration Skills

a) The ability to use custom-designed[19] software, such in-house software by understanding the various categories of custom-designed software and the techniques to employ for effective usage.
b) The ability to comply with legal copyright provisions and comprehend copyright laws and the consequences of non-compliance.
c) The ability to use software applications to efficiently and effectively access information.
d) The ability to migrate to new software applications within a short timeframe, with minimal effort and devoid of resistance to change.

[19] It is not possible for higher education institutions to teach students' how to use all custom-designed software, but students can be made aware about the different types of custom-designed software and the techniques on how to use it effectively.

5.2. Information systems domain

System Development & Troubleshooting Skills

a) The ability to assist in the analysis of an information system to provide support to the systems analyst in developing the systems requirements for systems maintenance or a new information system.

b) The ability to assist in the design of an information systems of an information system to provide support to the systems analyst in developing the systems requirements for systems maintenance or a new information system.

c) The ability to write software development code for the purpose of creating applications or to stimulate systematic thinking, creativity and confidence.

d) The ability to install software applications when new or updates software is released, to provide access to additional functionality.

e) The ability to ensure smooth functioning of the information system by complying with maintenance policies and schedules.

f) The ability to connect information systems to the Internet in the event that connectivity is lost, to prevent the loss of productivity.

g) The ability to troubleshoot information systems to efficiently prevent the loss of productivity.

Digital Device Usage, Information Systems Usage & Migration Skills

a) The ability to use mobile digital devices, such as smartphones to access email and cloud services, search for information and media, install and use mobile apps, conduct banking transactions, use social media, and make online purchases.

b) The ability to use information systems to process data into information, which may be used to perform transactions, improve business processes and assist with decision making.

c) The ability to use information systems for collaborating on projects, by successfully employing hardware, software, procedures, data and people to achieve common objectives.

d) The ability to use information systems for problem solving and decision making, using business process management, Enterprise Resource Planning (ERP) systems and/or Decision Support Systems (DSS).

e) The ability to migrate to new information systems through migration planning and management, in addition to following protocols laid out by the systems development team and acquiring training on the new information system.

5.3. Security measures in digital environments domain

Digital Content Security Skills

a) The ability to delete sensitive digital content by using third party wiping tools to avoid hackers from accessing sensitive digital content from the digital trashcan, and run a tool such as PANscan to confirm that sensitive digital content has been correctly deleted.

b) The ability to maintain secure user id and passwords by complying with password policy and guidelines to ensure that the password is strong enough to prevent unauthorised access to email accounts, websites and computer systems.

c) The ability to protect digital content against accidental damage by applying guidelines on preventing accidental damage, especially those guidelines relating to accidental damage that is not covered by insurance policies.

d) The ability to protect unauthorized use and modification of digital content by authentication, content protection, as well as implementing access rights and availability.

e) The ability to comply with legal issues regarding digital content by being knowledgeable of the various legal issues of social media, copyright laws and consequences of non-compliance.

f) The ability to determine the trustworthiness of digital sources by evaluation of the author, date, other sources citing digital source, web domain, accuracy of source, writing style and the design of the website.

g) The ability to identify digital frauds, suspicious activity and cyber-crimes by understanding the types and causes of cyber-crimes and digital fraud that exist.

High-Level Technical Security Skills

a) The ability to use anti-virus software to protect against a cyber-attack by ensuring that virus definitions are regularly updated and frequent virus scans are performed, manually or automatically.

b) The ability to install a local firewall on computer devices to control the outgoing and incoming network traffic with the aim of preventing malware from spreading across the network.

c) The ability to securely send and open digital messages and content by using digital certificates, digital signatures, and other security tools that supports this digital skill.

d) The ability to securely connect to networks by encrypting important files and folders, using the https web address[20], connecting to trusted networks, disconnecting from a network once

[20] Adding the S to the URL address will encrypt the data being transmitted.

complete, running a Virtual Private Network (VPN), and being cautious of shoulder surfing[21] when entering passwords.

e) The ability to encrypt sensitive information stored on a device by using full-disk encryption to encrypt all data on a device, for example BitLocker for Windows and FileVault for MacOS.

f) The ability to backup and store digital content on a local computer network or network drive by scheduling incremental backups and setting up the synchronisation service.

g) The ability to backup and store digital content on the Cloud, such as Google Drive and DropBox by performing incremental backups and setting up the synchronisation service.

Personal IT Security Skills

a) The ability to practice safe online behaviour by limiting personal information, practice safe browsing, enable privacy settings, using a secure Internet connection, download from trusted sources, using strong passwords, purchase from secure websites, ensuring antivirus is up-to-date, being cautious about what one posts, and by being wary about who you meet online (Kaspersky, 2020).

b) The ability to secure personal information against identity threats by understanding the threats of distributing personal information and following guidelines, such as using updated security software, identifying spam and scams, and monitoring bank statements to protect against threats.

c) The ability to maintain a secure digital footprint[22] by following guidelines, such as reviewing mobile usage, regularly update software, use strong passwords, check privacy settings, building one's reputation, and checking which sites have personal information that needs to be removed (NortonLifeLock, 2020).

d) The ability to report suspicious online activity by understanding what constitutes 'suspicious online activity', and obeying policies and procedures regarding the reporting of suspicious online activity, with the aim of preventing cyber-attacks and other fraudulent activities.

e) The ability to report breaches in security by understanding and complying with the organisational or national rules and regulations of reporting breaches, and the risks of non-compliance.

f) The ability to comply with employer's digital policy by understanding the policy and the legal implications of non-compliance.

[21] When an individual spies on another with the aim of acquiring personal information.

[22] "Your digital footprint includes all traces of your online activity, including your comments on news articles, posts on social media, and records of your online purchases." (NortonLifeLock, 2020, p. 1)

5.4. Chapter summary

As a developing country, it is not advisable for South African institutions to use generic frameworks that lacks the specific tools and details that this proposed framework has to offer. Time is running out and government needs to work smartly with academic institutions to upskill the youth, so that they are eligible for employment. There is not enough time for each institution to do their own research in identifying exactly what digital skills are required. Most of the frameworks discussed lack this level of detail with regards to digital skills.

This chapter proposed a framework on the digital skills that are needed for the Real Estate, Finance and Business Services sector in South Africa. This framework may be adopted by SAQA, in order to address the shortcomings of their current framework and to assist them in identifying the digital skills needed. This framework may be also used by HEIs to make the necessary curriculum adjustments, so that their graduates meet industry expectations. The framework may also be used by industry to systematically update their requirements, since technology rapidly evolves and so would their digital skills requirements. Owing to technological advancements and evolving requirements of industry, academia would need to periodically update the curricula. Hence, this framework enables academia, government and industry to work in synchronisation in ensuring that graduates are adequately prepared for industry, thereby enriching the economy.

The next section discusses the findings and analysis of phase two of this study, which attempts to achieve the second research objective and answer the second research question.

CHAPTER 6 – FINDINGS AND ANALYSIS OF PHASE 2

This chapter aims to achieve research the second research objective, which is to: *Assess the alignment of final year students' digital skills preparedness to their respective industry sector*; and answer the following research questions below:

2. Are South African universities adequately preparing students with the necessary digital skills required by the aforementioned sector?
    2.1. What are the tertiary students' digital skills preparedness for the career path they have chosen?
    2.2. Are the students' digital skills preparedness aligned to industry requirements of the said sector?

To establish higher education students' preparedness with the required digital skills for the Real Estate, Finance and Business Services sector in South Africa, it was first necessary to recognise the digital skills needs of the said sector. These results are discussed in Chapter 4, which is the first phase of this study. Chapter 6 presents the findings and analysis of the second phase, which is the survey of students in the top four HEIs in South Africa. The results from both phases are evaluated to determine if higher education students possess the necessary digital skills that this sector requires. The survey consisted of four sections: (1) Demographic Details; (2) Use of Digital Systems and Tools; (3) Use of Information Systems; and (4) Application of Security Measures in Digital Environments (*see Appendix F*). These are the same constructs used in phase one, to enable the comparison of the digital skills that industry needs graduates to possess, to the current perceived digital skills that these students possess.

A total of 381 surveys were completed by the students at the top four universities in South Africa, namely University of Cape Town (UCT), University of the Witwatersrand (WITS), University of Stellenbosch (SUN), and University of KwaZulu-Natal (UKZN).

6.1. Reliability

In order to evaluate the validity of the survey results as well as the study, Cronbach Alpha was used, ranging from 0 to 1. Generally, a value of 0.7 or higher is considered to be an indication of great reliability. Firstly, inter item correlations of all 54 questionnaire items were examined to see if there was any case of multi-collinearity. This occurs when there are very high correlations above 0.8. Multi-

collinearity would imply that the two items are in essence measuring the same thing and therefore one item will need to be deleted. The overall questionnaire had a very high reliability given by a Cronbach Alpha of 95.8%. This indicates that all the items in the construct are measuring the same thing. When an item was deleted, the measure did not indicate any increase of Cronbach Alpha hence, no item was deleted from the questionnaire. This is not surprising as no multi-collinearity was detected from the inter-item correlations.

After checking overall reliability, individual sections needed to be checked to establish if the created constructs indeed capture the same thing. The *use of digital systems and tools* section gave a Cronbach Alpha of 89.2% which shows very high internal consistency (see Table 24). There was no increase in Cronbach alpha value by deletion of any item. The *use of information systems* items had a Cronbach Alpha of 90.6%, also indicating very high internal consistency. Likewise, none of the items removed resulted in the increase of Cronbach Alpha. The *application of security measures in digital environments* construct scored a Cronbach Alpha of 92.8% indicating very high internal consistency. None of the item deletions caused an increase in the Cronbach Alpha.

Table 24 - Phase 2 - Cronbach Alpha of Questionnaire Constructs

Item	Number of Items	Cronbach's Alpha
Use of digital systems and tools	22	89.2%
Use of information systems	12	90.6%
Apply security measures in digital environments	20	92.8%
Overall Questionnaire	54	95.8%

Therefore, by combining the above results from the entire questionnaire and from the created constructs it can be concluded that the questionnaire achieved internal consistency and reliability. This means the result can be used to generalize the population. These findings are generalizable to all other South African universities, based on the data collected from the top four South African universities.

6.2. Gender of the participants'

Figure 16 reveals that substantially more males formed part of the sample, since 51.2% (n=195) were male and 45.1% (n=172) were female, while 1.8% (n=7) preferred not to say and 1.8% (n=7) did not provide a response.

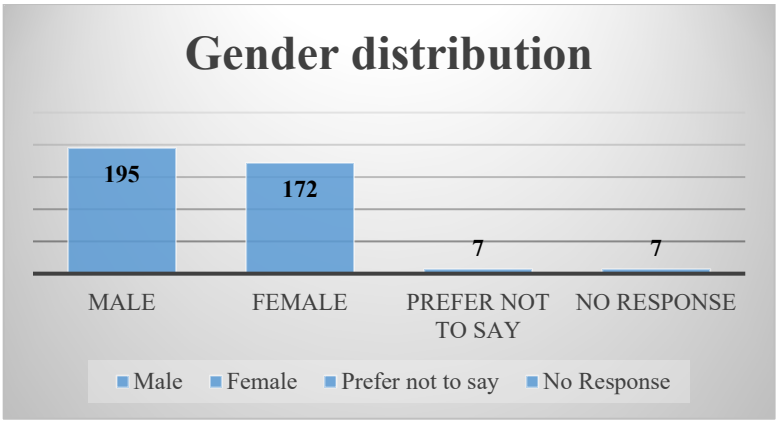

Figure 16 - Gender distribution among respondents

6.3. Interviewee Distribution

The participants were drawn from four universities across South Africa. Figure 17 shows that UKZN formed the majority of respondents contributing to 46.5% of the sample, followed by University of Witwatersrand, which made up 20.7%. Stellenbosch University made up 16.8% and lastly University of Cape Town making up 16%. UKZN's intake of undergraduate students in significantly higher than the other academic institutions in this study, therefore much more final year students were surveyed at UKZN.

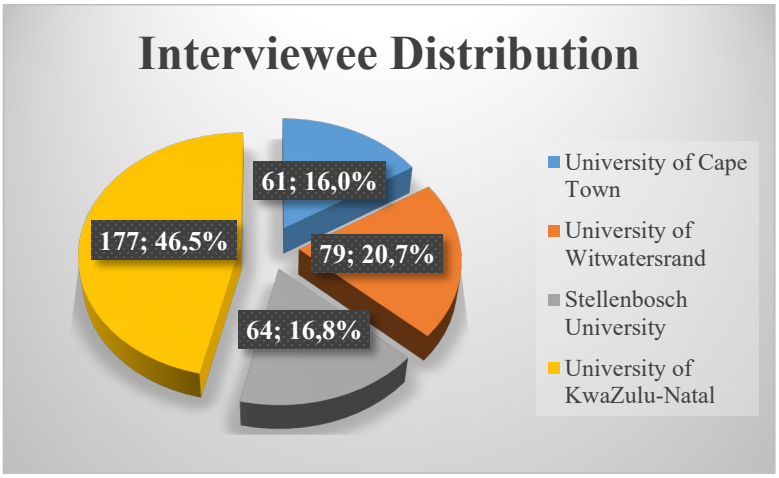

Figure 17 - Interviewee Distribution among respondents

6.4. Distribution of Subject Majors

The bar graph in Figure 18 below captures the visual distribution of the participants by their subject majors. Accounting was the modal major with 28.3% of the participants majoring in it. The second

and third most frequent majors were economics and information technology, which constituted 22.3% and 22%, respectively. Management studies and finance were the fourth and fifth majors making up 11% and 9.2%, respectively. Marketing and entrepreneurship followed with 4.7% and 2.1%, respectively. One respondent did not provide a response.

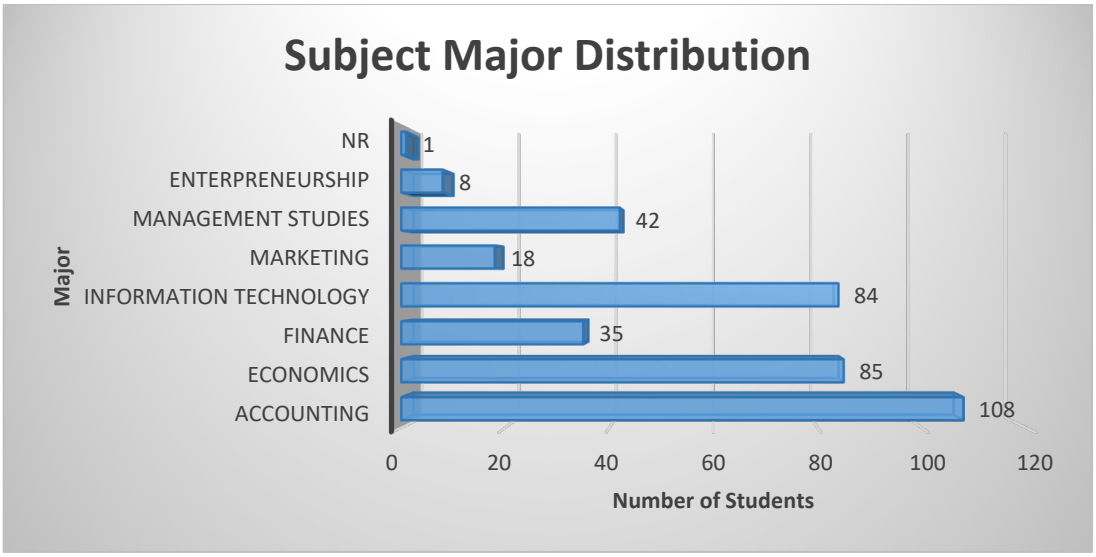

Figure 18 - Frequency distribution of subject majors

6.5. Factor analysis

Factor analysis was performed to try and reduce the data to a more compact form, which means that through factor analysis, items that are closely linked will be grouped together. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is calculated to determine if the data is suitable for factor analysis. It indicates the proportion of variance in the variables, which may be caused by underlying factors that have been obtained. In other words, it measures the sampling adequacy for each variable in the model and for the complete model. SPSS provides the Bartlett's test of sphericity, which tests the hypothesis that the correlation matrix is an identity matrix. If it is an identity, then this would mean that the variables are unrelated and therefore unsuitable for structure detection. Hence, the desire is to reject the hypothesis that the correlation matrix is an identity matrix.

6.5.1. Use of software applications and Web tools

This section of the questionnaire had 22 items under it. An initial run of factor analysis using an eigenvalue of one resulted in five factors, but one of the factors had only two items loading onto it (see Table 25). The factor analysis was then re-run with four fixed factors and the following was

obtained. The KMO was obtained as 0.880 (88%), which means that there was sampling adequacy in this data set. The Bartlett's Test of Sphericity had a p-value of 0.00, hence the null hypothesis of identity matrix is rejected and it is concluded that factor analysis may be useful with the current data. Total variance explained by the four factors was 56.25%.

Table 25 - Phase 2 - Principal Component Analysis for Use of Software Applications and Web Tools Construct

Pattern Matrix[a]				
	Component			
	1	**2**	**3**	**4**
Q2.1	.614			
Q2.2	.698			
Q2.3	.449			
Q2.4	.701			
Q2.5	.744			
Q2.6	.439			
Q2.7				.553
Q2.8				.600
Q2.9				.522
Q2.10				.852
Q2.11				.829
Q2.12				.760
Q2.13				.638
Q2.14				.664
Q2.15				.702
Q2.16			.696	
Q2.17			.693	
Q2.18			.693	
Q2.19		.830		
Q2.20		.858		
Q2.21		.522		
Q2.22			.495	

From the clustering of the items it suggests that factor 1 is NOVICE SKILLS, factor 2 is INTERMEDIATE SKILLS, factor 3 is ADVANCED SKILLS and factor 4 is EXPERT SKILLS, pertaining to the use of software applications and Web tools. Table 26 represents the frequency distribution of the first factor (i.e. Novice Skills) of the first construct (i.e. Use of Software Applications and Web Tools).

Table 26 - Use of software applications and Web tools - Novice Skills

NOVICE SKILLS The graduate's ability to:		Frequency Distribution							Descriptive	
		Very Poor	Poor	Fair	Good	Excellent	Do not know	% Good + Excellent	Mean	Std. Dev
1. use a computer operating system, e.g. Windows 10 is	Count	4	2	42	150	182	0	87.4	4.33	0.775
	%	1.1	0.5	11.1	39.5	47.9	0			
2. use word processing software, e.g. Microsoft Word is	Count	1	1	29	156	194	0	91.9	4.42	0.667
	%	0.3	0.3	7.6	40.9	50.9	0			
3. use audio and video software, e.g. Windows Movie Maker is	Count	24	73	135	77	49	22	33.2	2.97	1.299
	%	6.3	19.2	35.5	20.3	12.9	5.8			
4. use spreadsheet software e.g. Microsoft Excel is	Count	8	29	87	157	97	1	67.0	3.80	0.993
	%	2.1	7.7	23.0	41.4	25.6	0.3			
5. use presentation software, e.g. Microsoft PowerPoint is	Count	5	11	58	155	148	2	79.9	4.12	0.922
	%	1.3	2.9	15.3	40.9	39.1	0.5			
6. use multimedia software, e.g. Windows Media Player is	Count	8	24	69	119	145	16	69.3	3.84	1.286
	%	2.1	6.3	18.1	31.2	38.1	4.2			
	Cronbach's Alpha									**0.764**

The NOVICE SKILLS factor had six items loaded to it and together they had a Cronbach Alpha of 0.764, which indicates high internal consistency. Based on their perceived abilities, 87.4% of the respondents had a good to excellent ability to use a computer operating system, such as Windows 10. Only 1.6% of the respondents had poor to very poor ability, whilst no respondent indicated that they did not know of their ability. When asked about their ability to use word processing software like Microsoft Word, 91.9% of the respondents indicated that they had good to excellent ability and only 2% reported to have a poor to very poor ability, while no respondent indicated that they did not know. When asked about their ability to use audio and video software like Windows Movie Maker, 33.2% of the respondents perceived to have had a good to excellent ability, 25.5% had very poor to poor ability, whilst 5.8% did not know.

Of the respondents, 67% indicated that they had good to excellent ability on using spreadsheet software like Microsoft Excel, 9.8% had a very poor to poor ability. Only 0.3% i.e. one individual indicated that they did not know their ability. When it came to use presentation software like Microsoft PowerPoint, 79.9% of the respondents indicated that they had a good to excellent ability,

only 4.2% revealed that they had a very poor to poor ability, whilst 0.5% did not know their ability. When asked about their ability to use multimedia software like Windows Media Player, 69.3% of the respondents indicated that they had a good to excellent ability, only 8.4% indicated that they had a very poor to poor ability to use it, and 4.2% did not know. Table 27 represents the frequency distribution of the second factor (i.e. Intermediate Skills) of the first construct (i.e. Use of Software Applications and Web Tools).

Table 27 - Use of software applications and Web tools - Intermediate Skills

INTERMEDIATE SKILLS **The graduate's ability to:**		**Frequency Distribution**							**Descriptive**	
		Very Poor	**Poor**	**Fair**	**Good**	**Excellent**	**Do not know**	**% Good + Excellent**	**Mean**	**Std. Dev**
19.use social media and online collaboration tools, e.g. Facebook is	Count	1	3	26	104	245	2	91.6	4.53	0.756
	%	0.3	0.8	6.8	27.3	64.3	0.5			
20. use Web 2.0 tools, e.g. Google/YouTube is	Count	0	4	10	78	286	2	95.8	4.68	0.662
	%	0.0	1.1	2.6	20.5	75.3	0.5			
21. use of cloud computing applications, e.g. Google Docs is	Count	5	17	50	111	190	8	79.0	4.15	1.114
	%	1.3	4.5	13.1	29.1	49.9	2.1			
	Cronbach's Alpha									**0.669**

The INTERMEDIATE SKILLS factor was made up three items. The Cronbach alpha was 0.669, which despite being less than 0.7, is still acceptable considering that it constitutes only three items loading into the factor. When asked about their ability to use social media and online collaboration tools like Facebook, 91.6% of the respondents had a good to excellent ability, only 1.1% indicated having a very poor to poor ability, whilst 0.5% did not know. When asked about their ability to use Web 2.0 tools like Google/YouTube, 95.8% of the respondents indicated that their ability was good to excellent, only 1.1% revealed that they had a poor ability and 0.5% did not know. Of the respondents, 79% had the good to excellent ability to use of cloud computing applications like Google Docs, 5.8% had very poor to very poor ability, while 2.1% did not know.

Table 28 represents the frequency distribution of the third factor (i.e. Advanced Skills) of the first construct (i.e. Use of Software Applications and Web Tools).

Table 28 - Use of software applications and Web tools - Advanced Skills

ADVANCED SKILLS The graduate's ability to:		Frequency Distribution							Descriptive	
		Very Poor	Poor	Fair	Good	Excellent	Do not know	% Good + Excellent	Mean	Std. Dev
16. comply with legal copyright provisions is	Count	25	55	108	87	47	57	35.4	2.75	1.559
	%	6.6	14.5	28.5	23.0	12.4	15.0			
17. use software applications to access information is	Count	16	23	92	147	74	27	58.3	3.42	1.367
	%	4.2	6.1	24.3	38.8	19.5	7.1			
18. migrate to new software applications is	Count	24	46	98	113	52	41	44.1	3.00	1.494
	%	6.4	12.3	26.2	30.2	13.9	11.0			
22. critically evaluate software applications to determine its effectiveness in enhancing work performance is	Count	22	60	104	112	50	33	42.5	3.02	1.411
	%	5.8	15.7	27.3	29.4	13.1	8.7			
	Cronbach's Alpha									**0.754**

The ADVANCED SKILLS factor was made up of four items. The Cronbach Alpha obtained was 0.754, which shows high internal consistency. When asked about their ability to comply with legal copyright provisions, 35.4% of the respondents indicated good to excellent, whilst, 21.1% perceived their ability to be very poor to poor, and 15% did not know what their ability was. Of the respondents, 58.3% of the respondents believed that their ability to use software applications to access information is good to excellent, whilst, 10.3% rated their ability from very poor to poor, and 7.1% stated that they did not know. When asked about their ability to migrate to new software applications, 44.1% of the respondents indicated their ability is good to excellent, whilst 18.7% believed that they had very poor to poor ability, and 11% did not know. Of the respondents, 42.5% perceived their ability to critically evaluate software applications to determine its effectiveness in enhancing work performance as being good to excellent. 21.5% believed their ability to be very poor to poor ability, whilst 8.7% did not know. Table 29 represents the frequency distribution of the fourth factor (i.e. Expert Skills) of the first construct (i.e. Use of Software Applications and Web Tools).

Table 29 - Use of software applications and Web tools - Expert Skills

EXPERT SKILLS The graduate's ability to:		Frequency Distribution							Descriptive	
		Very Poor	Poor	Fair	Good	Excellent	Do not know	% Good + Excellent	Mean	Std. Dev
7. use desktop publishing software, e.g. Microsoft Publisher is	Count	39	81	109	74	26	52	26.2	2.50	1.441
	%	10.2	21.3	28.6	19.4	6.8	13.6			
8. use accounting software, e.g. QuickBooks is	Count	76	83	94	40	12	76	13.6	1.95	1.397
	%	19.9	21.8	24.7	10.5	3.1	19.9			
9. use database software, e.g. Microsoft Access	Count	44	65	119	77	26	50	27.0	2.54	1.444
	%	11.5	17.1	31.2	20.2	6.8	13.1			
10. use data management software, e.g. IBM Analytics	Count	80	84	66	35	7	109	11.0	1.63	1.389
	%	21.0	22.0	17.3	9.2	1.8	28.6			
11. use software for analysing Big Data, e.g. software to predict customer behaviour is	Count	77	85	56	38	13	112	13.4	1.66	1.456
	%	20.2	22.3	14.7	10.0	3.4	29.4			
12. use project management software, e.g. Microsoft Project is	Count	58	75	75	46	24	102	18.4	1.94	1.575
	%	15.3	19.7	19.7	12.1	6.3	26.8			
13. use design software, e.g. Microsoft Visio is	Count	65	71	60	56	38	90	24.7	2.11	1.662
	%	17.1	18.7	15.8	14.7	10.0	23.7			
14. use drawing and planning software, e.g. Corel Draw is	Count	73	75	63	53	17	97	18.5	1.88	1.531
	%	19.3	19.8	16.7	14.0	4.5	25.7			
15. use custom-designed software, e.g. in-house software is	Count	70	66	80	34	15	113	13.0	1.73	1.497
	%	18.5	17.5	21.2	9.0	4.0	29.7			
	Cronbach's Alpha									**0.882**

The EXPERT SKILLS factor was made up of nine items. A check of internal consistency amongst the selected items gave a Cronbach Alpha of 0.882, which shows high internal consistency amongst items. When asked about their ability to use desktop publishing software, 26.2% of the respondents had a good to excellent ability, 10.2% and 21.3% had very poor and poor ability, respectively, and 13.6% did not know their ability. Of the respondents, 13.6% had a good to excellent ability to use accounting software like QuickBooks, 19.9% and 21.8% had very poor and poor ability, respectively, and 19.9% did not know. When it came to the use of database software, such as Microsoft Access, 27% of the respondents had a good to excellent ability, 11.5% and 17.1%had a very poor and poor ability, respectively, and 13.1% did not know.

When asked about their ability to use data management software, such as IBM Analytics, 11% of the respondents had a good to excellent ability, which is the lowest amongst the items in this factor. The remaining 43% had a very poor to poor ability, and 28.6% did not know. While 29.4% of the respondents did not know of their ability to use software for analysing Big Data, only 13.4% had a good to excellent ability, and 42.5% had a very poor to poor ability. Of the respondents, 18.4% had a good to excellent ability to use project management software, e.g. Microsoft Project, 35% had very poor or poor ability, and 26.8% did not know their ability.

When it came to the use of design software like Microsoft Visio, 24.7% of the respondents had a good to excellent ability. Those whose abilities were very poor and poor were 17.1% and 18.7%, respectively, and 23.7% did not know their ability. When asked about their ability to use drawing and planning software, 18.5% of the respondents had a good to excellent ability, 19.3% and 19.8% had very poor and poor ability, respectively, and 25.7% had no knowledge of their ability. When asked about their ability to use custom-designed software, e.g. in-house software, 13% of the respondents had a good to excellent ability, while those who were very poor and poor were 18.5% and 17.5%, respectively, and 29.7% did not know.

6.5.2. Use of information systems

This section of the questionnaire had 12 items under it. The KMO was obtained as 0.899 (89.9%), which means that there was sampling adequacy in this data (see Table 30). The Bartlett's Test of Sphericity had a p-value < 0.001, hence the null hypothesis of identity matrix is rejected and it is concluded that factor analysis may be useful with this data. Total variance explained by the four factors was 68.8%.

Table 30 - Phase 2 - Measure of sampling adequacy - Use of information systems construct

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.899
Bartlett's Test of Sphericity	Approx. Chi-Square	2438.017
	df	66
	Sig.	.000

The factor analysis was run with four factors being obtained, based on eigenvalue of 1 (see Table 31).

Table 31 - Phase 2 - Principal Component Analysis for Use of Information Systems

Pattern Matrix[a]			
	Component		
	1	2	3
Q3.1		-.516	
Q3.2		-.624	
Q3.3		-.583	
Q3.4			.707
Q3.5			.660
Q3.6			.858
Q3.7			.798
Q3.8		.545	
Q3.9	.836		
Q3.10	.889		
Q3.11	.931		
Q3.12	.744		

From the clustering of the items it suggests that factor 1 is NOVICE SKILLS, factor 2 is INTERMEDIATE SKILLS and factor 3 is ADVANCED SKILLS, pertaining to the Use of information systems. Since there were three clusters, the factor for Expert Skills was excluded. Table 32 represents the frequency distribution of the first factor (i.e. Novice Skills) of the second construct (i.e. Use of information systems).

Table 32 - Use of information systems - Novice Skills

USE OF INFORMATION SYSTEMS NOVICE SKILLS The graduate's ability to:		Frequency Distribution							Descriptive	
		Very Poor	Poor	Fair	Good	Excellent	Do not know	% Good + Excellent	Mean	Std. Dev
9. use information systems to process information	Count	12	33	98	127	89	21	56.8	3.49	1.323
	%	3.2	8.7	25.8	33.4	23.4	5.5			
10. use information systems for collaborating	Count	18	51	111	97	58	41	41.2	3.01	1.480
	%	4.8	13.6	29.5	25.8	15.4	10.9			
11. use information systems for solving problems	Count	17	51	102	127	58	25	48.7	3.22	1.344
	%	4.5	13.4	26.8	33.4	15.3	6.6			
12. migrate to new information systems	Count	27	41	119	99	44	50	37.7	2.85	1.511
	%	7.1	10.8	31.3	26.1	11.6	13.2			
	Cronbach's Alpha									**0.887**

This factor had four items loaded to it and together they had a Cronbach Alpha of 0.887, which indicated high internal consistency. When asked about their ability to use information systems to process information, 56.8% of the respondents indicated that their ability is good to excellent, whilst, 11.9% perceived their ability as very poor to poor, and 5.5% did not know. Of the respondents, 41.2% said their ability to use information systems for collaborating is good to excellent, whilst, 18.4% rated their ability as very poor to poor, and 10.9% did not know. On ability to use information systems for solving problems, 48.7% of the respondents indicated that their ability is good to excellent, 17.9% believed they had a very poor to poor ability, and 6.6% did not know. When asked about their ability to migrate to new information systems, 37.7% had a good to excellent ability, 17.9% had a very poor to poor ability, whilst 13.2% did not know. Table 33 represents the frequency distribution of the second factor (i.e. Intermediate Skills) of the second construct (i.e. Use of information systems).

Table 33 - Use of information systems - Intermediate Skills

USE OF INFORMATION SYSTEMS INTERMEDIATE SKILLS **The graduate's ability to:**		**Frequency Distribution**							**Descriptive**	
		Very Poor	**Poor**	**Fair**	**Good**	**Excellent**	**Do not know**	**% Good + Excellent**	**Mean**	**Std. Dev**
1. assist in the analysis of an information system	Count	22	67	121	101	31	39	34.6	2.83	1.376
	%	5.8	17.6	31.8	26.5	8.1	10.2			
2. assist in the design of an information systems	Count	40	85	100	76	28	52	27.2	2.50	1.458
	%	10.5	22.3	26.2	19.9	7.3	13.6			
3. write software development code	Count	95	82	81	48	21	53	18.1	2.10	1.421
	%	25.0	21.6	21.3	12.6	5.5	13.9			
8. use mobile digital devices, e.g. smartphones	Count	0	4	23	98	253	3	92.1	4.55	0.768
	%	0	1.0	6.0	25.7	66.4	0.8			
	Cronbach's Alpha									**0.768**

This factor also had four items loaded to it and together they had a Cronbach Alpha of 0.768, which indicated high internal consistency. When asked about their ability to assist in the analysis of an information system, 34.6% of the respondents believed their ability to be good to excellent, whilst, 23.4% rated their ability as very poor to poor, and 10.2% did not know. Of the respondents, 27.2% claimed that their ability to assist in the design of an information systems is good to excellent, whilst, 32.8% rated their ability as very poor to poor, and 13.6% did not know. With regard to the ability to

write software development code, only 18.1% of the respondents indicated that their ability was good to excellent, 46.6% believed they had a very poor to poor ability, and 13.9% did not know. When asked about their ability to use mobile digital devices, such as smartphones, 92.1% had good to excellent ability, 1.0% had very poor to poor ability, whilst 0.8% did not know. Table 34 represents the frequency distribution of the third factor (i.e. Advanced Skills) of the second construct (i.e. Use of information systems).

Table 34 - Use of information systems - Advanced Skills

USE OF INFORMATION SYSTEMS ADVANCED SKILLS **The graduate's ability to:**		**Frequency Distribution**							**Descriptive**	
		Very Poor	**Poor**	**Fair**	**Good**	**Excellent**	**Do not know**	**% Good + Excellent**	**Mean**	**Std. Dev**
4. install software applications	Count	26	43	99	113	80	17	51.1	3.49	1.323
	%	6.9	11.4	26.2	29.9	21.2	4.5			
5. ensure smooth functioning of the information system	Count	40	74	122	75	24	46	26.0	3.01	1.480
	%	10.5	19.4	32.0	19.7	6.3	12.1			
6. connect information systems to the Internet	Count	24	59	109	97	55	35	40.1	3.22	1.344
	%	6.3	15.6	28.8	25.6	14.5	9.2			
7. troubleshoot information systems	Count	34	69	109	86	33	47	31.5	2.85	1.511
	%	9.0	18.3	28.8	22.8	8.7	12.4			
	Cronbach's Alpha									**0.789**

This factor had four items loaded to it and together they had a Cronbach Alpha of 0.789, which indicated high internal consistency. When asked about their ability to install software applications, 51.1% of the respondents indicated their ability was good to excellent, whilst 18.3% rated their ability from very poor to poor, and 4.5% did not know. Of the respondents, 26% perceived their ability to ensure smooth functioning of the information system as good to excellent, whilst 29.9% rated their ability as very poor to poor, and 12.1% did not know. With regard to the ability to connect information systems to the Internet, 40.1% rated their ability as good to excellent, whilst 21.9% of the respondents indicated they had a very poor to poor ability, and 9.2% answered that they did not know. When asked about their ability to troubleshoot information systems, 31.5% of the respondents revealed that their ability was good to excellent, 27.3% had a very poor to poor ability, whilst 12.4% did not know.

6.5.3. Apply security measures in digital environments

This section of the questionnaire had 20 items under it. The KMO was obtained as 0.918 (91.8%), which means there was sampling adequacy (see Table 35). The Bartlett's Test of Sphericity had a p-value of 0.00, hence the null hypothesis of identity matrix was rejected and it was concluded that factor analysis may be useful with this data. Total variance explained by the four factors were 62.4%.

Table 35 - Phase 2 - Measure of sampling adequacy - Apply security measures in digital environments

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.918
Bartlett's Test of Sphericity	Approx. Chi-Square	3810.641
	df	190
	Sig.	.000

An initial run of factor analyses based on eigenvalues resulted in five factors, but one factor only had two items loading onto it. Therefore, the factor analysis was re-run with four fixed factors and the following was obtained (see Table 36).

Table 36 - Phase 2 - Principal Component Analysis for Application of security measures in digital environments

Pattern Matrix[a]				
	Component			
	1	**2**	**3**	**4**
Q4.1		.668		
Q4.2		.688		
Q4.3		.689		
Q4.4		.669		
Q4.5	.513			
Q4.6				-.522
Q4.7				-.520
Q4.8				-.580
Q4.9				-.666
Q4.10	.781			
Q4.11	.825			
Q4.12	.707			
Q4.13	.630			
Q4.14	.613			
Q4.15				-.570
Q4.16				-.416
Q4.17	.499			
Q4.18			.906	
Q4.19			.874	
Q4.20			.670	

From the clustering of the items it suggests that factor 1 is NOVICE SKILLS, factor 2 is INTERMEDIATE SKILLS, factor 3 is ADVANCED SKILLS and factor 4 is EXPERT SKILLS, pertaining to the Application of security measures in digital environments. Table 37 represents the frequency distribution of the first factor (i.e. Novice Skills) of the third construct (i.e. Application of security measures in digital environments).

Table 37 - Application of security measures in digital environments – Novice Skills

NOVICE **The graduate's ability to:**		**Frequency Distribution**							**Descriptive**	
		Very Poor	**Poor**	**Fair**	**Good**	**Excellent**	**Do not know**	**% Good + Excellent**	**Mean**	**Std. Dev**
18. report suspicious online activity	Count	46	82	91	86	46	30	34.7	2.77	1.439
	%	12.1	21.5	23.9	22.6	12.1	7.9			
19. report breaches in security	Count	45	91	100	73	34	38	28.1	2.60	1.414
	%	11.8	23.9	26.2	19.2	8.9	10.0			
20. comply with digital policy	Count	29	34	111	108	60	39	44.0	3.05	1.494
	%	7.6	8.9	29.1	28.3	15.7	10.2			
	Cronbach's Alpha									**0.827**

The first factor had three items loaded to it and together they had a Cronbach Alpha of 0.827, which indicated high internal consistency. When asked about their ability to report suspicious online activity, 34.7% of the respondents perceived their ability as good to excellent, whilst 33.6 % rated their ability as very poor to poor, and 7.9% did not know. With regard to the ability to report breaches in security, only 28.1% of the respondents indicated good to excellent ability, 35.7% indicated that they had a very poor to poor ability, and 10% did not know of their ability. Of the respondents, 44% had a good to excellent ability to comply with digital policy, 16.5% had a very poor to poor ability, whilst 10.2% did not know. Table 38 represents the frequency distribution of the second factor (i.e. Intermediate Skills) of the third construct (i.e. Application of security measures in digital environments).

Table 38 - Application of security measures in digital environments – Intermediate Skills

INTERMEDIATE The graduate's ability to:		Frequency Distribution							Descriptive	
		Very Poor	Poor	Fair	Good	Excellent	Do not know	% Good + Excellent	Mean	Std. Dev
6. backup and store digital content on your local computer network	Count	6	23	87	130	130	5	68.2	3.89	1.074
	%	1.6	6.0	22.8	34.1	34.1	1.3			
7. backup and store digital content on the Cloud, e.g. Google Drive and DropBox	Count	9	14	72	117	161	8	73.0	4.01	1.145
	%	2.4	3.7	18.9	30.7	42.3	2.1			
8. delete sensitive digital content	Count	15	35	115	110	84	21	51.0	3.39	1.330
	%	3.9	9.2	30.3	28.9	22.1	5.5			
9. maintain secure user id and passwords	Count	4	17	83	117	150	9	70.3	3.96	1.126
	%	1.1	4.5	21.8	30.8	39.5	2.4			
15. practice safe online behaviour	Count	15	25	97	140	95	9	61.6	3.65	1.175
	%	3.9	6.6	25.5	36.7	24.9	2.4			
16. secure personal information against identity threats	Count	19	44	98	120	76	24	51.4	3.31	1.380
	%	5.0	11.5	25.7	31.5	19.9	6.3			
	Cronbach's Alpha									**0.815**

This factor had six items loaded to it and together they had a Cronbach Alpha of 0.815, which indicated high internal consistency. When respondents were asked about their ability to backup and store digital content on their local computer network, 68.2% indicated a good to excellent ability, 7.6% had a poor to very poor ability, whilst 1.3% did not know. With regard to backing up and storing digital content on the Cloud, such as Google Drive and Drobox, 73% of the respondents indicated that they had a good to excellent ability, only 6.1% indicated that they a had poor to very poor ability, and 2.1% did not know. Of the respondents, 51% had good to excellent ability to delete sensitive digital content, 13.1% had a very poor to poor ability, whilst 5.5% did not know.

When asked about their ability to maintain secure user IDs and passwords, 70.3% indicated that they had good to excellent ability, 5.6% had a very poor to poor ability, and 2.4% did not know. When it came to practicing safe online behaviour, 61.6% of the respondents indicated that they had a good to excellent ability, 10.5% rate their ability as very poor to poor, whilst 2.4% did not know. Of the respondents, 51.4% indicated that they had good to excellent ability to secure personal information against identity threats, 16.5% rated their ability as very poor to poor ability, and 6.3%

did not know. Table 39 represents the frequency distribution of the third factor (i.e. Advanced Skills) of the third construct (i.e. Application of security measures in digital environments).

Table 39 - Application of security measures in digital environments – Advanced Skills

ADVANCED SKILLS **The graduate's ability to:**		**Frequency Distribution**							**Descriptive**	
		Very Poor	**Poor**	**Fair**	**Good**	**Excellent**	**Do not know**	**% Good + Excellent**	**Mean**	**Std. Dev**
5. encrypt sensitive information	Count	43	97	101	57	27	55	22.1	2.38	1.436
	%	11.3	25.5	26.6	15.0	7.1	14.5			
10. protect digital content against accidental damage	Count	16	72	114	94	42	41	35.9	2.87	1.419
	%	4.2	19.0	30.1	24.8	11.1	10.8			
11. protect unauthorized use and modification of digital content	Count	20	77	108	98	27	51	32.8	2.69	1.438
	%	5.2	20.2	28.3	25.7	7.1	13.4			
12. comply with legal issues regarding digital content	Count	20	51	113	96	48	51	38.0	2.86	1.518
	%	5.3	13.5	29.8	25.3	12.7	13.5			
13. determine the trustworthiness of digital sources	Count	25	63	118	103	40	31	37.6	2.94	1.363
	%	6.6	16.6	31.1	27.1	10.5	8.2			
14. identify digital frauds, suspicious activity and cyber-crimes	Count	31	62	105	107	43	33	39.4	2.92	1.414
	%	8.1	16.3	27.6	28.1	11.3	8.7			
17. maintain a secure digital footprint	Count	25	51	128	81	51	45	34.7	2.86	1.481
	%	6.6	13.4	33.6	21.3	13.4	11.8			
	Cronbach's Alpha									**0.884**

The construct had seven items loaded to it and together they had a Cronbach Alpha of 0.884, which indicated high internal consistency. When asked about their ability to encrypt sensitive information, 22.1% of the respondents had a good to excellent ability, 36.8% had a poor to very poor ability, whilst 14.5% did not know. Of the respondents, 35.9% indicated that they had a good to excellent ability to protect digital content against accidental damage, 23.2% rated their ability as poor to very poor ability, and 10.8% did not know. With regard to protecting unauthorized use and modification of digital content, 32.8% of the respondents had a good to excellent ability, 25.4% had a very poor and poor ability, whilst 13.4% did not know. When asked about their ability to comply with legal issues regarding digital content, 38% indicated that they had a good to excellent ability, 18.8% had a very poor to poor ability, and 13.5% indicated that they did not know.

When it came to the ability to determine the trustworthiness of digital sources, 37.6% of the respondents indicated that they had a good to excellent ability, 23.2% perceived their ability as very poor and poor ability, whilst 8.2 % did not know their ability. When asked about their ability to identify digital frauds, suspicious activity and cyber-crimes, 39.4% of the respondents indicated that they had a good to excellent ability, 24.4% rated their ability as very poor to poor ability, and 8.7% did not know. Of the respondents, 34.7% perceived their ability to maintain a secure digital footprint as good to excellent, 20% rated it as very poor to poor, whilst 11.8% did not know. Table 40 represents the frequency distribution of the fourth factor (i.e. Expert Skills) of the third construct (i.e. Application of security measures in digital environments).

Table 40 - Application of security measures in digital environments – Expert Skills

EXPERT **The graduate's ability to:**		**Frequency Distribution**							**Descriptive**	
		Very Poor	**Poor**	**Fair**	**Good**	**Excellent**	**Do not know**	**% Good + Excellent**	**Mean**	**Std. Dev**
1. use anti-virus software to protect against a cyber-attack	Count	13	49	105	114	85	15	52.2	3.43	1.277
	%	3.4	12.9	27.6	29.9	22.3	3.9			
2. install local firewall on computers	Count	26	73	102	93	50	37	37.5	2.89	1.449
	%	6.8	19.2	26.8	24.4	13.1	9.7			
3. securely send and open digital messages and content	Count	10	43	92	118	98	17	57.1	3.53	1.303
	%	2.6	11.4	24.3	31.2	25.9	4.5			
4. securely connect to networks	Count	8	33	79	149	102	9	66.0	3.73	1.150
	%	2.1	8.7	20.8	39.2	26.8	2.4			
	Cronbach's Alpha									**0.774**

The construct had 4 items loaded to it and together they had a Cronbach Alpha of 0.774 which indicated high internal consistency. 52.2% of the respondents said their ability to use anti-virus software to protect against a cyber-attack is good to excellent. Whilst, 16.3 % said their ability is from very poor to poor. 3.9% said they did not know. 37.5% of the respondents said their ability install local firewall on computers is good to excellent, whilst, 26% rated their ability from very poor to poor. Another 9.7% said they do not know. On ability to securely send and open digital messages and content, only 57.1% of the respondents indicated good to excellent ability. 14% said they had very poor to poor ability and 4.5% no ability at all. 66% had good to excellent ability to securely connect to networks. 10.8% had very poor to poor ability. Whilst, 2.4% did not know.

6.6.Tests for independence

Cross tabulations were run with output for Fisher's Exact Test. This test was preferred due to cell counts of some categories being less than five, which violated the Pearson's chi-square assumption. The Fishers Chi-Square values were obtained using Monte Carlo simulations as the software failed to run the usual one, because of low memory and intense computation required.

Ho: The use of computer operating system, e.g. Windows 10 is independent on gender.

H_1: The use of computer operating system, e.g. Windows 10 is dependent on gender.

Table 41 - Cross-tabulation of gender by software application and Web tools digital skills

GENDER BY **The students' ability to _____.**	**Fishers exact test Value**	**P-Value**	**Monte Carlo Sig. (2-sided) 99% Confidence Interval**	
			Lower Bound	**Upper bound**
1.use a computer operating system, e.g. Windows 10	24.132	**.047**	0.041	0.052
2.use word processing software, e.g. Microsoft Word	32.554	**.005**	0.004	0.007
3.use audio and video software, e.g. Windows Movie Maker	13.708	.599	0.586	0.612
4.use spreadsheet software e.g. Microsoft Excel	19.796	.507	0.495	0.520
5. use presentation software, e.g. Microsoft PowerPoint	23.326	.238	0.227	0.249
6. use multimedia software, e.g. Windows Media Player	21.804	.120	0.112	0.128
7.use software applications to access information	18.098	.184	0.174	0.194
8. use accounting software, e.g. QuickBooks	17.690	.242	0.231	0.253
9. use database software, e.g. Microsoft Access	19.921	.101	0.094	0.109
10. use data management software, e.g. IBM Analytics	22.797	.059	0.053	0.065
11.use software for analysing Big Data, e.g. software to predict customer behaviour	23.322	**.038**	0.033	0.042
12.use project management software, e.g. Microsoft Project	19.237	.122	0.114	0.131
13. use design software, e.g. Microsoft Visio	17.361	.201	0.191	0.212
14. use drawing and planning software, e.g. Corel Draw	11.973	.777	0.766	0.788
15. use custom-designed software, e.g. in-house software	15.700	.395	0.382	0.407
16.comply with legal copyright provisions	10.382	.901	0.894	0.909
17. use software applications to access information	12.964	.724	0.712	0.735
18. migrate to new software applications	12.793	.673	0.661	0.685
19. use social media and online collaboration tools, e.g. Facebook	34.209	**.026**	0.022	0.030
20. use Web 2.0 tools, e.g. Google/YouTube	20.448	.258	0.247	0.269
21. use of cloud computing applications, e.g. Google Docs	20.378	.287	0.275	0.298
22. critically evaluate software applications to determine its effectiveness in enhancing work performance	17.644	.224	0.213	0.235

Table 41 above shows that from the p-values being less than 0.05, only a graduate's ability to use: a computer operating system, word processing software, software for analysing Big Data, and social media and online collaboration tools were dependent on gender. This means that gender had a statistically significant role on these four digital skills, from the construct: use of software applications and Web tools. Fisher's Exact Test was also conducted on the remaining two constructs: use of information systems and application of security measures in digital environments.

Table 42 - Cross-tabulation of gender by use of information systems digital skills

GENDER BY **The students' ability to _____.**	**Fishers exact test Value**	**P-Value**	**Monte Carlo Sig. (2-sided) 99% Confidence Interval**	
			Lower Bound	**Upper bound**
1. assist in the analysis of an information system	16.087	.357	0.345	0.370
2. assist in the design of an information systems	20.399	.082	0.075	0.089
3. write software development code	20.673	.074	0.068	0.081
4. install software applications	38.281	**.000**	0.000	0.000
5. ensure smooth functioning of the information system	22.672	**.041**	0.036	0.046
6. connect information systems to the Internet	18.213	.186	0.176	0.196
7. troubleshoot an information system	22.404	**.040**	0.035	0.045
8. use mobile digital devices, e.g. smartphones	13.162	.843	0.834	0.853
9. use information systems to process information	12.333	.800	0.789	0.810
10. use information systems for collaborating	18.139	.204	0.193	0.214
11. use information systems for solving problems	18.805	.179	0.170	0.189
12. migrate to new information systems	23.081	.038	0.033	0.043

Table 42 above shows that from the p-values being less than 0.05, only the ability of installing software applications, ensuring the smooth running of the information system, and troubleshooting an information system were dependent on gender. This means that gender also had a statistically significant role on these three digital skills, from the construct: use of information systems.

Table 43 - Cross-tabulation gender by the application of security measures digital skills

GENDER BY **The students' ability to _____.**	**Fishers exact test Value**	**P-Value**	**Monte Carlo Sig. (2-sided) 99% Confidence Interval**	
			Lower Bound	**Upper bound**
1. use anti-virus software to protect against a cyber-attack	22.826	.065	0.059	0.071
2. install local firewall on computers	26.095	**.010**	0.008	0.013
3. securely send and open digital messages and content	13.857	.683	0.671	0.694
4. securely connect to networks	12.731	.870	0.861	0.879
5. encrypt sensitive information	16.784	.269	0.257	0.280
6. backup and store digital content on your local computer network	23.765	.108	0.100	0.116
7. backup and store digital content on the Cloud, e.g. Google Drive and DropBox	21.678	.182	0.172	0.192
8. delete sensitive digital content	20.923	.107	0.099	0.115
9. maintain secure user id and passwords	18.294	.481	0.468	0.493
10. protect digital content against accidental damage	20.065	.113	0.104	0.121
11. protect unauthorized use and modification of digital content	28.066	**.006**	0.004	0.007
12. comply with legal issues regarding digital content	14.629	.480	0.467	0.493
13. determine the trustworthiness of digital sources	29.242	**.003**	0.002	0.004
14. identify digital frauds, suspicious activity and cybercrimes	24.272	.020	0.017	0.024
15. practice safe online behaviour	19.364	.246	0.235	0.257
16. secure personal information against identity threats	22.357	.053	0.047	0.059
17. maintain a secure digital footprint	28.193	**.005**	0.003	0.007
18. report suspicious online activity	17.733	.197	0.187	0.208
19. report breaches in security	16.861	.255	0.244	0.267
20. comply with digital policy	15.305	.414	0.401	0.427

Table 43 above shows that from the p-values being less than 0.05, only the ability of installing local firewall on computers, protecting unauthorized use and modification of digital content, determining the trustworthiness of digital sources, and maintaining a secure digital footprint were dependent on gender. This means that gender also had a statistically significant role on these four digital skills, from the construct: application of security measures in digital environments.

Table 44 - Cross-tabulation of university attended by software application and Web tools digital skills

UNIVERSITY BY The students' ability to _____.	Fishers exact test Value	P-Value	Monte Carlo Sig. (2-sided) 99% Confidence Interval	
			Lower Bound	Upper bound
1.use a computer operating system, e.g. Windows 10	22.762	**.008**	0.006	0.011
2.use word processing software, e.g. Microsoft Word	27.433	**.001**	0.000	0.002
3.use audio and video software, e.g. Windows Movie Maker	26.546	**.026**	0.021	0.030
4.use spreadsheet software e.g. Microsoft Excel	37.551	**.000**	0.000	0.001
5. use presentation software, e.g. Microsoft PowerPoint	24.836	**.020**	0.016	0.023
6. use multimedia software, e.g. Windows Media Player	12.795	.596	0.583	0.609
7.use software applications to access information	28.031	**.017**	0.013	0.020
8. use accounting software, e.g. QuickBooks	13.412	.560	0.547	0.573
9. use database software, e.g. Microsoft Access	33.250	**.004**	0.002	0.005
10. use data management software, e.g. IBM Analytics	24.766	**.038**	0.033	0.043
11.use software for analysing Big Data, e.g. software to predict customer behaviour	23.670	.057	0.051	0.063
12.use project management software, e.g. Microsoft Project	40.143	**.000**	0.000	0.001
13. use design software, e.g. Microsoft Visio	29.528	**.012**	0.009	0.015
14. use drawing and planning software, e.g. Corel Draw	22.310	.086	0.079	0.094
15. use custom-designed software, e.g. in-house software	19.782	.161	0.152	0.171
16.comply with legal copyright provisions	8.723	.896	0.889	0.904
17. use software applications to access information	12.390	.644	0.631	0.656
18 migrate to new software applications	25.078	**.041**	0.036	0.046
19. use social media and online collaboration tools, e.g. Facebook	17.434	.179	0.169	0.188
20. use Web 2.0 tools, e.g. Google/YouTube	12.063	.323	0.311	0.335
21. use of cloud computing applications, e.g. Google Docs	35.094	**.001**	0.000	0.001
22. critically evaluate software applications to determine its effectiveness in enhancing work performance	13.125	.583	0.570	0.595

The cross-tabulation in Table 44 was carried out to determine the dependence between the digital skills variables from the software application and Web tools construct and the university attended. Of the 22 items in this construct, the p-values derived from Fisher's Exact Test suggests that the university attended by students had a statistically significant effect on the user's ability to use a(n):

- computer operating system
- word processing software
- audio and video maker
- spreadsheet software
- presentation software
- software applications to access information
- database systems
- data management software
- design software
- migrate to new software applications
- cloud computing applications

This means that there is a significant relationship between university attended and the digital skills listed in the construct: software application and Web tools (Table 44).

Table 45 - Cross-tabulation of university attended by information systems digital skills

UNIVERSITY BY **The students' ability to _____.**	**Fishers exact test Value**	**P-Value**	**Monte Carlo Sig. (2-sided) 99% Confidence Interval**	
			Lower Bound	**Upper bound**
1. assist in the analysis of an information system	34.326	**.003**	0.002	0.004
2. assist in the design of an information systems	16.865	.318	0.306	0.330
3. write software development code	26.722	**.029**	0.025	0.033
4. install software applications	18.882	.204	0.193	0.214
5. ensure smooth functioning of the information system	18.970	.207	0.196	0.217
6. connect information systems to the Internet	32.127	**.006**	0.004	0.007
7. troubleshoot information systems	14.177	.508	0.495	0.521
8. use mobile digital devices, e.g. smartphones	9.933	.548	0.536	0.561
9. use information systems to process information	26.479	**.027**	0.023	0.031
10. use information systems for collaborating	38.291	**.001**	0.000	0.002
11. use information systems for solving problems	38.656	**.001**	0.000	0.001
12. migrate to new information systems	36.343	**.002**	0.001	0.002

The cross-tabulation in Table 45 was carried out to determine the dependence between the digital skills variables from the use of information systems construct and the university attended. Of the 12 items in this construct, the p-values derived from Fisher's Exact Test suggests that the university attended by students had a statistically significant effect on the graduate's ability to: assist in the analysis of an information system, write software development code, connect information systems to the Internet, use information systems to process information, collaborate and solve problems, and migrate to new information systems.

Table 46 - Cross-tabulation of university attended by application of security measures digital skills

UNIVERSITY BY **The students' ability to _____.**	**Fishers exact test Value**	**P-Value**	**Monte Carlo Sig. (2-sided) 99% Confidence Interval**	
			Lower Bound	**Upper bound**
1. use anti-virus software to protect against a cyber-attack	25.010	**.040**	0.035	0.045
2. install local firewall on computers	29.908	**.012**	0.009	0.015
3. securely send and open digital messages and content	18.266	.221	0.210	0.232
4. securely connect to networks	12.188	.637	0.625	0.649
5. encrypt sensitive information	30.286	**.011**	0.008	0.014
6. backup and store digital content on your local computer network	23.724	**.036**	0.031	0.040
7. backup and store digital content on the Cloud, e.g. Google Drive and DropBox	20.311	.112	0.104	0.120
8. delete sensitive digital content	18.818	.203	0.193	0.214
9. maintain secure user id and passwords	12.293	.609	0.596	0.621
10 protect digital content against accidental damage	31.093	**.007**	0.005	0.009
11. protect unauthorized use and modification of digital content	31.849	**.006**	0.004	0.008
12. comply with legal issues regarding digital content	15.460	.412	0.399	0.424
13. determine the trustworthiness of digital sources	19.487	.182	0.172	0.192
14. identify digital frauds, suspicious activity and cybercrimes	11.947	.674	0.662	0.686
15. practice safe online behaviour	29.185	**.009**	0.007	0.012
16. secure personal information against identity threats	23.430	.066	0.059	0.072
17. maintain a secure digital footprint	27.915	**.020**	0.017	0.024
18 report suspicious online activity	13.756	.538	0.525	0.551
19. report breaches in security	21.911	.104	0.096	0.112
20. comply with digital policy	13.778	.540	0.527	0.553

The cross-tabulation in Table 46 was carried out to determine the dependence between the digital skills variables from the application of security measures in digital environments construct and the university attended. Of the 20 items in this construct, the p-values derived from Fisher's Exact Test suggests that the university attended by students had a statistically significant effect on the graduates ability to: use anti-virus software to protect against a cyber-attack, install a local firewall on computers, encrypt sensitive information, backup and store digital content on their local computer network, protect digital content against accidental damage, protect unauthorized use and modification of digital content, practice safe online behaviour, and maintain a secure digital footprint.

Table 47 - Cross-tabulation of Gender by University

Gender * University Crosstabulation							
			University				Total
			University of Cape Town	University of Witwatersrand	Stellenbosch University	University of KwaZulu-Natal	
Gender	Male	Count	32	44	28	91	195
		% within University	53.3%	57.9%	45.9%	51.4%	52.1%
	Female	Count	28	31	33	80	172
		% within University	46.7%	40.8%	54.1%	45.2%	46.0%
	Prefer not to say	Count	0	1	0	6	7
		% within University	0.0%	1.3%	0.0%	3.4%	1.9%
Total		Count	60	76	61	177	374
		% within University	100.0%	100.0%	100.0%	100.0%	100.0%

Table 47 shows that the respondents from three out of the four universities were largely male. Stellenbosch University was the only institution whereby the respondents were mostly female (n=33; 53.2%). The University of Witwatersrand contained the highest number of male respondents when compared to the remaining three institutions. In total, seven respondents preferred not to indicate their gender, while seven respondents did not specify at all.

A Fisher's Exact Test gave a value of 5.252 and a p-value>0.05, hence it can be concluded that there is no significant association of gender and university.

Table 48 - Cross-tabulation of Gender by Student major

Gender * Student Major Crosstabulation										
			Student Major							
			Accounting	Economics	Finance	Information Technology	Marketing	Management Studies	Entrepreneurship	Total
Gender	Male	Count	52	45	19	51	7	18	3	195
		% within Majors	48.6%	54.9%	54.3%	61.4%	38.9%	43.9%	42.9%	52.3%
	Female	Count	53	35	14	32	11	22	4	171
		% within Majors	49.5%	42.7%	40.0%	38.6%	61.1%	53.7%	57.1%	45.8%
	Prefer not to say	Count	2	2	2	0	0	1	0	7
		% within Majors	1.9%	2.4%	5.7%	0.0%	0.0%	2.4%	0.0%	1.9%
Total		Count	107	82	35	83	18	41	7	373
		% within Majors	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 48 shows that males preferred economics (n=45; 54.9%), finance (n=19; 54.3%) and/or information technology (n=51; 61.4%), as their majors, while females preferred marketing (n=11; 61.1%), management studies (n=22; 53.7%) and entrepreneurship (n=4; 57.1%). However, seven respondents preferred not to answer. From the total of 381 responses, only 373 were valid cases. A Fisher's Exact Test using the Monte Carlo gave a value of 14.879 and a p-value >0.05, hence it can be concluded that there is no significant association of gender and major. This means that the choices of the majors are not affected by ones' gender.

The next section discusses the comparison of the digital skills between the data collected in phase one and phase two to determine if students at the four South African universities have the digital skills that industry deems important.

6.7.Comparison of Phase 1 and 2

To understand the digital skills readiness of South African higher education students for the Real Estate, Finance and Business Services sector, it was necessary to first determine this sector's digital skills requirements. So, phase one of this study comprised a survey of the Real Estate, Finance and Business Services sector. Professionals were asked about the digital skills that they deemed crucial for a graduate entering their sector to possess. The five-point Likert scale responses were: Not Important, Slightly Important, Moderately Important, Important, and Very Important. The next was to understand the nature of these students' digital skills abilities.

So, phase two comprised a survey of final year students at the top four universities in South Africa. These students were asked about their abilities, with regard to same digital skills outlined in phase one, which they answered by means of another five-point Likert scale: Very Poor, Poor, Fair, Good, and Excellent, with a separate option for 'Do not know'. Once both datasets were obtained, it was then possible to compare two datasets, with the aim of establishing the digital skills preparedness of the South African higher education students for the Real Estate, Finance and Business Services sector.

The obtained responses were then put together with two options in each section combined to facilitate a comparison of the digital skills that this sector expects graduates to possess, to the students perceived digital skills abilities. For industry, the *important* and *very important* response percentages were combined, whilst for students the *good* and *excellent* response percentages were combined. A difference in proportion z-test was conducted to determine if there exists a significant difference in the proportion of the required digital skills (i.e. expected) and the perceived digital skills available (i.e. actual).

The hypothesis was as follows:

Null hypothesis/$H_{0:}$ The two proportions are equal

Alternative hypothesis/$H_{1:}$ The two proportions are different from each other.

Each survey consisted of three identical constructs on which the z-tests were conducted:

- Construct 1: Use of software applications and Web tools
- Construct 2: Use of information systems
- Construct 3: Apply security measures in digital environments

The z-tests results were interpreted as having either:

- a significant difference, whereby the sectors' expectations of graduates' abilities exceeded the students' perceived abilities.
- a significant difference, whereby the students' perceived abilities exceeded the sectors' expectations of graduates' abilities.
- no significant difference in proportion of the expected abilities and the perceived abilities.

It can be argued that if a digital skill is considered important or very important to a particular sector, then the student feeding into that sector should possess a good or excellent ability in that skill. However, if a digital skill is deemed not important then the student's ability in that skill does not necessarily have to be good or excellent. The statistical proportions of the z-tests were interpreted in this way, with the intention of determining the digital skills readiness of students for the Real Estate, Finance and Business Services sector in South Africa.

6.7.1. Z-Test for the Use of software applications and Web tools Construct

Table 49 shows the z-test values for the phase one and phase two comparison of construct 1. For most of the questions in this construct, the null hypothesis was rejected in favour of the alternative, indicating a significant difference in the students' perceived abilities compared to the expected digital skills abilities required by this sector. The skills mismatch, where the student's perceived ability proportion had a significant difference to the skills that the sector placed high importance were:

- use a computer operating system, e.g. Windows 10
- use spreadsheet software e.g. Microsoft Excel
- use accounting software, e.g. QuickBooks
- use database software, e.g. Microsoft Access
- use data management software, e.g. IBM Analytics
- use software for analysing Big Data, e.g. software to predict customer behaviour
- use project management software, e.g. Microsoft Project
- use design software, e.g. Microsoft Visio
- use custom-designed software, e.g. in-house software
- comply with legal copyright provisions
- use software applications to access information
- migrate to new software applications
- critically evaluate software applications to determine its effectiveness in enhancing work performance

Table 49 - Z-Test for Phase 1 and Phase 2 Comparison of Construct 1

Software applications and Web tools digital skills **The ability to _____.**	**Important/ Very Important**	**Good/Excellent**	**Difference**	**P-value**	**Conclusion**
1. use a computer operating system, e.g. Windows 10	92,2	87,4	4,8	<0.05	Reject null hypothesis
2. use word processing software, e.g. Microsoft Word	90,0	91,9	-1,9	>0.05	Accept null hypothesis
3. use audio and video software, e.g. Windows Movie Maker	26,0	33,2	-7,2	<0.05	Reject null hypothesis
4. use spreadsheet software e.g. Microsoft Excel	88,2	67,0	21,2	<0.05	Reject null hypothesis
5. use presentation software, e.g. Microsoft PowerPoint	79,7	79,9	-0,2	>0.05	Accept null hypothesis
6. use multimedia software, e.g. Windows Media Player	32,4	69,3	-36,9	<0.05	Reject null hypothesis
7. use desktop publishing software, e.g. Microsoft Publisher	30,6	26,2	4,4	>0.05	Accept null hypothesis
8. use accounting software, e.g. QuickBooks	41,0	13,6	27,4	<0.05	Reject null hypothesis
9. use database software, e.g. Microsoft Access	45,7	27,0	18,7	<0.05	Reject null hypothesis
10. use data management software, e.g. IBM Analytics	41,2	11,0	30,2	<0.05	Reject null hypothesis
11. use software for analysing Big Data, e.g. software to predict customer behaviour	45,8	13,4	32,4	<0.05	Reject null hypothesis
12. use project management software, e.g. Microsoft Project	44,7	18,4	26,3	<0.05	Reject null hypothesis
13. use design software, e.g. Microsoft Visio	43,2	24,7	18,5	<0.05	Reject null hypothesis
14. use drawing and planning software, e.g. Corel Draw	21,1	18,5	2,6	>0.05	Accept null hypothesis
15. use custom-designed software, e.g. in-house software	54,5	13,0	41,5	<0.05	Reject null hypothesis
16. comply with legal copyright provisions	54,5	35,4	19,1	<0.05	Reject null hypothesis
17. use software applications to access information	77,6	58,3	19,3	<0.05	Reject null hypothesis
18. migrate to new software applications	63,6	44,1	19,5	<0.05	Reject null hypothesis
19. use social media and online collaboration tools, e.g. Facebook	45,5	91,6	-46,1	<0.05	Reject null hypothesis
20. use Web 2.0 tools, e.g. Google/YouTube	59,0	95,8	-36,8	<0.05	Reject null hypothesis
21. use of cloud computing applications, e.g. Google Docs	64,20	79,0	-14,8	<0.05	Reject null hypothesis
22. critically evaluate software applications to determine its effectiveness in enhancing work performance	59,40	42,5	16,9	<0.05	Reject null hypothesis

The Real Estate, Finance and Business Services sector placed a higher importance on these digital skills abilities of graduates entering their sector, then the perceived abilities that students claimed to

possess. With reference to the use of spreadsheet software, like Microsoft Excel, 88,2% of sector professionals indicated that this skill was important/very important, but 67,0% of students rated their perceived ability as good/excellent. This may be interpreted as students not being adequately proficient in spreadsheets for this sector. For South African HEIs, this means that their curricula require align to industry requirements with particular attention to this list of skills. The revised curricula ought to include training on these particular digital skills that students are deficient in.

Those digital skills, which students had a greater perceived ability, compared to the importance that the sector professionals placed on it were:

- use audio and video software, e.g. Windows Movie Maker
- use multimedia software, e.g. Windows Media Player
- use social media and online collaboration tools, e.g. Facebook
- use of cloud computing applications, e.g. Google Docs

The proportion of students that perceive their ability to be good/excellent in these four skills, pertaining to the use of software applications and Web tools, is higher than the proportion of importance placed on these skills by sector professionals. With reference to the use of audio and video software, such as Windows Movie Maker, 26,0 of sector professionals indicated that this skill was important/very important, and 33,2% of students rated their perceived ability as good/excellent. This finding may be interpreted as students being more than adequately prepared for this sector when using audio and video software. This interpretation may also hold true for the remaining three digital skills.

For the following digital skills, the null hypothesis was accepted indicating that there was no significant difference in proportion of digital skills abilities expected by sector professionals and the students' perceived abilities:

- use word processing software, e.g. Microsoft Word
- use presentation software, e.g. Microsoft PowerPoint
- use desktop publishing software, e.g. Microsoft Publisher
- use drawing and planning software, e.g. Corel Draw

With reference to the use of presentation software, such as Microsoft PowerPoint, 79,7% of sector professionals indicated that this skill was important/very important, and 79,9% of students rated their perceived ability as good/excellent. This can be interpreted as students having sufficient presentation skills that are required by the Real Estate, Finance and Business Services sector. The same interpretation may be applied to the remaining three skills in this grouping. The z-test that follows is based on the second construct, which is the use of information systems.

6.7.2. Z-Test for the Use of information systems construct

Table 50 shows the z-test values for the phase one and phase two comparison of construct 2. All differences were statistically significant for the use of information systems construct.

Table 50 - Z-Test for Phase 1 and Phase 2 Comparison of Construct 2

Use of information systems digital skills **The ability to _____.**	**Important/ Very important**	**Good/Excellent**	**Difference**	**P-value**	**Conclusion**
1. assist in the analysis of an information system	59,2	34,6	24,6	<0.05	Reject null hypothesis
2. assist in the design of an information systems	43,2	27,2	16,0	<0.05	Reject null hypothesis
3. write software development code	30,0	18,1	11,9	<0.05	Reject null hypothesis
4. install software applications	40,9	51,1	-10,2	<0.05	Reject null hypothesis
5. ensure smooth functioning of the information system	47,6	26,0	21,6	<0.05	Reject null hypothesis
6. connect information systems to the Internet	47,5	40,1	7,4	<0.05	Reject null hypothesis
7. troubleshoot information systems	45,5	31,5	14,0	<0.05	Reject null hypothesis
8. use mobile digital devices, e.g. smartphones	75,5	92,1	-16,6	<0.05	Reject null hypothesis
9. use information systems to process information	74,5	56,8	17,7	<0.05	Reject null hypothesis
10. use information systems for collaborating	70,9	41,2	29,7	<0.05	Reject null hypothesis
11. use information systems for solving problems	73,7	48,7	25,0	<0.05	Reject null hypothesis
12. migrate to new information systems	57,3	37,7	19,6	<0.05	Reject null hypothesis

The results show that the expected digital skills, which had a higher proportion as compared to the perceived abilities of students were:

- assist in the analysis of an information system
- assist in the design of an information systems
- write software development code
- ensure smooth functioning of the information system
- connect information systems to the Internet
- troubleshoot information systems
- use information systems to process information
- use information systems for collaborating
- use information systems for solving problems
- migrate to new information systems

Sector professionals place high importance on the above digital skills, but a smaller proportion of students perceived their abilities in these skills as good/excellent. This may be interpreted as students needing more exposure to digital skills that pertain to the use of information systems. Although some of these skills are high-level IT skills, research suggests that students require this programming knowledge to enhance their cognitive skills (Aras *et al.*, 2018). Additionally, many jobs today require knowledge in high-level IT skills, and it is anticipated that future jobs will require much more competence in high-level IT skills (W. Wang & Siau, 2019). For example, accounts of the past used to audit an organisation's finances without requiring knowledge in IT auditing. These days, accountants are required to be certified in IT auditing if they wish to continue in their profession.

Those digital skills, which students had a greater proportion of perceived ability, compared to the importance that the sector professionals placed on it were:

- install software applications
- use mobile digital devices, e.g. smartphones

Nowadays, many students possess digital devices, such as smartphones and tablet computers, therefore 92,1% of students perceive their abilities in this particular skill as good/excellent. Due to many businesses conducting electronic commerce[23], 75,5% of sector professionals place high importance on the use of mobile digital devices. This may be interpreted as students being more than adequately skilled in the use of mobile digital devices. The same interpretation may be applicable to the ability to install software applications, since installations are straight forward and provide step-by-step procedures for the installation process. The z-test that follows is based on the third construct, which is the application of security measures in digital environments.

6.7.3. Z-Test for the Application of security measures construct

Table 51 shows the z-test values for the phase one and phase two comparison of construct 3. For the application of security measures in digital environments, all digital skills were significantly different except one, which was ability to backup and store digital content on the Cloud, e.g. Google Drive and DropBox. Here, the industry expectation and the skills possessed were not significantly different.

[23] Electronic commerce is when business transactions that are conducted online.

Table 51 - Z-Test for Phase 1 and Phase 2 Comparison of Construct 3

Application of security measures in digital environments **The ability to _____.**	**Important/ Very important**	**Good/Excellent**	**Difference**	**P-value**	**Conclusion**
1. use anti-virus software to protect against a cyber-attack	75,8	52,2	23,6	<0.05	Reject null hypothesis
2. install local firewall on computers	55,8	37,5	18,3	<0.05	Reject null hypothesis
3. securely send and open digital messages and content	76,1	57,1	19,0	<0.05	Reject null hypothesis
4. securely connect to networks	79,9	66,0	13,9	<0.05	Reject null hypothesis
5. encrypt sensitive information	68,5	22,1	46,4	<0.05	Reject null hypothesis
6. backup and store digital content on your local computer network	79,1	68,2	10,9	<0.05	Reject null hypothesis
7. backup and store digital content on the Cloud, e.g. Google Drive and DropBox	75,1	73,0	2,1	>0.05	Accept null hypothesis
8. delete sensitive digital content	72,0	51,0	21,0	<0.05	Reject null hypothesis
9. maintain secure user id and passwords	88,9	70,3	18,6	<0.05	Reject null hypothesis
10. protect digital content against accidental damage	81,7	35,9	45,8	<0.05	Reject null hypothesis
11. protect unauthorized use and modification of digital content	83,2	32,8	50,4	<0.05	Reject null hypothesis
12. comply with legal issues regarding digital content	85,0	38,0	47,0	<0.05	Reject null hypothesis
13. determine the trustworthiness of digital sources	83,0	37,6	45,4	<0.05	Reject null hypothesis
14. identify digital frauds, suspicious activity and cyber-crimes	82,4	39,4	43,0	<0.05	Reject null hypothesis
15. practice safe online behaviour	90,8	61,6	29,2	<0.05	Reject null hypothesis
16. secure personal information against identity threats	91,5	51,4	40,1	<0.05	Reject null hypothesis
17. maintain a secure digital footprint	89,0	34,7	54,3	<0.05	Reject null hypothesis
18. report suspicious online activity	89,7	34,7	55,0	<0.05	Reject null hypothesis
19. report breaches in security	90,8	28,1	62,7	<0.05	Reject null hypothesis
20. comply with digital policy	95,6	44,0	51,6	<0.05	Reject null hypothesis

For all other digital skills in this construct, sector professionals placed a higher importance then the level students perceived their abilities to be. The proportional differences for this construct was much greater than the other two constructs. The minimum difference was 10,9% (i.e. backup and store digital content on your local computer network), while the maximum difference was 62,7% (i.e. report breaches in security).

With regard to the reporting of security breaches, 90,8% of sector professionals place high importance on this skill, but only 28,1% of students perceive their ability to be good/excellent. This study shows that the Real Estate, Finance and Business Services sector places great importance on security skills compared to all other digital skills, and students who will soon enter this sector is not adequately prepare to prevent or manage security-related issues. South African universities seem to resemble UK universities, as UK graduates emerge possessing degrees with a general knowledge of information technology, but lack detailed technical knowledge of certain disciplines or the technical skills required for a successful career (Blackwood, 2016). Employers typically want graduates to immediately apply their tertiary knowledge in a commercial context. Even though work experience is priceless, not all employers have the same labour requirements, nor are some willing or adequately resourced to train new staff.

6.8.Chapter summary

Based on the z-tests in this chapter, there is high a mismatch in all three constructs, in terms of the digital skills that the Real Estate, Finance and Business Services sector requires graduates to possess, when compared to the digital skills that final year commerce students possess. The major issue here is that these students, from the top four universities in South Africa, are meant to feed into the said sector once they graduate. However, the results from the z-tests suggests that these institutions are not adequately preparing their commerce students for the workplace, with regard to the digital skills that graduates need, in order to be successful in the digital economy. According to Blackwood (2016), digital skills are crucial to the UK's economy across various industries and business, but numerous adolescents are devoid of the necessary skills that employers need and they are incompetent to advance within the labour market.

The South African higher education system appears to be following a similar trend as the UK, with regard to the digital skills readiness of their graduates for industry. In-line with valuable recommendations made by Blackwood (2016), which may assist in upskilling existing students and employees, the South African Government should welcome recommendations to aid the delivery of digital skills necessary to improve the economy. The digital skills strategy must include a commitment from the South African Government to collaborate with industry players to develop industry-directed, vocationally driven career recommendations for universities to prepare the future workforce with the necessary digital skills. The South African Government should urge universities to offer 'code conversion courses' to assist non-computer science graduates with entering the workplace with a valued qualification.

Industry is transforming at a rapid pace, which presents a predicament for HEIs to keep abreast of industry demands. A key issue for graduates is that they must upskill and transform to changing job requirements, as their present degree will only take them to a certain point in their career. Hence, higher education needs to collaborate with industry with regard to curriculum design, assessment, accreditation, and the provision of internship opportunities and careers counselling. Not only is it the responsibility of HEIs to upskill their students, but Government participation is crucial for the overall success in producing a digitally skills workforce.

Chapter 4 provided the digital skills needs of the South African industry sector under study. However, Chapter 6 provided a statistical analysis of students' perceived digital skills at the top four South African universities, the digital skills that are lacking in current students, in addition to the students' digital skills preparedness for the said sector in the South African workplace. Industry, higher education and the South African government need to embrace the suggestions by Blackwood (2016), as they are also applicable to South Africa, since similar issues are being faced. While this chapter dealt with the analysis and findings of phase two, and achieved research objective two, the next chapter delves deeper into the study by attempting to achieve research objectives three to six.

CHAPTER 7 – FINDINGS AND ANALYSIS OF PHASE 3

This chapter discusses findings from phase three of this study (interviews of academic leaders (AL)). The structured interviews conducted face-to-face, but where an interviewee was unavailable, a telephonic interview was conducted.

The following research questions underpinned phase three:

3. What policies and procedures do these universities adopt with the intention of aligning the institution's curriculum to the industry requirements with regard to digital skills?
4. What are the challenges faced by these universities that reduces/impedes the curricula alignment to the digital skills requirements of industry?
5. How do South African public universities address the digital skills needs of industry?
6. How do the academic leadership at the top four universities envisage a change within their institution with the aim of addressing the needs of industry?

These questions are intended to understand the current challenges that the top four South African HEIs face, and the changes/tools necessary to remedy the situation. The following themes are aligned to the intervening variables of the conceptual framework outlined in section 1.6. Due to ethical reasons, specific names of institutions are not used in this chapter relating to the qualitative analysis.

Interviewees were first asked if they believe that it is necessary to align their institution's curriculum to the digital skills needs of the Real Estate, Finance and Business Services sector in South Africa (i.e. herewith referred to as 'industry'). They unanimously agreed that this alignment is absolutely necessary. The answer to this interview question directed the sub-questions that followed, which were analysed in the themes below regarding policies and procedures on digital skills, institutional challenges, perceived digital skills readiness of students, methods of addressing industry's digital skills needs, and envisaged transformation to ensure academia-industry alignment.

7.1. Policies and procedures to the ensure alignment of digital skills offerings

Policies and procedures are vital to HEIs, as some policies provide guidelines that inform curricula design, while others ensure the smooth functioning of the institution. Interviewees were asked about the policies and/or procedures that their institution employs with the intention of aligning their

institution's curriculum to the digital skills requirements of industry. All four interviewees indicated that an institutional policy of this nature did not exist, and that if it did exist s/he was not aware of such a policy. One comment that stands out as a 'need' for an overall institutional policy to ensure that students are adequately digitally skilled for industry, is: "*It's not a systemic intervention that comes right up from the top… there's very little overall strategy".*

Below is the particular situation at each institution regarding policies and procedures:

- Interviewee A does not have formal institutional policy document that outlines the strategies nor procedures to ensure the university-industry alignment of digital skills.
- Interviewee B faces the same shortfall regarding the absence of an institution-driven policy for disciplines to ensure that their curricula conform to the needs of its respective industry.
- Interviewee C was not sure if formalized policies existed, since the academic leader has never seen a policy if it did exist.
- Interviewee D indicated that there was no clear understanding of what the digital skills requirements of industry were, since industry had not categorically defined what its requirements are in terms of a framework, and no such institutional policy exists.

However, the information systems (IS) discipline at each of the four institution have mechanisms (discussed in section 7.4) in place to help with the alignment of the institution's offerings to industry requirements, which is ultimately aimed at bridging the digital skills gap between the the digital skills that students graduate with and the digital skills that industry requires. This section answered the third research question, that is: What policies and procedures do these universities adopt with the intention of aligning the institution's curriculum to the industry requirements with regard to digital skills? The next section discusses the challenges that each of these four universities face, which hinders the alignment of digital skills offerings to meet industry needs.

7.2. Institutional challenges that impedes curricula alignment to industry requirements

Institutional challenges are a major hinderance to HEIs' ability to align their curriculum to meet all industry's digital skills requirements, and these challenges also create a 'lag' in the delivery of adequately preparing graduates with the necessary digital skills. Consequently, addressing the challenges that hinders the curricula alignment to industry requirements, is important to adequately prepare higher education students with the digital skills needed for industry.

7.2.1. The philosophical problem

Firstly, there exists a philosophical problem, since universities are more theoretically oriented and do not train as much as TVET (Technical and Vocational Education and Training) colleges. Digital skills curricula require a more overt training intervention, which is not something that universities do, therefore one of the challenges that institutions face is how the alignment is philosophically approached. The comment made by Interviewee A below sheds light on this particular challenge.

> *You know, if we do not sit there at the sweatshop workshops, they are going to drag you out there. That is not what lecturers do. So, the challenge is more, you know, making industry understand that skills will come as a by-product of educational programs. They are not a replacement for educational programs.*

In order to work around this challenge, a specialist role may be required to establish networks with alumni and community members as developmental partners to create connections with industry, with the intention of boosting opportunities for student engagement with industry by means of observation or internships (Fung, 2017). This technique will help faculty members to acquire spectators to guide the curricula in tune with what industry expects. It will also assist students to obtain industry partners for the work they produce, with the possibility of employment prospects. However, some HEIs feel that industry has not yet recognised its role in curriculum design.

7.2.2. Industry's unassuming role in curriculum design

According to Atiku and Boateng (2020, p. 11), "the active involvement of practitioners in specific industries in curriculum review will go a long way in bridging the gap between industry and HEIs." However, Interviewee A suggests that industry players in South Africa have not acknowledged their role in stipulating specific tools and digital skills requirements, which leads to the adoption of a general teaching philosophy. For example, the idea is for IS students is to possess skills that are transferrable from 'syntax' to other coding environments and the like. This challenge is further explained below by Interviewee A.

> *Our students should have skill-sets that are diverse enough to move between methodologies and tools, whereas a lot of industry thinks that a specific tool should be taught and that is never going to happen. So, you might find that some of the things what you are experiencing when they are*

> *expecting something very specific and we do not. We are generalist educators, which means our students should be able to move effortlessly between. So, the job in terms of actual baseline skill, if it's a specific tool or technology, should be done doing a grad program, not during the university's three-year cycle.*

Similarly, Taylor and Calitz (2019, p. 2) maintain that although organisations like the "Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE)" have endeavoured to stipulate content and requirements for programmes in computer science, information systems and information technology, there exists no well-defined specification by industry on the graduate skills needed.

Moreover, Atiku and Boateng (2020) also suggest that the education system needs to rethink their curriculum review for Industry 4.0, which will motivate university stakeholders to prepare graduates for the modern-day labour market reality. In addition, the curricula should be updated on a continuous basis and used as a benchmark to improve graduates' employability in Industry 4.0. They further emphasize that since curriculum review is an ongoing process at HEIs, active participation of faculty members and industry practitioners is required to bridge the digital skills gap between industry and academia. Below is one such example of a university that aligns its curricula to industry, and provides their students with real-world settings, industry exposure and job opportunities.

According to Fung (2017), the University College London (UCL) has an interdisciplinary undergraduate degree called 'Integrated Engineering Programme (IEP)'. He explains that their programme combines advanced teaching approaches and industry-oriented curricula with discipline-specific, accredited degree structures. UCL students participate throughout the degree program in interdisciplinary activities, and acquire their professional skills in a real-world setting for their engineering course work. For example, in the engineering program, UCL takes students in groups through every phase of the design process, starting from researching and elucidating the client's requirements to engaging with industry experts and thereafter creating a design solution and prototype. "The programme leads up to 'Dragons' Den' style presentations with the proposed solutions being judged by industry partners and academics; and a Careers Expo involving employers from across the engineering sector" (Fung, 2017, p. 82). This approach is highly applicable to any other discipline, such as law and even the arts, not just engineering. Therefore, South African HEIs should adopt a similar approach to help bridge the gap between their curriculum configuration and

industry requirements. However, the academic staff need to first be equipped with the necessary resources and skill-sets.

7.2.3. The staffing issues

For some institutions, it is the academic's responsibility to research the digital requirements of industry, and to revise the curricula pertaining to the modules s/he are teaching. Consequently, research needs to be done into industry requirements and the curricula must to be updated accordingly. The academic would need to determine the industries that their students will feed into, and then investigate what its needs are. This staffing challenge includes a few limitations.

Firstly, some lecturers' have inadequate knowledge and training in digital skills, and for that reason they may be reluctant to integrate the skills that industry requires into the curricula. Once an individual joins a university as an academic, there is little or no incentive for them to up-skill in line with industry trends. So, some academics end up teaching the same thing year on year, which may influence institutions perceptions of students' readiness for industry. For example, if in the IS discipline lecturers teach dated systems development lifecycle models and they do not update their curricula, methodologies and tools which underpin their curricula often enough. However, the ideal solution would be to teach the traditional model in second year and an agile model in third, so students have both.

Additionally, if staff do not have any inclination to update the skills and methodologies that they teach, then this becomes a further limitation. At some point the curricula would need updating and if not done in a timely manner, the curriculum could need a major overhaul. There is no authentic way that a university can enforce academics to upskill, and when advised to do so, academics just "wave academic freedom in your face". The UK Commission for Employment and Skills (2010) (in Fung (2017)) has advocated that tertiary institutions, particularly universities, must focus more attention on advancing the teaching staff and curricula with the intention of improving students' occupational attributes. The UK Commission for Employment and Skills (2010, p. 6) therefore suggests:

> The prize for securing real improvements in the delivery of employability skills is that we develop more individuals with the skills necessary to get a job that is fulfilling and offers a real platform for progression in work. In

> turn this will ensure that businesses striving to innovate and grow have the kind of employees they need to both to lead and support their ambition.

Over and above their teaching workloads and research responsibilities, lectures may not have sufficient time to upskill themselves nor incorporate industry requirements into curricula. Furthermore, some lecturers may not wish to put in the effort, as it may require too much effort on their part to upskill themselves with the digital skills that industry needs. Lastly, the staff's willingness to update the curricula parallel to industry trends. Some lecturers may be adamant that it is not their responsibility to teach students the digital skills required by industry. In essence, these issues contribute to the staffing challenges that reduces the alignment of digital skills curricula in accordance with industry requirements. In addition, enforcing collaborations tools is another challenge that impedes curricula alignment to industry requirements.

7.2.4. Issues with enforcing collaboration tools

The 21st century has seen a growth in the creation and usage of collaboration tools, which are now considered an essential component for industry, especially since many professionals are required to use such tools to accomplish fundamental business activities. Although collaboration tools, like Slack provide much support for project work, there are a few issues with regards to officially enforcing collaboration tools like Slack as part of the curriculum, according to Interviewee A. The main reason for this is that these tools depend on students having mobile data if they need to use the mobile application off-campus. However, not many zero-rated websites were being used at the time of the interviews, therefore due to socio-economic imbalances many students would not receive complete exposure.

Consequently, the traditional methods of academic activities through electronic documentation is the only other practical method. Interviewee A further stated: "The actual usage of the Cloud collaboration tools as an eight hour a day way of working, I cannot do that without external funding." The general issue with collaboration tools is that while they are ideal for project work, some of these preferred tools do not work effectively due to financial shortcomings. According to Kuran *et al.* (2017), tertiary students at seven different universities work on the assigned projects, in groups online. Consequently, they predominantly use diverse collaboration tools to successfully complete allocated projects. In addition, Dyer (2019) maintains that collaboration tools are one of the main objectives of an operational and efficient intranet, since these tools enable and support present collaborations within an organization, which corresponds to the method that staff desire to collaborate, and further

supports the shift to a more virtual approach to working. Due to the COVID-19 pandemic, these tools are needed now more than ever and students need to be sufficiently skilled to use them.

Rhoads *et al.* (2018) explains that there are several categories of collaborative tools, namely collaborative writing applications, video conferencing, cork boards and digital whiteboards, social bookmarking tools, and wikis. Given that there is presently a great deal of digital tools available to enable online collaboration, it is essential for lecturers to prepare their students for the 21st century workplace, by enriching their collaboration skills (Rhoads *et al.*, 2018). Since some institutions experience difficulties when enforcing collaborations tools due to financial constraints, possible solutions require institutions to either look to cheaper or free collaboration alternatives, or seek sponsorships from business partners to implement the desired collaboration tools. Collaboration tools have certainly had a major influence on the way that academia and industry communicate and conduct business, therefore policies and procedures should be implemented for acquiring such vital digital tools. Further to that, another challenge that impedes curricula alignment to industry requirements is the high volume of students who are accepted into HEIs, but lack adequate digital skills needed at tertiary level.

7.2.5. Digital skills gap among students

The four interviewees indicated a significant number of student intake with inadequate digital skills. As a result of this high intake of students who lack the necessary digital skills when they enter university, there is a massive spread between the digitally unskilled and the highest skilled students. Essentially, there are a number of students with excellent digital skills and many of them with extremely poor digital skills. The difficulty is to then get all students to the same level, before they begin the proper degree program, as mentioned earlier. The first academic year is partially consumed by advancing the digitally under-skilled students to the same level as the digitally skilled students. However, students who are already sufficiently digitally skilled get easily bored or distracted. The problem is that many students are finishing schools, not at the digital skills level they should be, which places a tremendous resource strain on tertiary institutions to bring these students to the required level.

The information technology taught in schools is critically limited. According to Hinostroza (2018), many teachers and students in developing countries lack the digital skills essential to use available ICT tools effectively. The result of this deficiency is threefold: it constrains the potential of the student and the teacher, it negatively impacts students' learning, and intensifies educational

inequalities, particularly in developing countries like South Africa. For example, Kikkenborg (2019) found that the main rationale behind student drop-out from university was due to their lack of digital skills. He explains that once students graduate from high school, they join tertiary education devoid of adequate knowledge on utilising the new digital environment and are frequently left to figure out on their own, how the educational system works. Although this study is not based on school students, it was important to include, since it reveals the root cause of the digital skills gap among tertiary students, as pointed by two interviewees.

Kikkenborg (2019, p. 12) coordinated the Up to University (Up2U) project, which is aimed at bridging the "gap between high school and university by improving the students' digital skills via a learning platform". The Up2U project integrates formal and informal learning and modifies the methodology and technology used at universities. Up2U also supports high school students to develop digital skills to ease the transition from secondary to tertiary education. Up2U project was piloted at numerous schools within seven European countries, namely Greece, Hungary, Italy, Germany, Lithuania, Portugal, and Poland. Digitally skilling students at school level ought to reduce the number of tertiary student drop-outs.

The Department of Basic Education (DBE) in South Africa can explore studies like that of Hinostroza (2018), which examines the challenges regarding ICT policies in education including digital skills sets that school students and teachers need to attain, the incorporation of these digital skills in the curricula, the strategic designs and implementation to guarantee that students and teachers cultivate these digital skills, as well as the design and execution of pedagogical approaches that benefit from these digital skills during the teaching and learning of the core subject areas. The DBE can also adopt a similar project as Up2U in a South African context, and explore successful techniques used by other developing countries that are endeavouring to digitally skill their teachers and students at school level. Furthermore, the DBE should explore digital skills initiatives and ICT policies of developed countries, like the UK that have been successfully implemented. Until government resolves the lack of digital skills of students and teachers at school level, HEIs will continue to struggle with the challenge of bridging the digital skills gap of students at their institutions.

This lack of digital skills of students at secondary school level creates a problem, whereby HEIs are left with the mammoth task of upskilling students to an acceptable level of generic digital skills. As a result, much time is spent on bringing all students to the same digital skills level, before teaching advanced digital skills that is required for their degree structure. The only practical method

to overcome this challenge pertaining to the high intake of students that are devoid of digital skills, is for government intervention, as well as policies and procedures designed to ensure that all students should start acquiring digital skills from primary school level. Of course, there will be challenges associated with this endeavour of upskilling learners at school level, such as insufficient funding and inadequate infrastructure. However, if South Africa wishes to successfully compete in the global economy, government needs to develop strategic plans to implement digital education at schools, which will relieve the burden of HEIs spending additional time on bringing all students to the same digital skills level. This approach will also benefit students that do not proceed to tertiary institutions, and instead leap straight into the job market.

7.2.6. Insufficient time to cover curricula

Another challenge that arises is that of inadequate time, which was experiences by all four institutions. Since much time is required to address the shortfall of students entering the university with inadequate knowledge of generic digital skills, there is insufficient time to cover all fundamental aspects of digital skills. For example, Interviewee C pointed out that although practical sessions are available to students, the number of practical sessions is often insufficient due to time constraints. Additionally, there is insufficient time for tutorials, which is an essential curricula component that enables institutions to ensure knowledge is being effectively conveyed to students. This challenge is particularly due to the fact that students are required to register for other modules as well, and there are approximately 26 weeks of lecture time in an academic year.

Given the fact that there are a vast number of digital skills that are considered fundamental to the successful functioning of a society and important for industry, the current time allocation for the teaching and learning of digital skills is inadequate. Such training requires a minimum of two academic years, if HEIs are to meet the digital skills requirements of industry. Tasovac *et al.* (2019) revealed a similar finding, whereby during the first and second academic year there were difficulties in trying to cover the entire course content over the allocated hours. This resulted in insufficient time for the practical components of the courses relating to digital upskilling. They also found that when more time was allocated and the course was split into two components, the outcome was met with great success. Tasovac *et al.* (2019) maintains that there is a trend towards face-to-face training against the backdrop of small group, hands-on training and workshops, which enables students to learn by ‘doing’. But the problem they found with this learning technique is that practical sessions require much time to coordinate and conduct. ‘Practice makes perfect’, so when teaching digital skills

adequate time is vital, as there are many aspects of digital skills that organisations currently require like software applications, Web tools, information systems and most importantly, security skills.

Each year, progressively more organisations move to innovative digital solutions to conduct business. Consequently, students should be sufficiently skilled to be able to evolve their digital competency with the evolution of technology. If adequate time is spent on the teaching and learning of digital skills at academic institutions, then the graduates entering the 21st century job market will be adequately prepared to work competently. This challenge of HEIs having insufficient time to cover curricula can be resolved to a high degree, if much of the basic digital skills are taught at school level (see section 7.2.5 for more information). However, tertiary institutions also require sufficient resources to improve the curricula alignment in order to accommodate industry requirements.

7.2.7. Inadequate resources available

Interviewee A and C pointed out that they are under-resourced, especially when teaching digital proficiencies. This is due to either inadequate funding or their considerably larger class sizes. For example, Interviewee C pointed out that although an entire floor is devoted to computer laboratories, they are always overbooked. Interviewee C further explains the dynamics of this particular challenge below.

> *So that's one challenge just that the input side is people coming out of schools are not at the point where we would hope they would be and that then puts a tremendous load on the university level for us then bringing them to the same level and then getting them to the to the upward level. So, we feel that are we're under-resourced and I suspect all South African universities feel like that. But we feel our class sizes are a bit too big.*

Antiwi-Boampong and Sørensen (2018) concur that HEIs have experienced a huge influx of students, globally. They also argue that this upsurge in student numbers together with inadequate resources are two of the main challenges educational systems currently face.

Nevertheless, as a result of the high intake of students and inadequate computer resources, the digital skills curricula are largely instructed in a traditional lecture theatre, especially for first year students. This situation makes it difficult for students to grasp the ICT concepts, since they need to be able to perform many functions on a computer device, on their own. This is analogous to teaching

a learner to drive a vehicle. When teaching a learner how to drive, one simply cannot expect the learner to know how to drive by merely 'telling' the him/her how to drive. Instead, the learner needs to be instructed on driving, whilst sitting in a car, behind the steering wheel. So, the general ideology is that if all students brought their computer devices to the traditional lecture venue, or had their digital skills training in the backdrop of a computer laboratory, they would have a greater understanding of the curriculum. However, due to inadequate resources, it is very costly to roll out laptops to all students or set up hi-tech computer laboratories, especially in developing countries.

Some HEIs roll out laptops to their first-year students each year, Interviewee D belonging to one such institution experiences minimal challenges and inadequate resources is not one of them. HEIs need to find ways to improve their resources and relook at their teaching styles/methods, in addition to providing the necessary computer resources to facilitate a teaching methodology that suites the needs of the discipline. But before doing so, they need to first have a complete knowledge of the digital skills that industry needs, so that they can plan the infrastructure, software and curriculum, accordingly.

7.2.8. Incomplete knowledge of industry's digital skills needs

All four institutions pointed out that there is a lack of knowledge of what exactly industry requires, in terms of digital skills. Although some institutions have their advisory board to ascertain industry's requirements of digital skills, they only investigate the skills needed for their students that major in information systems. The advisory board does not inquire about the digital skills needed for commerce students majoring in other disciplines, even though the commerce students take an IT module as part of their degree structure. Interviewee D highlights the dynamics around this challenge by emphasizing that industry has not defined what their requirements are. As a result, the institution drives the enquiry into the digital skills requirements of industry by meeting with industry professionals to solicit their requirements, which are then used to underpin the curriculum. Interviewee D further remarks that industry has never provided the institution with their precise requirements. Therefore, for Interviewee D industry's requirements, in terms of a framework, are unclear.

Further to this, Interviewee C describes the possible reasons for this particular challenge is attributable either to inadequate communication from industry to academia, or that HEIs do not seek out the digital skills requirements from industry. There are no formal set of industry requirements to compare students' current digital skills level to, and many HEIs have not yet established exactly what

industry requires, so it is difficult to determine at what level the students need to be. In light of this challenge, several researchers call on academia to collaborate with industry to ensure continuous relevance of digital skills are being taught (Fourie *et al.*, 2014; Vogel, 2016). It is also suggested that long-term solutions involve collaboration between academia, industry and government to manage workforce development training with follow-up collaboration in order to ensure successful implementation (Vogel, 2016).

Vogel (2016) explains that an initiative in the UK, which solved a similar problem was the 'Cybersecurity Challenge UK', where its objective was to increase the number of professionals in cybersecurity. This initiative has been running since 2010 by a non-profit British organisation that has been running competitions related to IT security, particularly aimed at boosting the number of people proficient in cyber security, and at the same time actively addressing the digital skills scarcity in the UK. The 'Cybersecurity Challenge UK' involves networking initiatives and national contests, designed to help recognize people with suitable IT skills, thereby making them cognisant of training and educational opportunities, as well as to present career opportunities in the cyber security field (Vogel, 2016).

In addition, the UK government also works with academia to develop "cybersecurity programs—in 2014 gave its stamp of approval to six specific universities in the UK to train cyber experts to combat rising levels of cybercrime and build resilience in its digital environment" (Vogel, 2016, p. 36). These initiatives and programs in collaboration with academia, industry and government have been serving many functions (i.e. networking initiatives, career opportunities, training and educational opportunities, and bridging the digital skills gap) in 'one go'. If they have proven successful for first world countries, such as the UK, US and Australia, then one can argue that there is a good possibility of similar initiatives being successful in developing countries, such as South Africa since developing countries typically adopt first world technologies and practices. The implementation of such initiatives and programs will offer academia a good understanding of the digital skills requirements of industry, so that the curriculum can be adapted accordingly, and on a continuous basis (seeing as technology evolves every 18 months or so). Failure to implement such initiatives will result in the recurring delay in the alignment of curricula to meet industry's digital skills requirements.

7.2.9. Tardiness of curriculum alignment to industry

Institutions find that adapting the curriculum to new digital developments and industry needs is a slow process. Consequently, they find it difficult keeping up with the latest tech trends, methodologies and frameworks, and often fail to purchase software that closely corresponds what is being used in industry, owing to a lack of funding. This particular challenge is further described by Interviewee C below:

> *I think there is also to be honest an issue that industry is moving very quickly, so the digital skills are, of course, you know advancing at a pace that far outstrips our ability to adapt the curriculum. So, were industry wants our graduates to be and where we think they want our graduates to be is sometimes two years apart, and so that is another source of misalignment.*

Florea (2019) concurs that education slowly progresses from identifying the need for innovative academic programs, which offer certification specific to the digital workplace to the proposal, endorsement and accreditation of such qualifications for a new academic program. He further adds that the evolution of some educational systems is not progressing at the same rate as the swift transition to Industry 4.0. This means that industry is evolving much faster than academia with regard to Industry 4.0.

One of the reasons why HEIs are unable to keep up with industry's rapid transitions is largely due to financial constraints. While large conglomerates, such as banks and insurance companies can afford the various tools and technologies, in some instances, it is not possible for educational institutions to bridge that gap due to affordability (see section 7.2.7 for more information). Fung (2017) introduced the 'Connected Curriculum framework' which is aimed at empowering students to become skilled through active enquiry and research, in addition to how this method can reinforce practice for the workplace. However, the most likely solution to this challenge of slow curriculum transformation lies in investigating strategies that will rapidly reform the curriculum to meet the rapidly evolving digital skills requirements of industry.

All key stakeholders, such as academia, industry and government, need to work together as one unit to achieve a common goal (i.e. curriculum alignment to industry needs). Achieving this core objective will have a ripple effect and ultimately benefit all stakeholders, the digital economy and

society at large. The first and most prominent step in achieving this objective, as well as addressing the other challenges pointed out, is for policies and procedures to be designed and implemented at national level, so that the main stakeholders will be obliged to work in tandem to ensure that academia is not far behind industry, with regard to the academic curriculum and transition to new technologies/frameworks thereof. This way, each stakeholder will know what is expected of them in curriculum development, which needs to be done periodically. Once policies and procedures regarding digital skills frameworks have been implemented at a national level, this will provide academic institutions with the necessary support and direction to then develop and implement policies and procedures at an institutional level.

7.2.10. Lack of policies and procedures

The current academic climate reveals a lack of policies and procedures at institutional level to promote the alignment of digital skills curricula to industry requirements, a challenge which is not being addressed. Several institutional challenges discussed in this chapter, which impedes the academia-industry alignment may be solved, partially or completely, by resolving the lack of policies and procedures. Nonetheless, the only obvious method of overcoming this challenge is by developing and implementing institutional policies. As a developing country in Africa, this challenge is not confined to South African universities, as the "Eduardo Mondlane University in Mozambique and the University of Rwanda" also revealed that their institutions lacked clear institutional policies and procedures in this regard (Claude *et al.*, 2019, p. 82).

Claude *et al.* (2019) had similar findings when they conducted a case study on two academic institutions. Their findings particularly relating to this study include:

(1) a high level of 'resistance to change' from staff with regard to technology acceptance,

(2) a lack of well-defined institutional policies on ICT,

(3) an above average student-computer ratio (more students than computers, and

(4) a lack of policies for staff preservation and career growth.

As pointed out by Interviewee A, some staff do not wish to change the curricula regularly to ensure up-to-date digital skills is being offered by incorporating the latest technological tools, thereby disadvantaging their students. The 'resistance to change' in this case is potentially due to staff not wanting to accept added responsibilities of frequently updating the curricula. There ought to be other reasons as well, but these where not specified in this study. As stated earlier that there is a lack of institutional policies and there is an exceptionally high intake of students than there are computers to support them on campus. In addition, since there is no policy to motivate or guide staff in adopting

cutting-edge tools and technologies to adequately prepare graduates with the digital skills needed by industry.

Although section 7.2 was aimed at discussing the institutional challenges that impedes curricula alignment to the digital skills needs of industry, the researcher felt it necessary to provide further information (i.e. within section 7.2) on how these challenges may be resolved. Research suggests that many of these challenges can be addressed by government and industry working together with HEIs. It seems as though government is either unaware of these challenges or have other priorities. Nevertheless, HEIs need to make the first move in addressing their challenges to government, while simultaneously forging new partnerships with industry players that can assist in resolving some of the challenges in the interim. Solving these ten challenges (i.e. 7.2.1 to 7.2.10) are key to cultivating the graduates' digital skills preparedness for industry. This section answered the third research question. The next section deals with the top four institution's perceived preparedness of their graduates' digital abilities.

7.3. Perceived digital skills preparedness of students for industry

Each institution was asked if they believe that their final year students are adequately prepared to meet the digital skills requisites of industry. Interviewee A and D believe that their students are adequately prepared, while Interviewee B and C believe that their students are not entirely prepared for industry. Interviewee A believes that their final year commerce students are sufficiently prepared for industry's digital skills demands. The main reason for this confidence is that their advisory board ensures the curricula and methodologies they teach are built around industry requirements. Additionally, Interviewee A suggests that the reason for their student preparedness is the fact that they are a technology discipline, which drives them to be more digitally literate than many other disciplines.

Interviewee B believes that their final year commerce students are not entirely prepared for industry, owing to the current digital skills gap. Additionally, Interviewee B does not believe that they are completely aligning their curricula in accordance with the digital skills that is needed by Industry 4.0, and further explains the reason for this:

> *Industry 4.0 technology has an increasing trend towards the use of artificial intelligence, Big Data, Internet of Things, robotics and predictive analytics. All of this, which is revolutionizing the way businesses currently*

operate and also cyber security is another major concern with the use of technologies.

A recent study by Aasheim *et al.* (2019) revealed that entry-level IT employees in the United States (US) usually require further training on operating systems, packaged software programs and hardware used by their firms. They also found that industry placed a higher degree of importance than academia on packaged software skills, operating systems, hardware concepts and work experience. Seeing as South Africa is usually behind the US in terms of technological infrastructure advancements and digital skill levels, a similar if not worse situation may possibly exist in South Africa. In light of the statement made by Interviewee B above, HEIs need to also align the curricula to support Industry 4.0 technologies.

Interviewee C believes that their students are about 80 percent prepared to meet the digital skills requirements of industry, because they received informal communication from industry that their students are not adequately equipped with the necessary digital skills. However, Interviewee C also believes that their students fall short in the manner that many other students do, as well. This suggests that they do not fall short, exclusively and they believe that other disciplines are also 'in the same boat', such as computer science, mathematics, finance and many other fields, which is further commented on below by Interviewee C:

There is a general dissatisfaction amongst you know employers about all kinds of university graduates that there's just not quite the skill set and they have to invest time and effort in adding to that.

Their honours program takes students from all areas of commerce and other degree programs, as well. Even though students are encouraged do an honours degree in IS, only one in four students register for honours in IS. After graduation, the remaining 75 percent go into industry and find jobs.

Interviewee D believes that their students are prepared to meet industry requirements, as they have been accredited by the British Chartered Institute for Information Systems and Computer Science. For Interviewee D, this means that their honours programme is placed at an international level, which from that perspective leads them to believe that their students are most probably prepared for industry. However, this digital skills preparedness pertains specifically to their IS graduates. They have not looked into the digital skills preparedness of their students (i.e. non-IS majors) for other

commerce fields that require specific digital skills. The word tree in Figure 19 below is based on the responses from the interview question: 'Do you believe that the digital skills of the final year students at your institution is adequately aligned to meet industry requirements?' Although two of the four institutions believe that their students are prepared for industry, the terms 'fall short' appear frequently.

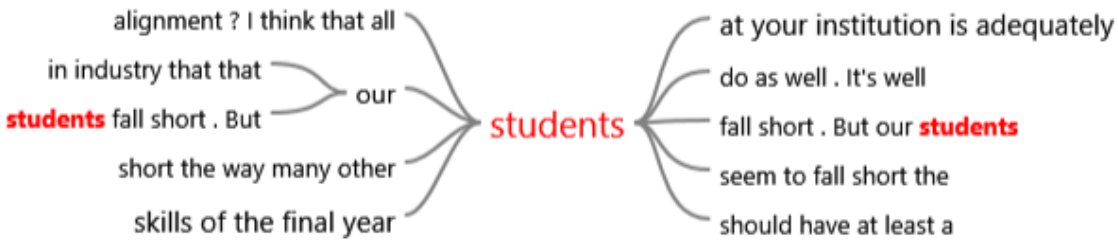

Figure 19 - Word tree on perceived students' preparedness

Interviewee A believes that their students are digitally prepared for industry, based on the work conducted by their advisory board. Interviewee B believes that their students are not entirely prepared for industry, as their curricula is not completely aligned to Industry 4.0 technology and standards. Similarly, Interviewee C believes that their students are not completely prepared for industry, as they get informal industry feedback which indicates this. Interviewee D believes that their students are digitally prepared for industry, based on the fact that their IS honours programme is internationally accredited. However, all four institutions are concerned exclusively about their IS students, and none of the institutions indicated that they have ensured curricula alignment for the digital skills required by other commerce fields that their students feed into. The next section explores the mechanisms that these institutions use in addressing the digital skills alignment of their curricula to meet industry requirements.

7.4. Mechanisms used to address digital skills requirements of industry

Institutions were asked about how they address the digital skills requirements of industry. These institutions do not have a clear policy, nor procedures that they presently employ to align their curricula with the digital skills requirements of industry. However, they have several mechanisms/initiatives in place to foster the use of technology for teaching and learning, which can be seen in the word cloud below. As the saying goes: 'A picture is worth a thousand words.' Figure 20 is a word cloud to depict the visual representation of interviewee responses, regarding the mechanisms that their institutions adopt to ensure that their curricula aligns to industry requirements pertaining to

digital skills. Much emphasis has been placed on the following terms: advisory board, guest lectures, practical sessions, internship programs, accreditation bodies, and blended learning among others.

Figure 20 - Word Cloud on mechanisms used to address digital skills requirements of industry

7.4.1. Mechanism 1 - Advisory board

One mechanism that is used to address industry's digital skills requirements is the use of advisory boards. Interviewee A suggests that his/her advisory board meets biannually with approximately twelve large industry partners. Their advisory board specifically focuses on aligning the IS curriculum (i.e. pertaining to the IS students) to meet industry requirements. This means that the IS module(s) that are recommended for all commerce students are not entirely driven by industry requirements, since the advisory board purely focuses on students that major in IS. For example, students majoring in finance may be required by industry to emerge with a different set of digital skills to that of IS students. While the commerce students may have a more in-depth knowledge of digital skills pertaining to the IS industry at the end of their IS module, they may very well lack the digital skills required for the finance domain, since the IS discipline does not cover digital skills specifically

pertaining to the finance field. Interviewee A further explains below how their advisory board functions:

> *Our policy would be that ours our curriculum is underpinned by meetings with an advisory board. And then a procedure is to go through the, you know, looking at existing curricula and seeing where the alignments and synergies are with the requirements of industry. Yes. But again, that is most definitely about discipline specific and not guided by an overall curriculum driven by the institution or driven by faculty.*

The IS discipline of Interviewee B frequently review their curricula to meet industry's digital skills requirements, by partnering with big computer companies, like IBM and Microsoft. Consequently, they have incorporated a digital skills component into a third-year module, where students can be certified for that component from the said companies. Moreover, they have developed a new module on big data management analytics for their honours program. In addition, Interviewee C indicated that they are aware that there should be a technology/industry advisory board, per department or per degree program. However, at the time of the interview such an advisory board did not yet exist, but plans were underway on soliciting board members from industry.

Conversely, while the institution of Interviewee D does not have an advisory board as such, but the academic leader of their IS discipline occasionally meets with industry players to elicit their digital skills requirements. So, Interviewee D enquires from industry about their requirements at departmental level and then aligns their IS curriculum to the stipulated requirements. The academic leader meets with several corporations that employ their students, such as Discovery, Procter & Gamble and Facebook to obtain digital skills requirements, and then formulates their curriculum based on what these corporations are looking for from students. The implementation and regular use of advisory boards is an effective mechanism that is used by most institutions in South Africa (Taylor & Calitz, 2019).

Taylor and Calitz (2019) investigated the practices and uses of industry advisory boards (IABs) by the computer science, information systems and information technology disciplines at HEIs in South Africa. They found that of their 23 respondents from 17 HEIs were actively using IABs, since it plays a crucial role in the development of the academic programmes, as well as maintaining high academic standards. However, there is inadequate research available to indicate if the IS and IT

disciplines at other South African HEIs utilize IABs, and the methods in which the IABs are used to its full potential. In addition, they highlight the lack of guidelines on the implementation of IABs in South African HEIs. Taylor and Calitz (2019) also added that the average size of an IAB was 20 members, which included academics, alumni, industry professionals, one undergraduate and one postgraduate student. The IABs similarly included a minimum of 10 members, which also included senior management.

The main reason that advisory boards are important for these specific disciplines is due to the rapidly evolving environment. IABs are known to provide several benefits, such as to (1) offer diverse perspectives and guidance for faculty members on academic issues and are a priceless source of advice to strengthen and shape curriculum; (2) offer various career choices for students; (3) monitor graduate performance and the effectiveness of the curriculum; (4) enable HEIs to keep abreast of industry trends and requirements; and most importantly (5) assist academic disciplines to meet accreditation requirements (Refae *et al.*, 2016; Summers, 2002; Taylor & Calitz, 2019). It is evident that institutions that do not currently use IABs stand to gain copious benefits if they do employ IABs, and those institutions that do use IABs can guarantee that their curriculum offerings are of high standards and comply with industry's best practices to ensure curriculum effectiveness. Nevertheless, Taylor and Calitz (2019) advise that most accreditation bodies necessitate the existence and usage of industry advisory boards by academic disciplines. Another mechanism used to address industry's digital skills requirements is the affiliation to accreditation bodies.

7.4.2. Mechanism 2 - Accreditation bodies

Interviewee D points out that their digital skills are typically taught through accreditation bodies, which also stipulate their digital skills requirements, but their present requirements are very low. The digital skills requirements of accreditation bodies are specifically for finance and IS students at the institution of Interviewee D, since they offer a Bachelor of Commerce (BCom) degree in finance and information systems, as a double major. In this case, Interviewee D speaks to the big banks and enquires what those corporations would like from the students. These requirements can be high-level IS skills like business analysis or low-level skills like coding.

It is important to note that only one of the four institutions interviewed is affiliated to an accreditation body, while the remaining three institutions have either not considered accreditation at all or are in the process of getting their programmes accredited. Taylor and Calitz (2019) concur that a limited number of computer science and information systems programmes are accredited by the

'South African National Accreditation System (SANAS)'. Moreover, they suggest that the accreditation of programmes ought to be moulded by a course of action that involves faculty members, students, IABs and alumni.

Accreditation is necessary to ensure that a programme meets the fundamental standards required for graduates entering industry domains. Additionally, research suggests that there is much value to be gained by the use of accreditation bodies. Furthermore, the endorsing of academic programmes by accreditation bodies ensures that qualifications are internationally recognised, which is essential for 21st century employees. An alternative mechanism used by some of these institutions to address industry's digital skills needs is the implementation of internship programmes.

7.4.3. Mechanism 3 – Internship programmes

Internship programmes are a form of knowledge transfer with a predefined duration, where the student is placed in an organisation, with or without remuneration, under one mentor from the organisation and another from the university (Franco *et al.*, 2019). This mechanism enables students to acquire skills that can be applied in the workplace, once they graduate and obtain employment in their chosen profession.

Interviewee A explains that internship programs at his/her institution are run in their third year and honours programmes, as a means of addressing the digital skills requirements of industry. Students get assessed on their ability to use those tools, as well as the strategies used to ensure the tools underpin collaborative project work. While Interviewee B made no mention of internships during the interview, Interviewee C pointed out the need for greater industry involvement, such as more frequent guest lecturers and extended internships, as detailed below:

> *But I think you know more direct involvement from the industry side would help us tremendously. So, it could be providing people even more regularly for guest lectureships and internships for our students. Our honours students do have a short internship, but it would be helpful if we had that extended and in fact several times during the year, because right now it's only during the winter holiday, so short internships during the year would help.*

Interviewee D explains that companies like Amazon, IBM, Facebook, and Discovery take in their students for internship programs. For example, Discovery invites students during the June/July holidays participate in their internship programs. These internship programs are being used to bridge the gap between the skills required by industry and the skills that graduates are emerging with.

There are many benefits attached to internships that are not confined to students alone, but to HEIs and organisations, as well. Firstly, internships offer students a gradual passage to the labour market. It also stimulates a mutual relationship between industry and HEIs, while simultaneously obtaining 'hands-on' knowledge from the workplace. In addition, internships are used to assist HEIs as a complementary and integral component of teaching and learning, enabling students to acquire the necessary skills for their future profession (Franco *et al.*, 2019; Koyana & Mason, 2018). The internship benefit for industry is that "employers use the internship as a recruitment tool, as it offers the employer a good opportunity to entice prospective employees and to get a better idea of the intern's suitability and ability to adapt to the organisation's culture than in an interview" (Koyana & Mason, 2018, p. 188). Research suggests that this mechanism is highly effective for curricula alignment and it creates partnerships between industry, HEIs and students, which benefits everyone.

Notwithstanding its numerous benefits, there are a few issues that may impede internship offerings, such as employers unsure how to obtain suitable interns, lacking adequate projects for suitable candidates, or lacking financial resources to offer and manage an internship programme (an issue more prone to small organisations) (Koyana & Mason, 2018). However, in order for organisations to successfully offer internship programmes, they ought to follow best practices, which include clear recruitment procedures, approved learning objectives, remuneration for interns, and the opportunity for interns to be mentored by multi-talented professionals to meet the clients' needs (Koyana & Mason, 2018). Failure to follow the best practices, could result in their image being damaged and their interns feeling exasperated. While not all institutions offer internship programmes, the mechanism that is used by most institutions to address industry's digital skills needs is blended learning.

7.4.4. Mechanism 4 – Blended learning

Blended learning amalgamates two extremes modes of learning, that is face-to-face lecture style in a traditional campus setting on one end of the spectrum and distance learning on the other end (Fresen, 2018). The permutation of different characteristics of these two extremes is what brings about the 'blend'. Blended learning has become increasingly popular among HEIs, and has proven to be a

valuable mechanism for managing a more diverse student population, while simultaneously improving the teaching and learning environment by means of incorporating online teaching materials (Ubah *et al.*, 2019). Interviewee A & B uses a variety of teaching methods to teach digital skills, such as lectures to explain concepts, tutorials to get students to think critically and solve problems, case studies, simulations, and practical sessions. Although, the institutions lack clear policies and procedures on digital skills, initiatives are being used. They have adopted a formal learning management system, like Moodle and this is encouraged to be used in all modules for blended learning. There are also online assessments, which is either conducted via Moodle or via an alternate learning platform.

The other initiative employed by Interviewee B is the partnership between their IS discipline and the institution's extended learning department, which offers a digital teaching module aimed at empowering lecturers to advance their own digital skills technology usage, so they can enhance their blending skills. They also offer an end user computing module to provide general digital skills, like Microsoft Office skills training. The empowering of lecturers is intended to motivate them to incorporate digital skills components into their core modules, in addition to the end user computing curriculum strategy. Interviewee B explains that the diverse methods adopted work well for his/her institution, since they all complement one another. Each method covers some kind of knowledge, whether it is procedural knowledge or conceptual knowledge. Practical sessions and simulations in the computer laboratories work really well, as they offer students 'hands on' experience when working with the pertinent tools and technologies. Interviewee B points out that all the methods used at his/her institution work well, as they are all designed to complement one another.

Interviewee C uses lectures, practical sessions and tutorials purely, as a means of addressing the digital skills requirements of industry. The curriculum is predominantly oriented towards IS students, but some modules are available to commerce students with other majors. The main method that Interviewee C found not to work well was traditional lectures. However, Interviewee C points out below that the blended learning mechanisms is used by students when they have missed their face-to-face lectures.

> *So many of us give lectures, but we see that students you know are busy with social media and or gaming or doing other things rather than listening to the lecture. So, students at least perceive that they can miss the content of the lecture, catch up online and then rather do the tutorial, so the highest*

impact then is guest lectures and tutorials or practice. Our lecturers are unfortunately in a rather traditional lecture hall.

Owning to the large student numbers and the use of traditional lecture halls, modules for the first three academic years do not facilitate group work, particularly at first year. However, the blended mechanism is better received by students.

Interviewee D conducts all online assignments, tests and examinations for all first-year commerce students that study information systems. In this way, students are forced to type during their assignments and assessments, so they barely ever write. One of the first-year assignments for all commerce students is that they need to design an e-commerce business, so they must be able to set up an e-commerce business from start to the end. They are also required to do intensive training on Microsoft Excel and practical sessions. Similarly, Tasovac *et al.* (2019) concur that practical exercises are the most valuable among the course materials, since they comprised well-defined, detailed instructions that each students could comprehend in class. "Step-by-step instructions were also seen as a major time saver for the instructor, because the preparation of similar exercises by the workshop facilitator would have required a significant time investment" (Tasovac *et al.*, 2019, p. 17). They also evaluated the module and found that online written content was incredibly popular, but video content demonstrated otherwise. This was probably due to the fact that students need to purchase data in order to watch those videos, which comes at a high cost, especially in South Africa.

On the contrary, the authors believe that this may be attributable to language barriers, since written content provides for additional time to fully comprehend the content. Although video content is more dynamic, it does not provide the student sufficient time for comprehension, especially videos relating to complex topics being discussed, or if the student is not too familiar with spoken language (Tasovac *et al.*, 2019). Therefore, it is important to understand what works well and what does not, with regard to blended learning tools. Some academics, especially those in non-technical disciplines, are intimidated by technology and avoid blended learning tools, and as a result lose much of the benefits associated with blended learning. In order for blended learning to be used to its full potential, institutions need to address various critical success factors.

Below is a taxonomy of critical success factors by Fresen (2018) that is intended to stimulate quality online teaching and learning in a blended environment:

(1) Institutional factors (e.g., technology strategy, student entry into courses, programme evaluation);
(2) Technology factors (e.g., reliability, availability, accessibility, support);
(3) Lecturer factors (e.g., interaction, provision of feedback, professional development);
(4) Student factors (e.g., time management, self-directed learning, communication);
(5) Instructional design factors (e.g., layout and presentation, use of media, learning principles);
(6) Pedagogical factors (e.g., learning outcomes, assessment strategies, self-reflection)" (Fresen, 2018, p. 229).

Consequently, it is important for South African academic institutions to ensure that teachers and/or lecturers possess the necessary resources and proficiencies needed to obtain the complete benefits associated with blended learning. The last mechanism that was found to be very effective and popular in addressing industry's digital skills needs is the use of guest speakers from industry.

7.4.5. Mechanism 5 – Guest speakers from industry

HEIs typically acquire immense benefits when they hire industry professionals to train a cohort of students aligned to a particular field. The industry experts usually deliver a few lectures as a guest speaker or guest lecturer. It is not ideal for students to obtain all their knowledge from a textbook, and then be expected to enter industry with a complete skillset. Therefore, industry experts share their experiences, and demonstrate to students how the theoretical knowledge can be manifested in practice. Interestingly, this study found that all four institutions invite guest speakers from industry, on a regular basis to enlighten students on what industry is like and what industry is looking for, in terms of the characteristics of future employees and their competences. Interviewee C strongly believes that this mechanism was works really well, and elaborates below:

> *Probably the only one that truly works well is inviting guest lecturers from industry. We find that they're enthusiastic. We find that students pay more attention, because it's a new face there. They're very up to date and they provide leading edge input.*

Since guest speakers are very knowledgeable in current trends, they also provide enormous value to the curriculum. Interviewee C invites guest lecturers to his/her institution when possible to enlighten their students on what is expected from industry, which then feeds directly into their

curriculum. Additionally, Interviewee D points out that industry engagement works really well, and probably works the best above all other mechanisms, as stated below:

> *So, I think engagement with industry works really well. So, for example today in the afternoon the students will have a lesson on cloud computing and in the afternoon and the second session a colleague from Amazon will come and give an overview so that that method probably works best when we have real engagement with industry.*

In as much as guest speakers are popular at these institutions, it is important to ensure that this mechanism is being used to its full potential. Consequently, Khan and Zhang (2017) identified and explained seven tips for the effective use of guest speakers, which follows. The seniority of the guest speaker should be aligned more dexterously to their function in the support programme. Guest speakers can teach a topic, co-teach a case study, discuss a project, form part of a panel of judges, or be a 'war veteran' at the beginning or the end of a module. It is preferable to hire senior level management, so that students can gain a greater knowledge level, greater insight into industry, knowledge on how to manage business opportunities and challenges, in addition to career counselling of students and a path of entry into industry. Guest speakers typically lecturer in a unique way and can help students to think beyond their own working environment (i.e. 'outside the box'). Guest speakers should be used to supplement traditional lectures with insights into the implementation and use of theories.

Faculty should make the process easier for guest speakers by providing guidelines and outlines prior to sessions, session times and information about available facilities for the session (i.e. projector, pointer, etc.) and to enlighten the guest speakers on what can be expected from the students. Lastly, since the experience of professionals do not guarantee that they will be excellent speakers, to minimize the risk academics should acquire some information about the speaker before offering them sessions (Khan & Zhang, 2017). South African HEIs can use the seven tips by Khan and Zhang (as mentioned in the previous paragraph) to ensure that the use of guest speakers is successful in achieving its objectives and used to its full potential. Although the top four HEIs in South Africa use various mechanisms to address the digital skills requirements of industry, they do however, envisage institutional transformation to ensure better alignment of their academic offerings to meet industry requirements.

7.5. Envisaged transformation to ensure industry alignment

Academic transformation is necessary for all South African universities to a varying degree, in order to overcome challenges faced, to keep up with international standards of teaching and learning, and to ensure that graduates are adequately prepared for industry. Institutions were thus asked how they envisaged a change within their institution with the aim of overcoming their challenges related to aligning their offerings to meet industry requirements. Six key themes were formed from the responses, that is policy implementation, the need to investigate industry requirements, formation of partnerships with industry to address industry needs, industry experience of lecturers, additional government funding at school level, and drastic curriculum changes.

7.5.1. Policy implementation

Policies are typically necessary to establish an action plan, in order to achieve specific objectives and is also an essential instrument that aids decision-making. South African HEIs need a policy to resolve a number of challenges that is being experienced, which hinders the alignment of the digital skills offerings to meet the requirements of industry. Consequently, such a policy needs to be strictly implemented and clearly communicated to all employees, since in section 7.2.1. it was found that a few interviewees were unaware of any policies related to ensuring that their digital skills offerings meet the requirements of industry.

Interviewee A denoted a possible solution to their challenge of staffing would be policy implementation, which would enforce the upskilling of academics and updating of curriculum. However, devoid of a formal policy it very difficult to 'police' staff from a managerial perspective. Interviewee A explains below, what the implementation of a policy would do to help convalesce managerial endeavours.

> *I think a policy would allow something to be weaponized on behalf. So, I can then as a manager, weaponized the policy and say, look, you guys are not aligned with the policy you need to get with the program, whereas without something formal coming top down, all it is idealism talking and people can dismiss that very easily. So, it's not to say a policy is a golden ticket, but it would certainly be something that could be used as leverage in some kind of intervention program.*

Interviewee B concurs that policies and procedures are needed to encourage standardisation of academia-industry alignment. Interviewee B further suggests that there should be institutional policies and procedures related to the International Organization for Standardization (ISO) standards, which are essential in promoting the digital skills alignment to industry. The implementation of policies and procedure will thus enable management to monitor compliance, so that academics will be forced to comply and those who do not comply will be dealt with accordingly. As harsh as it seems, however the crude reality is that academia is lagging behind industry, since industry is advancing at a rapid pace and the general public could soon lose faith in HEIs. As a result, it is important to first understand industry requirements, so that graduates can be better prepared for the workplace.

7.5.2. Investigate industry requirements

As discussed in section 7.2.8, most HEIs interviewed in this study highlighted the lack of information pertaining to the digital skills requirements of industry. Interviewee D explains below that industry has not categorically specified their requirements, therefore their institution fosters the curriculum alignment.

> *So, at the moment we as a university are driving what we believe the industry needs and the way we do that is by asking industry what do they require and we then align our curriculum to the requirements. But the industry itself have never formulated do they need to excel in their skills or do they need coding skills what they actually need. So, when we talk about digital skills. It is currently unclear what the requirements actually are in terms of a framework that's why I'm saying that the requirements are not clear.*

Interviewee B subsequently believes that ensuring academia-industry alignment starts with researching and incorporating the technologies used by particular industries, especially in manufacturing, insurance and finance. Moreover, Interviewee C believes that the reason for the misalignment between their graduates and what industry needs is due to inadequate communication from industry to academia, or that academia does not actively enquire from industry about their digital skills requirements. For this reason, it is important for academia to establish partnerships with industry and government[24].

[24] Partnership with government is necessary not only for funding, but government can provide directives to industry to ensure cooperation with academia.

7.5.3. Partnerships with industry

Interviewee A uses about 12 of their industry partners to sit on their advisory board in order to ensure that their curriculum offerings meet the requirements of industry. This type of partnership also provides many other perks as discussed in section 7.4.1 on advisory boards. Additionally, Interviewee C suggests that industry should be directly involved with HEIs, in order to aid the alignment of curricula to meet industry requirements. For example, there should be more frequent 'guest lectureships' and increased opportunities for extended internship programs. Furthermore, Interviewee C maintains that since the acquisition of software licenses that are generally not affordable by universities, industry should sponsor some licenses for a particular timeframe. Another fundamental benefit of academia partnership with industries is the regular review of the curricula through the lenses of industry, especially since technology changes at a rapid pace. Numerous researchers concur that academia partnerships with industry is an effective approach that has several benefits got both groups.

For instance, Sadeghnezhad *et al.* (2018) reviewed 28 studies and described the mutual benefits associated with such partnerships into four categories, namely cooperation in empowerment and training of human resources, access to shared resources, education improvement, and facilitate creation and implementation of valuable knowledge. They concluded that shared benefits in the academic-industry partnership comprise a variety of interests, expectations, goals and requirements of partner companies that is attainable and quantifiable by means of preparation and collaboration. They consequently suggest that policymakers of academia and industry consider these benefits when planning and assessing partnership programs. It is evident from past research, as well as this study that there is immense value in HEIs partnering with industry. Industry partnerships are working well for the institution of Interviewee A and they are reaping the awards accordingly. Nevertheless, Interviewee C firmly believes that lecturers also need some industry experience, especially since industry is moving at a rapid pace.

7.5.4. Industry experience of lecturers

The most highly recommended transformation necessary is permitting lecturers spend some time in the industry to gain a better understanding of what actually transpires in industry. Interviewee C advocates that since the IS lecturers at their institution have absolutely no industry experience, they do not have a clear understanding of how industry truly works. Interviewee C further elaborates below.

So, these are some oh and then the last way I would say which would really help tremendously and this is what we used to do when I was working overseas is have lecturers themselves spend a little bit of time at in the industry so not months or years like a sabbatical but a couple of days during a couple of months throughout the year to gain a better comprehension of what really happens in industry.

Gumbi and McKenna (2020) also found that a lecturer's industry expertise was very important and that novice lecturers ought to be exposed to industry, since a Master's degree is insufficient in addressing the practical aspects. They also explain that industry experience has traditionally been a requirement of lecturers at TVET colleges and promotion was largely dependent on industry experience. The magnitude of industry connections was considered an essential source of expertise and significant to integrating latest workplace practices into the curriculum (Gumbi & McKenna, 2020). However, the effects of Industry 4.0 are overflowing into the traditional universities that are beginning to see the need for their lecturers to regularly acquire industry experience, since industry is continuously changing due to rapid technological advancements. In light of this, it is recommended that South African universities ensure their lecturers acquire regular industry exposure as part of industry partnerships. This will surely grow industry's and society's faith in South African higher education. The next transformation envisaged by the participants of this study is increased government funding for schools.

7.5.5. More government funding at school level

Government funding at primary and secondary schools is an envisaged transformation that should highly influence the addressing of industry's digital skills needs. This funding may be used to cover basic digital skills at primary school level and intermediate digital skills at secondary school level. This will consequently leave enough room for HEIs to have more time to teach expert skills at tertiary level, since the basic and intermediate skills would have been covered at school. Interviewee C elaborates on this particular envisaged transformation below:

We would love it if the government would be able to fund more strongly this kind of thing. I personally think it would have very high impact if the government didn't just put more money into universities but more money into primary and secondary schools. You know the digital skills simply are the future worldwide and so catching people at the time with them more

impressionable and kids of course use social media but there's more digital skills than that and an investment in schools would I think have maximum impact, being more dynamic on the curriculum.

Digitally skilling children from a young age would have a greater impact than trying to teach all the required digital skills at tertiary level only. Teaching basic and intermediate digital skills at school will help bridge the digital skills gap found at tertiary level, where some students bring their own laptops and can write a computer program, while others have never used a computer before (as explained in the Institutional Challenges section 7.2). The digital skills gap should partially be addressed at school level, since presently some students attend schools where tablet computers are used and other students attend schools that do not even offer computer literacy courses. This digital divide results in a bigger digital skills gap, which tertiary intuitions are left with the mammoth task of bridging that gap that could be easily eluded if basic digital skills is taught at school level.

In addition, not all students that finish high school get the opportunity to study at tertiary institutions, resulting in thousands of matriculants[25] without jobs each year, partly because they do not possess the digital skills that industry requires. If the South African Department of Basic Education does not address the need for basic ICT or digital skills in schools, the high unemployment rates will only continue to rise. Furthermore, Ojo and Adu (2018) found that most respondents indicated a lack of funding in the ICT programmes of schools in the Eastern Cape, South Africa. They subsequently advocate that government actively participates in the efficacy of ICT usage by funding ICTs in schools. It is clear that the allocation of government funding for more structured ICT programmes in schools will alleviate some of the current pressures of tertiary institutions and their need to 'waste' curriculum time and resources on ensuring that all entry-level students have the basic digital skills, since some students would have attended schools that did not covered these foundation skills. In light of this and the fact that a greater curriculum alignment to industry is needed, drastic curriculum changes is another envisaged transformation to ensure that the digital skills requirements of industry is adequately met.

7.5.6. Drastic curriculum changes

Drastic curriculum changes are an envisaged transformation to ensure industry alignment. However, the key to successfully update curriculum that meets the needs of industry is industry involvement.

[25] Learners that have completed grade 12 and exited the schooling system.

Interviewee D advises that the higher education sector should determine what not to teach, in order to provide students more time to learn new digital skills. Currently, the curriculum does not offer much room to include other fundamental digital skills and time is very limited. For example, cyber-security is only offered at honours level, which is too late in the degree structure as most students who take IS at first year do not proceed to honours, and some students who major in IS do not register for the honours program. Additionally, Interviewee B strongly advocates that all commerce students should possess a conceptual understanding of the latest technologies, Industry 4.0 technologies, such as the Internet of Things, predictive analytics, Big Data and artificial intelligence, and how these technologies impact on the intended professions.

Ohei *et al.* (2019) maintains that the failure of South African universities to adequately align their curricula to meet industry's expectations remains a problem, and for this reason issues related to employability are mounting. In light of this, they propose a framework, which suggests that HEIs are a direct link between the students and the industries, therefore these institutions should give more attention to industry expectations, in order to make graduates more employable. The implication is that primary, secondary and tertiary curriculum requires transformation based on industry requirements and expectations (Ohei *et al.*, 2019). HEIs can collaborate with SAQA and industry, collectively, to drastically transform the curriculum pertaining to digital skills, with the aim of saving time, so that each institution will not have to 'reinvent the wheel' independently. It is evident that major curriculum changes are needed, not just at tertiary level, but at school level, as well.

According to Surendra and Denton (2019) there is a crucial need for classifying information systems curricula by means of a framework that constitutes three broad categories for functional relevance to industry. Their first classification is to arrange introductory courses centred on the traditional information systems curricula. The second classification should entail customized and localized courses to meet the requirements of regional employers of graduates of each information systems program. The third classification is to conduct systems thinking and business assessment courses that empower information systems graduates to evaluate and recognise organizational opportunities and requirements in equivocal and disordered organizational situations, as well as to design systems that leverage opportunities and achieve requirements.

Similarly, the IS disciplines need to classify curricula for other commerce students who will not feed into the IS industry, but into other commerce sectors instead. This suggestion is based on the fact that at most South African universities, their commerce students are required to do a digital

literacy module. In addition, Chapter 6 revealed that the current cohort of final year students at the top four South African universities perceived that much of their digital skills are not very good, especially the digital skills that industry deemed important or very important. The next section concludes the analysis and findings of phase three of this study.

7.6. Chapter summary

This chapter answered research questions three through to six of this study. Interviewees were first asked about the policies and procedures that exist at their institution to ensure that their digital skills offerings meet the needs of industry. However, in section 7.1, all four interviewees indicated that an institutional policy of this nature did not exist, and that if it did exist s/he was not aware of such a policy. Section 7.2 was aimed at understanding the current challenges that these institutions face that impedes curricula alignment to industry requirements. This section also highlighted ten main challenges that emerged by analysing the qualitative data in NVIVO, which was discussed and possible solutions were provided on how South African HEIs can overcome these challenges to ensure that their graduates are equipped with the digital skills that industry demands.

Section 7.3 explains how these institutions perceive their students' digital skills readiness for industry. Interviewee A and D believe that their students are digitally prepared for industry. However, Interviewee B and C believe that their students are not entirely prepared for industry. Section 7.4 examined the five mechanisms that these institutions use to address the digital skills of industry. Although some institutions did not have a complete understanding of industry requirements, they endeavoured to prepare their students with the digital skills they believed was necessary by use of various mechanisms. Section 7.5 reports on the envisaged transformation that these institutions believe are necessary to ensure that their digital skills curriculum is aligned to industry requirements.

The next chapter revisits the research questions, summarises the study's main contributions, discusses the limitations, provides recommendations for future studies and concludes the study.

CHAPTER 8 – CONCLUSION AND RECOMMENDATIONS

8.1. Introduction

Chapter 1 provided an insight into the background of the study, the research objectives, theoretical and conceptual framework, and the significance of the study. Chapter 2 explored the existing literature pertaining to the study's research objectives, which assisted in positioning this study. Chapter 3 provided details about the research design and applied to this study, the research paradigm employed, data quality control and ethical considerations. Chapter 4 discussed the findings and analysis of quantitative data collected for phase one of this study. Chapter 5 presented a proposed digital skills framework. Chapter 6 discussed the findings and analysis of quantitative data collected for phase two of this study. Chapter 7 discussed the findings and analysis of qualitative data collected for phase three of this study.

This chapter comprises the study's concluding remarks and recommendations, which is structured by first revisiting the research questions, summarising the key contributions of the study, following a discussion of the study's implications and recommendations, highlighting the limitations of the study, offering suggestions for future research and lastly the concluding remarks on the study.

8.2. Revisiting the overall research

The literature reviewed indicated that several countries face a digital skills shortage globally, and are currently working on ways and means that are suitable to their country's needs, to address this challenge. As a developing country, South Africa is lagging behind the more developed countries and also face a similar challenge. In addition, the South African Department of Higher Education has identified the need for a digital skills framework, but have not yet formed a team to establish the digital skills requirements of industries in South Africa. Furthermore, they have not yet implemented a digital skills framework within their higher education system that is aligned to meet the needs of industry. Consequently, more recent research pointed out the need for a digital skills framework of this nature. Seeing as it would have been a mammoth task to identify the digital skills needs of all industry sectors in South Africa, the study was narrowed down to focus on the Real Estate, Finance and Business Services sector, since the said sector was a major contributor to the country's GDP.

The overall objective of the study was to establish the digital skills preparedness of higher education students for the Real Estate, Finance and Business Services sector in South Africa. In order to achieve this objective, the key research questions were as follows:

1. What are the digital skills that industry requires university graduates to have when they enter the Real Estate, Finance and Business Services Sector in South Africa?
2. Are South African universities adequately preparing students with the necessary digital skills required by the aforementioned sector?
    2.1. What are the tertiary students' digital skills preparedness for the career path they have chosen?
    2.2. Are the students' digital skills preparedness aligned to industry requirements of the said sector?
3. What policies and procedures do these universities adopt with the intention of aligning the institution's curriculum to the industry requirements with regard to digital skills?
4. What are the challenges faced by these universities that reduces/impedes the curricula alignment to the digital skills requirements of industry?
5. How do South African public universities address the digital skills needs of industry?
6. How do the academic leadership at the top four universities envisage a change within their institution with the aim of addressing the needs of industry?

With the intention of answering these research questions, the study was divided into three phases. The first phase was necessary to establish the digital skills needs of the Real Estate, Finance and Business Services sector and was designed to answer the first research question. Industry professionals from the said sector were surveyed and a total of 389 valid responses were used for the analysis. The survey comprised four sections: (1) Background Information; (2) Use of Digital Systems and Web Tools; (3) Use of Information Systems; and (4) Application of Security Measures in Digital Environments, with a total of 54 specific digital skills (*see Appendix E*). In Chapter 4, the validity and reliability of the research instrument was tested, and frequency distributions were calculated for all constructs in this phase to determine the requirements and importance level of each digital skill to industry. Factor analysis was then conducted to reduce the data to a more compact form, so that items which were closely linked were grouped together, which guided the development of a new framework on digital skills in Chapter 5. The next phase involved identifying the digital abilities of final year commerce students that feed into the said sector.

Phase two entailed a survey of final year commerce students at the top four universities in South Africa. This phase was necessary to determine the perceived digital abilities of these students and their digital skills preparedness for the industry that they typically feed into (i.e. Real Estate, Finance and Business Services). Therefore, this phase was designed to answer the second research question. This survey comprised four sections: (1) Demographic Details; (2) Use of Digital Systems and Tools; (3) Use of Information Systems; and (4) Application of Security Measures in Digital Environments (*see Appendix F*). These are the same constructs used in phase one, to enable the comparison of the digital skills that industry needs graduates to possess, to the current perceived digital skills that these students possess. In Chapter 6, the validity and reliability of the research instrument was tested, and frequency distributions revealed the perceived digital abilities of these students. By comparing the results from phase one to the results of phase two, this further analysis revealed the digital skills readiness of final year commerce students for the said sector.

Phase three involved interviewing the academic leader (AL) of Teaching and Learning, or the equivalent, in the school/college/faculty of commerce, from each of the top four universities in South Africa. This phase involved understanding the policies and mechanisms used by the top four universities to address industry's digital skills requirements, the challenges faced that hinders the curriculum alignment to industry requirements, and the envisaged transformation needed to ensure that the curriculum of these institutions meet the digital skill needs of industry. Hence, this phase was designed to answer research questions three to six. The interview questions were structured and there was a total of four participants, since purposive sampling was used (*see Appendix G*).

8.3. Summary of key contributions of the study

8.3.1. Digital skills requirements of industry sector

There is currently no 'list' of industry requirements with regard to digital skills in a South African context, and to the best of the researcher's investigation this may hold true, globally. As a result, HEIs are left to carry out the task of investigating such requirements, independently. The study has identified and outlined the digital skills that are required by the Real Estate, Finance and Business Services sector in South Africa, as well as the level of importance of each digital skill. This finding will help HEIs to systematically align their curriculum to meet this sector's digital skills need. The finding will also help government in understanding the type of support required by HEIs to ensure that industry's needs are met.

8.3.2. Digital skills framework

The proposed digital skills framework presented in Chapter 5 is designed to be versatile and may be used as a 'blueprint' by other countries to establish their industry sectors digital skills requirements, as well as their graduates' digital skills preparedness for industry. Additionally, this framework may be used to periodically determine the changing needs of South African industries, and may be applied by other scholars to establish the digital skills requirements of other sectors within South Africa. Furthermore, scholars may use this framework as a basis for a modified framework by building on to it additional constructs that are applicable and was not considered in this study. It can be further used as a benchmark by tertiary institutions to determine probable curriculum inadequacies.

8.3.3. Digital skills preparedness students for industry sector

The study enlightens South African HEIs on their students perceived digital abilities, in addition to their preparedness for the industry that they are envisaged to feed into. This is important, especially since South Africa is a developing country and its industry sectors are striving to keep abreast of global IT benchmarks. Consequently, these HEIs can utilise the findings from this study to make the necessary adjustments to their digital skills curriculum.

8.3.4. Current digital skills gap between academia and industry

This study reveals a gap between the digital skills that students perceive to possess and the digital skills that industry requires graduates joining their sector to possess. This gap needs to be addressed by academia, industry and government working together. The largest digital skills gap was found in the construct related to the application of security measures in digital environments. Security is a vital component of IT in many organisations today, therefore HEIs need to ensure that graduates are adept with these critical digital skills. Addressing this skills gap at tertiary level will save organisations unnecessary costs and resources to upskills their newly employed graduates on common skills that would have been covered at university.

8.3.5. Policies and procedures to ensure academia-industry alignment of digital skills

This study has identified a current lack of policies and procedures to ensure that higher education curricula address industry's digital skills needs. The findings from this study provides a foundation to the South African Qualifications Authority for developing future policies and procedures in relation to the digital skills at various academic levels. Since there is no well-established list of industry requirements, institutions are independently enquiring from industry about their needs, without clear guidelines and against the current challenges faced, as discussed in section 7.2. These policies and

procedures are important to provide direction to HEIs, in order to ensure the alignment of academic offerings to industry needs, and to alleviate some of the challenges being faced.

8.3.6. Challenges that impedes academia-industry alignment

The study presents ten challenges that hinders the alignment of curricula offerings in addressing industry's digital skills requirements:

a) The philosophical problem - there exists a philosophical problem, since universities are more theoretically oriented and do not train as much as TVET colleges. Digital skills curricula require a more overt training intervention, which is not something that universities do, therefore one of the challenges that institutions face is how the alignment is philosophically approached.

b) Industry's unassuming role in curriculum design - industry players in South Africa have not acknowledged their role in stipulating specific tools and digital skills requirements, which leads to the adoption of a general teaching philosophy.

c) Staffing issues - some lecturers' have inadequate knowledge and training in digital skills, and for that reason they may be reluctant to integrate some digital skills that industry requires into the curricula. Once individuals join universities as academics, there is little or no incentive for them to up-skill in line with industry trends. Additionally, if staff do not have any inclination to update the skills and methodologies that they teach, it is a colossal challenge. There is currently no authentic way that a university can enforce academics to upskill.

d) Issues with enforcing collaboration tools - Collaboration tools, such as Slack provide much support for project work, but there are a few issues with regards to the officially enforcing collaboration tools as a curriculum component. The main reason for this is that these tools depend on students having mobile data if they need to use the mobile application off-campus. However, due to socio-economic imbalances, many students will not receive the complete exposure.

e) Digital skills gap of students entering university - The four interviewees indicated a high student intake with inadequate digital skills at their institution. As a result of this high intake of students that lack the necessary digital skills when they enter university, there is a massive spread between the digitally unskilled and the highest skilled students. Essentially, there are many students with excellent digital skills and some with extremely poor digital skills. The difficulty is to get all

students to the same level, before they begin the proper degree program, as there are a large number of students, inadequate resources and insufficient time to achieve this objective.

f) Insufficient time to cover curriculum - Since much time is required to address the shortfall of students entering the university with inadequate knowledge of generic digital skills, there is insufficient time to cover all fundamental aspects of digital skills. Given the fact that there are a vast number of digital skills that are considered fundamental to the successful functioning of a society and industry, the current time allocation for the teaching and learning of many essential digital skills is inadequate.

g) Inadequate resources available - Interviewee A and C pointed out that they are under-resourced, especially when teaching digital proficiencies, which is either due to inadequate funding or that their class sizes are a lot larger than it should be (owing to the high intake of students). Consequently, HEIs need to find ways to improve their resources and relook at their teaching styles/methods, in addition to providing the necessary computer resources to facilitate a teaching methodology that suites the needs of the discipline.

h) Incomplete knowledge of industry's digital skills needs - All four institutions indicated that there is a lack of knowledge of what exactly industry requires, in terms of a digital skills 'list of requirements'. Although some institutions have their advisory board to ascertain industry's requirements, they only investigate the skills needed for their students who major in information systems. The advisory board does not inquire about the digital skills needed for commerce students majoring in other disciplines, even though the commerce students take an IT module as part of their degree structure.

i) Tardiness of curriculum alignment to industry - Institutions find that adapting the curriculum to new digital developments and industry needs is a slow process. They find it difficult keeping up with the latest tech trends, methodologies and frameworks, and often fail to purchase software that closely corresponds to what is being used in industry, owing to a lack of funding.

j) Lack of policies and procedures - The current academic climate reveals a lack of policies and procedures at institutional level to promote the alignment of digital skills curricula to industry requirements, a challenge which has not yet been addressed. Several institutional challenges

discussed in this chapter, which impedes this alignment may be solved, completely or to a certain degree, by resolving this particular challenge, that is a lack of policies and procedures.

8.3.7. Proposed solutions to challenges being faced

Proposed solutions based on other research has been provided to help alleviate these challenges faced by higher education intuitions in South Africa. Solving these challenges are key to improving the digital skills preparedness of graduates for industry, amongst other things. Nonetheless, several of these challenges may be subdued by developing and implementing institutional policies and procedures related to aligning curricula to industry requirements. However, research suggests that the solutions to most of these challenges can be addressed by government and industry working together with HEIs.

8.3.8. Higher education's perceived digital skills preparedness

Higher education's perceived digital skills preparedness of their graduates for industry is higher than that of the students perceived digital abilities. Higher education perceives that their curriculum is adequately aligned to industry requirements. However, the z-tests in Chapter 6 suggests that students are not adequately prepared to meet industry requirements. If the curriculum was aligned to industry needs, then the students perceived abilities would have been more closely associated to the digital skills need of industry.

8.3.9. Mechanisms to address the digital skills requirements of industry

This study revealed the mechanisms that are being used by HEIs to address the digital skills requirements of industry. Based on the findings from Phase 3 of this study, the following mechanisms may be used as best practices for other tertiary institutions:

a) Advisory boards – The advisory board should meet biannually with approximately ten to twelve industry partners, like IBM and Microsoft with the focus of aligning the digital skills curriculum to meet industry requirements for each degree program. This means that the digital literacy module(s) which are recommended for tertiary students should be driven by industry requirements, but should also take global standards into consideration. The findings revealed that in order for a successful alignment between the digital skills curricula and industry requirements, utilizing industry partners as key players in an advisory board is crucial for success.

b) Accreditation bodies – Teaching digital skills via accreditation bodies that stipulate their digital skills requirements is another mechanism that assists in adequately preparing graduates with the necessary digital skills for industry. The endorsing of academic programmes by accreditation bodies ensures that qualifications are internationally recognised, which is essential for graduates entering the 21st century workplace. Institutions' whose degree programs are accredited enjoy many benefits, such as legitimacy, good institutional reputation and competitive advantage.

c) Internship programs - Internship programs may be used as an effective mechanism, as a means of addressing the digital skills requirements of industry. This mechanism enables students to develop their digital skills further, where they get the opportunity to put theory into practice, thereby making them more prepared for the workplace once they graduate and obtain employment in their chosen profession. There are numerous benefits for the students and the academic institution when internship programs are incorporated into the degree structures, as discussed in section 7.4.3.

d) Blended learning – A variety of teaching methods may be used to teach digital skills, such as lectures to explain concepts, tutorials to get students to think critically and solve problems, case studies, simulations, and practical sessions. Since students have different learning styles, blended learning provides students with the tools necessary to better understand the digital skills curriculum. A formal learning management system, like Moodle is encouraged to be used in all modules for effective blended learning. With blended learning, online assessments and assignments may be conducted via Moodle or an alternate learning platform.

e) Guest speakers from industry - Guest speakers from industry should be invited on a regular basis to enlighten students on what industry is like and what industry is looking for, in terms of the characteristics of future employees and their competences. The lectures material of guest speakers should then feed directly into the curriculum. This mechanism was found to be highly effective, since all four institutions found that industry engagement works really well, and probably works the best above all other mechanisms.

8.3.10. Higher education's envisaged transformation

The findings revealed the envisaged transformation needed by HEIs to overcome the challenges hindering the alignment of their offerings to meet industry requirements. Six key transformations were envisaged as follows:

a) Policy Implementation - South African HEIs need a policy or a few policies to resolve a number of challenges that is being experienced, which hinders the alignment of the digital skills offerings to meet the requirements of industry.

b) Investigate Industry Requirements - Commerce students largely feed into industry's Real Estate, Finance and Business Services sector. However, there is currently inadequate information from this industry sector regarding their digital skills requirements of graduates entering the said sector. This study attempts to bridge this gap by providing the digital skills requirements of the Real Estate, Finance and Business Services sector in South Africa, as well as a digital skills framework.

c) Partnerships with Industry - Numerous researchers concur that academia partnerships with industry is an effective approach that has several benefits got both groups. Industry partnerships are working well for Interviewee A and D, and they are reaping the awards accordingly. It is evident from past research, as well as this study that there is immense value in HEIs partnering with industry.

d) Industry Experience of Lecturers - The effects of Industry 4.0 are overflowing into the traditional universities that are beginning to see the need for their lecturers to regularly acquire industry experience, since industry is continuously changing due to rapid technological advancements.

e) More Government Funding at School Level – More government funding is needed at schools to teach basic and intermediate digital skills to help bridge the digital skills gap found at tertiary level, where some students bring their own laptops and can write a computer program, while others have never used a computer before. This digital divide results in a bigger digital skills gap, which tertiary intuitions are left with the mammoth task of bridging that gap, which could be easily eluded if basic digital skills is taught at school level.

f) Drastic Curriculum Changes - Major curriculum changes are needed, not just at tertiary level, but at school level, as well. Ohei *et al.* (2019) maintains that the failure of South African universities to adequately align their curricula to meet industry's expectations remains a problem, and for this reason issues related to employability are mounting. The implication is that primary, secondary and tertiary curriculum requires transformation based on industry requirements and expectations (Ohei *et al.*, 2019).

8.4. Implications and recommendations

The pervasive infiltration of incessantly evolving technology has shaped the approaches used by 21st century industries to function, and has also transformed society at large. As a result, students need to be fully equipped with digital skills of the new learning paradigm for the 21st century (Kivunja, 2014). The digital skills preparedness of graduates and the workforce is a global concern for many countries. Each country is addressing their digital skills shortage based either on generic frameworks, such as AT21CS, P21 and the Content Standards framework, which recognise that members of society should be digitally skilled or 'skilled in ICT'. This study provides vital information that will assist the South African Department of Basic Education, as well as the Department of Higher Education with digitally skilling its emerging workforce, and possibly parts of its current workforce that possess a digital skills shortage, which hinders the South African digital economy. It is important to adopt a customized framework that addresses the digital skills requirements in a South African context.

HEIs may also look upon this study to determine interim solutions for their current challenges discussed in section 7.2, whilst government initialises policies and procedures to digitally skill its current and future workforce (this may take some time). Institutions may also use this study to understand the digital skills requirements of the Real Estate, Finance and Business Services sector, so that some short-term endeavours may be made to address the digital skills needs of the said sector. The top four South African universities were selected, since they are highly ranked and usually have many strategic processes in place to ensure that their students are adequately prepared for industry. Hence the recommendations may be adopted by other institutions in the Times Higher Education BRICS ranking of South Africa. The following recommendations are underpinned by the results of this study, with the intention of improving the digital skills preparedness of students for industry.

<u>Recommendation 1: Create a synergy between academia, government and industry to develop policies and procedures that address the challenges faced by higher education institutions</u>

As this study has unfolded the various challenges that impedes higher education's ability to align their curriculum to meet the digital skills needs of industry. Many of these challenges may be addressed by government working together with higher education to formulate appropriate, sound solutions, accompanied by the input of key industry players. The result of this synergy should be comprehensive policies and procedures, which incorporates international best practices to address those challenges that hinder HEIs from adequately preparing their graduates with the necessary skills that industry deems essential.

For example, the staffing issues may be overcome with the combination of the following suggested solutions: (1) There needs to be novel management interventions that would balance lecturers research responsibilities and teaching workloads; (2) Training workshops lead by industry professionals and leading computing organisations, such as Microsoft and IBM to ensure that lecturing staff are motivated to upskill themselves; and (3) Policy implementations to guarantee that lecturing staff adhere to the upskilling requirements, with the aim of using their updated skills-sets to consistently align the curricula with the changing needs of industry. All three solutions address these staffing issues at a more granular level and will not achieve the desired result if conducted independently or partially. Hence, these suggested solutions are more likely to achieve the desired result if executed collectively.

Recommendation 2: Revise the National ICT Policy and the National Qualifications Framework

The National ICT Policy needs to be revised in a manner that will benefit all scholars and citizens in South Africa. The National ICT Policy is largely associated with the ICT infrastructure needs of the country, in addition to bridging the digital skills gap relating to technology accessibility. Now that South Africa has addressed much of their ICT infrastructure and accessibility objectives, their focus needs to move to educating their citizens on using the technology and infrastructure, with the aim of maximising their return on investment. Similarly, SAQA needs to revise the National Qualifications Framework by incorporating the digital skills framework, so that mechanisms can be put in place to address the needs of industry. Furthermore, this revision of policies and frameworks will have a ripple effect on the nation and the economy, holistically.

Recommendation 3: Government funding for ICT in schools

As highlighted by Interviewee C, more government funding needs to be injected in the Department of Basic Education to nurture basic digital skills in primary education and intermediate digital skills in secondary education. This is only possible by government investment in computing devices in schools, as well as the training of teachers. This investment will also provide opportunities to explore and benefit from blended learning techniques at school level, since the communication and learning styles of Generation Z[26] is more technically oriented than the Millennials (Nicholas, 2020). However, some schools in rural areas currently lack basic resources like access to water and sanitation, so this may be a challenge for the government, one that is possible to overcome. Nevertheless, if South Africa

[26] A cohort of individuals born between 1996 and 2010.

wishes to compete in the global economy, then more funding at schools is a necessity to offer students a curriculum that is more aligned to the modern workforce.

Recommendation 4: Use best practices when employing mechanisms to address digital skills requirements of industry

Research suggests that advisory boards, accreditation bodies, internship programs and guest lecturers are great mechanisms to support higher education in their endeavour to address industry requirements. However, although some institutions have implemented a few of these mechanisms, they have not exercised best practices and therefore are not receiving the full benefits associated with such mechanisms. The mechanisms utilise valuable resources, like time and money, therefore they should be used to its full potential. Consequently, it will be wise to first explore global best practices prior to implementing mechanisms that address the digital skills requirements of industry.

Recommendation 5: Academic staff should get more industry exposure

The study suggests the need for academic staff to obtain industry exposure, because once lecturers join the academic institution, their teaching and research workloads leave little room to keep abreast with industry's technology practices. Academics programs should be established where lecturers could periodically spend allocated time at industry to attain exposure to current technology trends and practices. This strategy will save academics time in trying to attain the same goal if done independently. It will also enable them to make quick curriculum changes, if necessary. However, higher education needs to for strong alliances with industry, in order for this program to be successful. Success can be guaranteed if industry sees the value in a program of this nature and not merely as a 'complete waste of time'.

Recommendation 7: Ensure that the curriculum largely reflects the needs of industry in the constantly evolving advancement of technology

Given the fact that technology is constantly evolving, so too will the digital skills requirement of industry, therefore there is a need to periodically investigate these changing requirements. As with other frameworks, such as the 'Technology Acceptance Model (TAM)' and the 'Unified Theory of Acceptance and Use of Technology (UTAUT)' presented by past researchers, so too will the need arise to revise the proposed Digital Skills framework presented in this study. This implies that the initial framework proposed in this study will also evolve to reflect industry's evolving requirements. Therefore, the proposed Digital Skills framework may be used as a starting point for future studies

that wish to investigate the digital skills requirements of other industry sectors or the evolving needs of each sector.

8.5. Limitations of the study

As with other studies, this study is subject to the following limitations:

8.5.1. Time constraints and framework validation

Due to time constraints and the COVID19 pandemic, it was not feasible to validate the conceptual framework, which was used to investigate the digital skills preparedness of higher education students for the Real Estate, Finance and Business Services sector in South Africa. Additionally, although the digital skills framework proposed in Chapter 5 was developed by means of factor analysis of the phase one data, this framework was also not validated. However, these models will be validated in subsequent research.

8.5.2. Data completeness

Although the questionnaires in phases one and two covered a large variety of digital skills, the quality of the data was good and incomplete surveys were excluded from the study. The data collection for phase one was conducted online via GoogleDocs, and some respondents may not have been familiar with a few IT terms. However, where necessary the researcher provided examples in the questionnaire. Nevertheless, the data accuracy may have been compromised in a few instances. The data collection process in phase two was aided by research assistants where the researcher was not available, in order to ensure that questions were understood by students. In some instances where the student was a non-English 'mother tongue' speaker and did not clarify the query, there may have been inaccuracies in such instances.

8.5.3. Survey method to measure students' digital skills

Another limitation is that using the survey method to measure the students' digital skills relies on self-reported findings. The ideal situation would have been to conduct online testing of each digital skill with the sample students in phase two, in order to determine their digital abilities. However, there were 54 individual skill areas to examine, which would have taken a very long time and some students would have eventually dropped out of the testing. Consequently, the survey method was adopted to eliminate the effect(s) of this limitation.

8.6. Suggestions for future research

8.6.1. The proposed Digital Skills Framework

a) Replication of this study to determine the digital skills requirements of other industry sectors in South Africa

The digital skills framework presented in this study may not be a "one size fits all' blueprint for all industry sectors in South Africa, since each industry sector may have varying digital skills requirements. Hence, using the proposed framework and research techniques, the study will need to be replicated for other industry sectors, to determine their requirements. The framework could be used as is or may need minor adjustments to suit other industry sectors within South Africa, with the objective to determine the digital skills preparedness of graduates for the respective industry that will be investigated in future studies. A comparison of these digital skills requirements can be conducted across all business sectors in South Africa, in order to identify the common digital skills that can be addressed at school level, since many scholars do not proceed into higher education and therefore lack much needed digital skills. Especially since the 21st century workplace is digitally evolving at a rapid pace the world over. Furthermore, the replication of this study for other sectors can be conducted by research organisations like the 'Council for Scientific and Industrial Research (CSIR)', as the findings will need to be obtained in the shorted time possible. Seeing as technology is constantly evolving at a rapid pace, the consequence of a delay in the further investigations will result in addressing digital skills needs that would have changed by the time policies and procedure are implemented. However, since the results of the Real Estate, Finance and Business Services sector has already been established in this study, this sector may be used as a pilot test for other sectors.

b) Investigation of digital skills preparedness of international students – While this study pertains to one industry sector in a South African context, the digital skills framework may, therefore be used to underpin investigations into the digital skills preparedness of students for industry in a global context. No two countries may operate exactly the same, thus future studies may be conducted to determine the digital skills requirements of industry, student preparedness for respective industry, challenges faced by HEIs, mechanisms used to align curriculum to industry, and the envisaged transformation required to ensure students are adequately prepared for industry.

c) Comparison between South Africa and other developing countries – It may be argued that developing countries have similar characteristics, so in order to do a comparative study with other developing countries, it would be necessary to first replicate this South African study with other developing countries, with regard to the entire research methodology used in this study. By establishing the digital skills preparedness of students in a global context, as indicated in the previous suggestion, a comparison between the local and international preparedness of students for industry can be to determine how South Africa is faring in comparison with other developing countries. This information is necessary to determine exactly how far behind or ahead South Africa is in terms of student preparedness for industry, notwithstanding the identification of the digital skills gap between what skills industry requires to what HEIs are offering in those developing countries.

d) Comparison between South Africa and other developed countries

As with the comparison in the suggestion above, it is necessary to investigate how South Africa is faring in comparison with developed countries. Again, this information will determine exactly how far behind South Africa is in terms of international standards of readiness of their students for industry. This information will reveal the type of skills that will be required by the local industry in the near future, since developing countries are delayed in adopting new technologies. New technologies mean a probable change in the digital skills requirements, so this type of investigation will give South Africa an idea of future developments with regards to the digital skills requirements of industry, before they actually happen.

8.6.2. Digital skills curriculum at school level

This study has revealed that basic and intermediate digital skills should ideally be covered in the school curriculum, in order to create more time for higher education to focus on the advanced digital skills. This means that a future study is needed to understand exactly which digital skills should be covered in the school curriculum pertaining to primary and secondary education. This type of study should also indicate the technical requirements and teacher training needed to successfully impart the necessary digital skills at both primary and secondary school levels, separately. In the course of time, the current teaching and learning methods in schools will no longer be effective for Generation Z students. Hence, this is another reason to include basic and intermediate digital skills in the school curriculum, apart from the fact that HEIs will have more time to cover the various branches of advance digital skills, like cyber security which is currently not being adequately aligned to industry needs. Furthermore, integrating digital skills at both schooling levels (i.e. primary and secondary), will

benefit those students who fail to acquire tertiary education, which will ultimately upskill the entire nation.

8.6.3. Type of policies and techniques to implement policies

This study revealed that the current policies and procedures are either inadequate or non-existent. Therefore, a study is needed to understand what policies are adopted globally to address the digital skills needs of industry and what policies govern the alignment of curriculum to address those needs, as well as the best methods to implement such policies to ensure adoption effectiveness. These developments of such policies should address the challenges being experienced by basic and higher education, with the main objective of meeting the digital skills needs of industry. In this way, South Africa can implement those policies and best practices that are applicable to the nature of their education system. The adoption of such policies will be dynamic in nature and will require minor, periodic updates owing to technology advancements.

8.6.4. Collaboration between academia, government and industry

As pointed out in this study, researchers strongly recommend that many challenges related to the digital skills preparedness of students for the workplace can be resolved or even prevented by academia, industry and government working in collaboration. As a result, a future study is required to determine strategies that may be used for these three cohorts to successfully collaborate and achieve the desired objectives. Such a study may also include the benefits associated with all three cohorts, which will enlighten each of these cohorts so that they will be aware of the benefits they stand to gain. In turn, this will motivate each of them to participate in future collaborations. This will undoubtedly benefit the economy, as each of the specified challenges are addressed and resolved.

8.7. Concluding remarks

This study was designed to first create an understanding of the digital skills requirements of the Real Estate, Finance and Business Services industry sector in South Africa, as phase one. However, phase one also contributed to the development of a proposed digital skills framework. Subsequently, this study endeavoured to determine the perceived digital abilities of the final year commerce students at the top four HEIs in South Africa, as phase two. As a result, the researcher was able to establish the digital skills preparedness of final year commerce students for the Real Estate, Finance and Business Services sector in South Africa. This study also contributes to curriculum development related to the teaching and learning of digital skills and offers pertinent information with regard to the digital skills gap presented by this study.

In addition, this study contributes theoretically on the academia-industry digital skills alignment, the challenges that are being faced by HEIs, higher education's perceived digital skills preparedness of students for industry, mechanisms that these institutions used to address the digital skills requirements of industry, and higher education's envisaged transformation to ensure their curricula is better aligned to meet industry needs. In light of the COVID-19 pandemic, many organisations are forced to adopt e-commerce and some of their employees have needed to work from home due to the lockdown. The challenge for some these employees is that they may not have the digital skills necessary to avoid security breaches, since the IT departments of many organisations typically implement security measures. There may also be a shortfall in terms of the digital skills needed to work remotely, which may consequently lead to security related issues, as well as more resources being spent on fully preparing workers to successfully work from home. Consequently, it is necessary to ensure that the workforce is equipped with the necessary digital skills to prevent future instabilities in the digital economy, which could arise as a result of an inadequately prepared workforce.

In the academic sphere, apart from the IS majors[27], all institutions are lacking in the alignment of digital skills to meet industry requirements for all *other* commerce major students, such as digital skills pertaining to finance majors. Furthermore, an Interviewee Driven policy that ensures the curricula for each university major comprises the digital skills that is required by the industry that its students feed into. There is also an absence of an institution-driven policy for disciplines to ensure that their curricula conform to the needs of its respective industries. Although some institutions do not have a complete understanding of the digital skills requirements of industry, they currently use mechanisms like the advisory boards and accreditation bodies to improve their understanding of what industry requires and what their curricula should entail. Even though these institutions have several mechanisms in place, they all felt the need to vastly improve their knowledge on industry requirements. Furthermore, the lack of an Interviewee Driven policy, procedure or framework makes the academia-industry alignment a mammoth task. Nevertheless, all four institutions provided feedback regarding the envisaged transformation that is required to ensure their curricula is better aligned to meet industry needs.

Undoubtedly, digital technologies are characterised by their rapidly evolving nature, which has prospective implications for professional occupations. The shortage of digital skills in industry is

[27] A subject that the student chooses to specialize in, by completing all modules in that particular discipline necessary to complete the degree.

evidently a global concern, therefore HEIs need to prepare students with the digital skills that are aligned to meet industry needs, in order to facilitate proficiency and efficiency in the workplace. The likely role of industry to direct higher education is currently being under-utilised, therefore it is strongly advocated that partnerships be made between HEIs, industry and government, in order to guarantee that the necessary digital skills are being injected into industry for a successful digital economy. This is also confirmed by Craffert *et al*. (2014). A digital skills shortage has been identified in several countries around the world and is being supported by the G20 forum to reduce the digital skills gap. This study contributes to narrowing the digital skills gap in the South African context by proposing a digital skills framework and may assist other developing countries facing similar issues, and may also aid developed countries.

8.8. A self-reflective journey

While writing my thesis, I have learned a great deal on the various research approaches. The multi-phase mixed-methods approach, helped me gain more insight into quantitative and qualitative research. The research process provided me with the knowledge and tools to be a better research supervisor and motivated me to write more articles for publication. Although I was on sabbatical leave when doing the final write-up, it was rather challenging as this was undertaken during the COVID-19 pandemic, while at home with two kids in primary school. I needed to home-school them, while trying to earnestly finish my write-up and meet the submission deadline. As a mother of two, I was literally working day and night during the epidemic.

Nevertheless, the part of the study that I enjoyed the most was the data collection for phases two and three, as they required me to travel to the top four South African universities that I have never visited before and may not have had reason to visit in the future, if it were not for this study. The aspects that was highly challenging, and which discouraged and demotivated me was the data collection for phase one, in which I faced many challenges. I created a spreadsheet with names and email address of candidates that fitted within my target population and ensured that all nine provinces were equally represented. I then sent about 2000 emails to those prospective participants, however, only 12 of them responded. I spent much time and effort sending those emails. Especially, since the email server at UKZN only allows 100 emails to be sent out on a daily basis, so I had to keep within this limit otherwise I would get locked out of my email account, which meant that it took around 20 days to send the 2000 emails. Outlook enables one to send personalized bulk emails using the Mail Merge feature, but it does not facilitate such emails with an attachment. Therefore, I had to download special software that enabled me to Use Mail Merge to send bulk emails, but which included

attachments (i.e. the consent form and survey). After enduring this painstaking process with no success, I decided to try approaching prospective candidates via LinkedIn. This was a much more successful, as I got a 49% response rate. In future, I will never do data collection via email.

The study can be adapted by modifying the methodology in each of the three phases, in a manner that will still achieve the research objectives. For example, in phase one, the industry participants could be interviewed in a future study, to get more rich data. Other researchers can use this study to learn more about a multi-phase mixed methods study of this nature. Mixed-methods studies have a great deal to offer, in terms of achieving complex research objectives and enlightening the researcher on various research approaches used within their mixed methods study.

Overall, it was a paradoxical experience whereby I enjoyed the doctoral process, while enduring and subduing the challenges whenever they arose. When I look back, I can confidently say that God was my guiding light and inspiration to complete the thesis under such turbulent times in my life. I am just glad that I was able to overcome the challenges and succeed in submitting before the deadline.

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Appendix A – Ethical Clearance Letter for Phase 1

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

13 June 2018

Mrs Surika Civilcharran (202515580)
School of Management, IT & Governance
Pietermaritzburg Campus

Dear Mrs Civilcharran,

Protocol Reference Number : HSS/0244/018D
Project title: Digital skills preparedness of higher education students for the 'Real Estate, Finance and Business' sector in South Africa

Approval Notification – Expedited Application (PHASE 1 ONLY)

In response to your application received 20 March 2018, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

[redacted]

Professor Shenuka Singh (Chair)

/ms

Cc Supervisor: Professor MS Maharaj
cc Academic Leader Research: Professor Isabel Martins
cc School Administrators: Ms Debbie Cunynghame

Humanities & Social Sciences Research Ethics Committee
Professor Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

Appendix B – Provisional Ethical Clearance Letter for Phases 2 and 3

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

05 October 2018

Mrs Surika Civilcharran (202515580)
School of Management, IT & Governance
Pietermaritzburg Campus

Dear Mrs Civilcharran,

Protocol reference number: HSS/1594/018D (Linked to HSS/0244/018D)
Project title: Digital skills preparedness of Higher Education students for the "Real Estate, Finance and Business" sector in South Africa

Provisional Approval - Expedited Application (PHASE 2 & 3)

I wish to inform you that your application received on 06 September 2018 in connection with the above, has been granted provisional approval, subject to the following:

- Gatekeeper permission letter(s) obtained

Kindly submit your response to Professor Shenuka Singh (Chair) Research Office (Ethics Section), as soon as possible.

This approval is granted provisionally and the final approval for this project will be given once the above condition has been met. Research may not begin until full approval has been received from the HSSREC.

Yours faithfully

[redacted]

.....
Dr Rosemary Sibanda (Deputy Chair)

/ms

cc Supervisor: Professor Manoj S Maharaj
cc Academic Leader Research: Professor Isabel Martins
cc School Administrator: Ms Debbie Cunynghame

Humanities & Social Sciences Research Ethics Committee
Professor Shenuka Singh (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

Appendix C – Phase 2 and 3 Gatekeeper's Approval Letters from Top Four Universities in S.A.

Faculty of Commerce

Private Bag X3, Rondebosch, 7701
2.26 Leslie Commerce Building, Upper Campus
Tel: +27 (0) 21 650 4375/ 5748 Fax: +27 (0) 21 650 4369
E-mail: com-faculty@uct.ac.za
Internet: www.uct.ac.za

@Commerce UCT UCT Commerce Faculty Office

06 November 2018

Ms Surika Civilcharran
Department of Information System
University of Cape Town

REF: REC 2018/011/131

Dear Surika Civilcharran,

Digital skills preparedness of higher education students for the "Real Estate, Finance and Business" sector in South Africa.

We are pleased to inform you that your ethics application has been approved. Unless otherwise specified this ethical clearance is valid for 1 year and may be renewed upon application.

Please be aware that you need to notify the Ethics Committee immediately should any aspect of your study regarding the engagement with participants as approved in this application, change. This may include aspects such as changes to the research design, questionnaires, or choice of participants.

The ongoing ethical conduct throughout the duration of the study remains the responsibility of the principal investigator.

We wish you well for your research.

Modie Sempu
Administrative Assistant
University of Cape Town
Commerce Faculty Office
Room 2.26 | Leslie Commerce Building

Office Telephone: +27 (0)21 650 4375
Office Fax: +27 (0)21 650 4369
E-mail: modie.sempu@uct.ac.za
Website: www.commerce.uct.ac.za<http://www.commerce.uct.ac.za/

HR194	ACCESS TO UCT STAFF FOR RESEARCH PURPOSES	UNIVERSITY OF CAPE TOWN IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

NOTES

- Forms must be downloaded from the UCT website: http://www.uct.ac.za/depts/sapweb/forms/forms.htm
- This form must be completed by applicants who are requesting to access UCT staff for the purpose of research.
- A copy of the research proposal as well as the Ethics Committee approval must be attached.
- It is the **responsibility of the researcher/s to apply for ethical clearance** from the relevant Faculty's Research in Ethics Committee (REC).
- If you are requesting staff information, you are required to complete the HR Information Request Form (HR190) and submit it together with all the required documentation.
- The turnaround time for a reply is **approximately 10 working days unless specified as urgent.**
- Return the completed application form and all the above documentation to Joy Henry via email: joy.henry@uct.ac.za; or deliver to: For the Attention: Executive Director, Human Resources Department, Bremner Building, Room 214, Lower Campus, UCT.

SECTION A: APPLICANT DETAILS

Title	Mrs	Name	Surika Civilcharran
Telephone number	0832955690	Email address	civilcharran@ukzn.ac.za
Student number	202515580	Staff number	653104
Visiting researcher ID / passport number	8401100100082		
Faculty Officer contact details	Ms Debbie Cunynghame		
	Cunynghamed@ukzn.ac.za; 033-2606152		
University or institution at which employed or a registered student	University of KwaZulu-Natal		
Faculty or department in which you are registered or work	Discipline of Information Systems & Technology (IS&T)		
Address (if not UCT)	Private Bag X01		
	Scottsville		
	3209		

SECTION B: SUPERVISOR DETAILS

	Title and name	Telephone number	Email address
Supervisor	PROF MS MAHARAJ	0837866034	MAHARAJMS@UKZN.AC.ZA
Co-Supervisor			

SECTION C: APPLICANT'S FIELD OF STUDY (if applicable) / TITLE OF RESEARCH PROJECT / STUDY

Degree	DOCTOR OF PHILOSOPHY (IS&T)		
Research project or title	Digital skills preparedness of higher education students for the "Real Estate, Finance and Business" sector in South Africa		
Research proposal attached	☒ Yes	☐ No	
Target population (number of UCT staff)	1 (DEAN OF COMMERCE)		
Amount of time required for an interview and/or questionnaire	20-30 MINUTES		
Lead Researcher details	SAME AS APPLICANT DETAILS		
Proof of ethical clearance status attached	☒ Yes	☐ No	

SECTION D: FOR OFFICE USE (Approval status to be completed by the Executive Director, Human Resources or Nominee)

Support or approval			Role	Signature	Date
Supported?	☑ Yes	☐ No	Joy Henry (Office Co-Ordinator)	[redacted]	23/11/18
Approved?	☑ Yes	☐ No	Miriam Hoosain (Executive Director: HR)	[redacted]	20/11/18

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

OFFICE OF THE DEPUTY REGISTRAR

26 October 2018

Surika Civilcharran
PhD Candidate
University of KwaZulu-Natal

TO WHOM IT MAY CONCERN

"Digital skills preparedness of higher education students for the "Real Estate, Finance and Business" sector in South Africa"

This letter serves to confirm that the above project has received permission to be conducted on University premises, and/or involving staff and/or students of the University as research participants. In undertaking this research, you agree to abide by all University regulations for conducting research on campus and to respect participants' rights to withdraw from participation at any time.

If you are conducting research on certain student cohorts, year groups or courses within specific Schools and within the teaching term, permission must be sought from Heads of School or individual academics.

Ethical clearance has been obtained (HSS/1594/018D)

[redacted]
Nicoleen Potgieter
University Deputy Registrar

Private Bag 3, Wits, 2050, South Africa | **T** +27 11 717 1204/8 | **F** +27 86 553 2271 | www.wits.ac.za

UNIVERSITEIT • STELLENBOSCH • UNIVERSITY
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INSTITUTIONAL PERMISSION:

AGREEMENT ON USE OF PERSONAL INFORMATION IN RESEARCH

Name of Researcher: Surika Civilcharran

Name of Research Project: Digital skills preparedness of higher education students for the "Real Estate, Finance and Business" sector in South Africa

Service Desk ID: IRPSD-1122

Date of Issue: 25 January 2018

You have received institutional permission to proceed with this project as stipulated in the institutional permission application and within the conditions set out in this agreement.

1 WHAT THIS AGREEMENT IS ABOUT	
What is POPI?	1.1 POPI is the Protection of Personal Information Act 4 of 2013. 1.2 POPI regulates the entire information life cycle from collection, through use and storage and even the destruction of personal information.
Why is this important to us?	1.3 Even though POPI is important, it is not the primary motivation for this agreement. The privacy of our students and employees are important to us. We want to ensure that no research project poses any risks to their privacy. 1.4 However, you are required to familiarise yourself with, and comply with POPI in its entirety.
What is considered to be personal information?	1.5 'Personal information' means information relating to an identifiable, living, individual or company, including, but not limited to: 1.5.1 information relating to the race, gender, sex, pregnancy, marital status, national, ethnic or social origin, colour, sexual orientation, age, physical or mental health, well-being, disability, religion, conscience, belief, culture, language and birth of the person; 1.5.2 information relating to the education or the medical, financial, criminal or

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

28 August 2018

Mrs Surika Civilcharran (SN 202515580)
School of Management, IT and Governance
College of Law and Management Studies
Pietermaritzburg Campus
UKZN
Email: civilcharran@ukzn.ac.za maharajms@ukzn.ac.za

Dear Mrs Civilcharran

RE: PERMISSION TO CONDUCT RESEARCH

Gatekeeper's permission is hereby granted for you to conduct research at the University of KwaZulu-Natal (UKZN), towards your postgraduate studies, provided Ethical clearance has been obtained. We note the title of your research project is:

"Digital skils preparedness of higher education students for the "Real Estate, Finance and Business" sector in South Africa".

It is noted that you will be constituting your sample as follows:

- with a request for responses on the website. The questionnaire must be placed on the notice system http://notices.ukzn.ac.za. A copy of this letter (Gatekeeper's approval) must be simultaneously sent to (govenderlog@ukzn.ac.za) or (ramkissoonb@ukzn.ac.za).

Please ensure that the following appears on your questionnaire/attached to your notice:

- Ethical clearance number;
- Research title and details of the research, the researcher and the supervisor;
- Consent form is attached to the notice/questionnaire and to be signed by user before he/she fills in questionnaire;
- gatekeepers approval by the Registrar.

You are not authorized to contact staff and students using 'Microsoft Outlook' address book. Identity numbers and email addresses of individuals are not a matter of public record and are protected according to Section 14 of the South African Constitution, as well as the Protection of Public Information Act. For the release of such information over to yourself for research purposes, the University of KwaZulu-Natal will need express consent from the relevant data subjects. Data collected must be treated with due confidentiality and anonymity.

Yours sincerely

[redacted]

MR SS MOKOENA
REGISTRAR

Appendix D – Ethical Clearance Letter for Phase 2 and 3

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

04 February 2019

Mrs Surika Civilcharran (202515580)
School of Management, IT & Governance
Pietermaritzburg Campus

Dear Mrs Civilcharran,

Protocol reference number: HSS/1594/018D
Project title: Digital skills preparedness of Higher Education students for the "Real Estate, Finance and Business" sector in South Africa

Approval Notification - Expedited / Amendment Application (PHASE 2 & 3)

With regards to your response received on 01 February 2019 and request for an amendment on 01 February 2019 to our letter of 05 October 2018, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

AMENDMENT:

- **Change in Research Sites**
- **Change in Research Methodology**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

[redacted]
.....
Dr Shamila Naidoo (Deputy Chair)

/ms

cc Supervisor: Professor Manoj S Maharaj
cc Academic Leader Research: Professor Isabel Martins
cc School Administrator: Ms Debbie Cunynghame

Humanities & Social Sciences Research Ethics Committee
Dr Rosemary Sibanda (Chair)
Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Telephone: +27 (0) 31 260 3587/8350/4557 **Facsimile:** +27 (0) 31 260 4609 **Email:** ximbap@ukzn.ac.za / snymanm@ukzn.ac.za / mohunp@ukzn.ac.za
Website: www.ukzn.ac.za

Appendix E – Phase 1 Questionnaire

UNIVERSITY OF KWAZULU-NATAL
School of Management, IT and Governance

Dear Respondent,

Doctoral Research Project

Researcher: Surika Civilcharran (Telephone number: 033 260 6210) (Email: civilcharran@ukzn.ac.za)
Supervisor: Prof. M.S. Maharaj (Telephone number: 031 260 8023) (Email: maharajms@ukzn.ac.za)
Research Office: Humanities & Social Sciences Research Ethics Administration, Govan Mbeki Building, Westville Campus,
Tel: + 27 (0)31 260 8350, Email: hssrechms@ukzn.ac.za

I, Surika Civilcharran, am a PhD student in the School of Management, IT and Governance, at the University of KwaZulu-Natal. You are invited to participate in a research project entitled:

Digital skills preparedness of higher education students for the "Real Estate, Finance and Business" sector in South Africa

South African institutions of higher education need to ensure that their graduates possess the digital intelligence necessary for the workplace, in order to ensure a thriving economy. Hence, the aim of this study is to determine if South African universities adequately equip their students with the core digital skills that are required by industry.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this research project. Confidentiality and anonymity of records will be maintained by the researcher and the School of Management, IT and Governance, UKZN. All collected data will be used solely for research purposes and will be destroyed after 5 years.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number: HSS/0244/018D).

The survey should take about 10 minutes to complete. Thank you for your time.

Sincerely,

[redacted]
Surika Civilcharran

12/02/2019
Date

This page is to be retained by participant

UNIVERSITY OF KWAZULU-NATAL
School of Management, IT and Governance

Research Project

Researcher: Surika Civilcharran (Telephone number: 033 260 6210) (Email: civilcharran@ukzn.ac.za)

Supervisor: Prof. M.S. Maharaj (Telephone number: 031 260 8023) (Email: maharajms@ukzn.ac.za)

Research Office: **Humanities & Social Sciences Research Ethics Administration, Govan Mbeki Building, Westville Campus, Tel: 27 31 2604557, Email: HSSREC@ukzn.ac.za**

CONSENT

I_____(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

_____ _____

Signature of Participant Date

This page is to be retained by researcher

1. BACKGROUND INFORMATION

When answering questions, please circle your response.

1.1. Industry sub-sector	Finance		Real Estate		Business		
1.2. Qualification(s)	*Undergraduate Degree/Diploma*	*Postgraduate Degree*	*Honours*	*Masters*	*PhD*	*Other*	*None*
1.3. Gender	Male		Female				
1.4. Which province is your organisation situated in?	Northern Cape Western Cape Free State	Mpumalanga Eastern Cape Gauteng	KwaZulu-Natal Limpopo North West				

2. USE OF SOFTWARE APPLICATIONS

Please rate the degree of importance of each of the following Digital Technical Skills related to the USE OF SOFTWARE APPLICATIONS in your sector.

Graduates entering this sector should be able to _____.	**Not Important**	**Slightly Important**	**Moderately Important**	**Important**	**Very Important**
2.1. use a computer operating system, e.g. Windows 10	1	2	3	4	5
2.2. use word processing software, e.g. Microsoft Word	1	2	3	4	5
2.3. use audio and video software, e.g. Windows Movie Maker	1	2	3	4	5
2.4. use spreadsheet software e.g. Microsoft Excel	1	2	3	4	5
2.5. use presentation software, e.g. Microsoft PowerPoint	1	2	3	4	5
2.6. use multimedia software, e.g. Windows Media Player	1	2	3	4	5
2.7. use desktop publishing software, e.g. Microsoft Publisher	1	2	3	4	5
2.8. use accounting software, e.g. Quickbooks	1	2	3	4	5
2.9. use database software, e.g. Microsoft Access	1	2	3	4	5
2.10.use data management software, e.g. IBM Analytics	1	2	3	4	5
2.11.use software for analysing Big Data, e.g. software to predict customer behaviour	1	2	3	4	5
2.12.use project management software, e.g. Microsoft Project	1	2	3	4	5
2.13.use design software, e.g. Microsoft Visio	1	2	3	4	5
2.14.use drawing and planning software, e.g. Corel Draw	1	2	3	4	5
2.15.use custom-designed software, e.g. in-house software	1	2	3	4	5
2.16.comply with legal copyright provisions	1	2	3	4	5
2.17.use software applications to access information	1	2	3	4	5
2.18.migrate to new software applications	1	2	3	4	5
2.19.use social media and online collaboration tools, e.g. Facebook	1	2	3	4	5
2.20.use Web 2.0 tools, e.g. Google/YouTube	1	2	3	4	5
2.21.use of cloud computing applications, e.g. Google Docs	1	2	3	4	5
2.22.critically evaluate software applications to determine its effectiveness in enhancing work performance	1	2	3	4	5

a) What other Digital Technical Skills related to the USE OF SOFTWARE APPLICATIONS are required in your sector?	b) Please indicate proficiency level of the Digital Technical Skills that you specified in questions 2.23 to 2.25.				
Graduates entering this sector should be able to _____.	**Not Important**	**Slightly Important**	**Moderately Important**	**Important**	**Very Important**
2.23.	1	2	3	4	5
2.24.	1	2	3	4	5
2.25.	1	2	3	4	5

3. USE OF INFORMATION SYSTEMS

Please rate the degree of importance of each of the following Digital Technical Skills related to the USE AND IMPLEMENTATION OF INFORMATION SYSTEMS in your sector.

Graduates entering this sector should be able to _____.	**Not Important**	**Slightly Important**	**Moderately Important**	**Important**	**Very Important**
3.1. assist in the analysis of an information system	1	2	3	4	5
3.2. assist in the design of an information systems	1	2	3	4	5
3.3. write software development code	1	2	3	4	5
3.4. install software applications	1	2	3	4	5
3.5. ensure smooth functioning of the information system	1	2	3	4	5
3.6. connect information systems to the Internet	1	2	3	4	5
3.7. troubleshoot information systems	1	2	3	4	5
3.8. use mobile digital devices, e.g. smartphones	1	2	3	4	5
3.9. use information systems to process information	1	2	3	4	5
3.10.use information systems for collaborating	1	2	3	4	5
3.11.use information systems for solving problems	1	2	3	4	5
3.12.migrate to new information systems	1	2	3	4	5

a) What other Digital Technical Skills related to the USE OF INFORMATION SYSTEMS are required in your sector?	b) Please indicate proficiency level of the Digital Technical Skills that you specified in questions 3.13 to 3.15.				
Graduates entering this sector should be able to _____.	**Not Important**	**Slightly Important**	**Moderately Important**	**Important**	**Very Important**
3.13.	1	2	3	4	5
3.14.	1	2	3	4	5
3.15.	1	2	3	4	5

4. APPLY SECURITY MEASURES IN DIGITAL ENVIRONMENTS

Please rate the degree of importance of each of the following Digital Technical Skills related to the APPLICATION OF SECURITY MEASURES IN DIGITAL ENVIRONMENTS in your sector.

Graduates entering this sector should be able to _____.	**Not Important**	**Slightly Important**	**Moderately Important**	**Important**	**Very Important**
4.1. use anti-virus software to protect against a cyber attack	1	2	3	4	5
4.2. install local firewall on computers	1	2	3	4	5
4.3. securely send and open digital messages and content	1	2	3	4	5
4.4. securely connect to networks	1	2	3	4	5
4.5. encrypt sensitive information	1	2	3	4	5
4.6. backup and store digital content on your local computer network	1	2	3	4	5
4.7. backup and store digital content on the Cloud, e.g. Google Drive and DropBox	1	2	3	4	5
4.8. delete sensitive digital content	1	2	3	4	5
4.9. maintain secure user id and passwords	1	2	3	4	5
4.10.protect digital content against accidental damage	1	2	3	4	5
4.11.protect unauthorized use and modification of digital content	1	2	3	4	5
4.12.comply with legal issues regarding digital content	1	2	3	4	5
4.13.determine the trustworthiness of digital sources	1	2	3	4	5
4.14.identify digital frauds,suspicious activity and cyber crimes	1	2	3	4	5
4.15.practice safe online behaviour	1	2	3	4	5
4.16.secure personal information against identity threats	1	2	3	4	5
4.17.maintain a secure digital footprint	1	2	3	4	5
4.18.report suspicious online activity	1	2	3	4	5
4.19.report breaches in security	1	2	3	4	5
4.20.comply with employer's digital policy	1	2	3	4	5

a) What other Digital Technical Skills related to the APPLICATION OF SECURITY MEASURES IN DIGITAL ENVIRONMENTS are required in your sector?	b) Please indicate proficiency level of the Digital Technical Skills that you specified in questions 4.21 to 4.23.				
Graduates entering this sector should be able to _____.	**Not Important**	**Slightly Important**	**Moderately Important**	**Important**	**Very Important**
4.21.	1	2	3	4	5
4.22.	1	2	3	4	5
4.23.	1	2	3	4	5

Appendix F – Phase 2 Questionnaire

UNIVERSITY OF KWAZULU-NATAL
School of Management, IT and Governance

Dear Respondent,

Doctoral Research Project

Researcher: Surika Civilcharran (Telephone number: 033 260 6210) (Email: civilcharran@ukzn.ac.za)
Supervisor: Prof. M.S. Maharaj (Telephone number: 031 260 8023) (Email: maharajms@ukzn.ac.za)
Research Office: Humanities & Social Sciences Research Ethics Administration, Govan Mbeki Building, Westville Campus, Tel: + 27 (0)31 260 8350, Email: hssrechms@ukzn.ac.za

I, Surika Civilcharran, am a PhD student in the School of Management, IT and Governance, at the University of KwaZulu-Natal. You are invited to participate in a research project entitled:

Digital skills preparedness of higher education students for the "Real Estate, Finance and Business" sector in South Africa

South African institutions of higher education need to ensure that their graduates possess the digital intelligence necessary for the workplace, in order to ensure a thriving economy. Consequently, the aim of this study is to determine if South African universities sufficiently equip their students with the core digital skills that is required by industry.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this research project. Confidentiality and anonymity of records will be maintained by the researcher and the School of Management, IT and Governance, UKZN. All collected data will be used solely for research purposes and will be destroyed after 5 years.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number: HSS/1594/018D).

The survey should take about 10 minutes to complete. Thank you for your time.

Sincerely,

[redacted]

Surika Civilcharran

05 March 2019

Date

UNIVERSITY OF KWAZULU-NATAL
School of Management, IT and Governance

Research Project

Researcher: Surika Civilcharran (Telephone number: 033 260 6210) (Email: civilcharran@ukzn.ac.za)

Supervisor: Prof. M.S. Maharaj (Telephone number: 031 260 8023) (Email: maharajms@ukzn.ac.za)

Research Office: **Humanities & Social Sciences Research Ethics Administration, Govan Mbeki Building, Westville Campus, Tel: 27 31 2604557, Email: HSSREC@ukzn.ac.za**

CONSENT

I _____ (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

_____ _____

Signature of Participant Date

SECTION A: Demographic Details

NB. This information is required for statistical purposes and no reference to specific individuals will be made.

1.1. Which University do you attend?	☐ University of Cape Town ☐ University of the Witwatersrand ☐ University of Stellenbosch ☐ University of KwaZulu-Natal
1.2. What are your majors?	☐ Accounting ☐ Economics ☐ Finance ☐ Information Technology ☐ Marketing ☐ Management Studies If other, please specify: _____
1.3. Gender	☐ Male ☐ Female ☐ Prefer not to say

SECTION B: DIGITAL SKILLS PREPAREDNESS

When answering questions, please circle your response.

2. USE DIGITAL SYSTEMS AND TOOLS

Please rate your abilities in the use of the following Digital Technical Skills related to the USE OF DIGITAL SYSTEMS AND TOOLS.

My ability to:	Very Poor	Poor	Fair	Good	Excellent	Do not know
2.1. use a computer operating system, e.g. Windows 10 is	1	2	3	4	5	☐
2.2. use word processing software, e.g. Microsoft Word is	1	2	3	4	5	☐
2.3. use audio and video software, e.g. Windows Movie Maker is	1	2	3	4	5	☐
2.4. use spreadsheet software e.g. Microsoft Excel is	1	2	3	4	5	☐
2.5. use presentation software, e.g. Microsoft PowerPoint is	1	2	3	4	5	☐
2.6. use multimedia software, e.g. Windows Media Player is	1	2	3	4	5	☐
2.7. use desktop publishing software, e.g. Microsoft Publisher is	1	2	3	4	5	☐
2.8. use accounting software, e.g. Quickbooks is	1	2	3	4	5	☐
2.9. use database software, e.g. Microsoft Access is	1	2	3	4	5	☐
2.10. use data management software, e.g. IBM Analytics is	1	2	3	4	5	☐
2.11. use software for analysing Big Data, e.g. software to predict customer behaviour is	1	2	3	4	5	☐
2.12. use project management software, e.g. Microsoft Project is	1	2	3	4	5	☐
2.13. use design software, e.g. Microsoft Visio is	1	2	3	4	5	☐
2.14. use drawing and planning software, e.g. Corel Draw is	1	2	3	4	5	☐
2.15. use custom-designed software, e.g. in-house software is	1	2	3	4	5	☐
2.16. comply with legal copyright provisions is	1	2	3	4	5	☐
2.17. use software applications to access information is	1	2	3	4	5	☐
2.18. migrate to new software applications is	1	2	3	4	5	☐
2.19. use social media and online collaboration tools, e.g. Facebook is	1	2	3	4	5	☐
2.20. use Web 2.0 tools, e.g. Google/YouTube is	1	2	3	4	5	☐
2.21. use of cloud computing applications, e.g. Google Docs is	1	2	3	4	5	☐
2.22. critically evaluate software applications to determine its effectiveness in enhancing work performance is	1	2	3	4	5	☐

3. USE SOFTWARE APPLICATIONS

Please rate your abilities in the use of the following Digital Technical Skills related to the USE OF SOFTWARE APPLICATIONS.

My ability to:	Very Poor	Poor	Fair	Good	Excellent	Do not know
3.1. assist in the analysis of an information system is	1	2	3	4	5	☐
3.2. assist in the design of an information systems is	1	2	3	4	5	☐
3.3. write software development code is	1	2	3	4	5	☐
3.4. install software applications is	1	2	3	4	5	☐
3.5. ensure smooth functioning of the information system is	1	2	3	4	5	☐
3.6. connect information systems to the Internet is	1	2	3	4	5	☐
3.7. troubleshoot information systems is	1	2	3	4	5	☐
3.8. use mobile digital devices, e.g. smartphones is	1	2	3	4	5	☐
3.9. use information systems to process information is	1	2	3	4	5	☐
3.10.use information systems for collaborating is	1	2	3	4	5	☐
3.11.use information systems for solving problems is	1	2	3	4	5	☐
3.12.migrate to new information systems is	1	2	3	4	5	☐

APPLY SECURITY MEASURES IN DIGITAL ENVIRONMENTS

Please rate your abilities in the use of the following Digital Technical Skills related to the APPLICATION OF SECURITY MEASURES IN DIGITAL ENVIRONMENTS.

My ability to:	Very Poor	Poor	Fair	Good	Excellent	Do not know
4.1. use anti-virus software to protect against a cyber attack is	1	2	3	4	5	☐
4.2. install local firewall on computers is	1	2	3	4	5	☐
4.3. securely send and open digital messages and content is	1	2	3	4	5	☐
4.4. securely connect to networks is	1	2	3	4	5	☐
4.5. encrypt sensitive information is	1	2	3	4	5	☐
4.6. backup and store digital content on your local computer network is	1	2	3	4	5	☐
4.7. backup and store digital content on the Cloud, e.g. Google Drive and DropBox is	1	2	3	4	5	☐
4.8. delete sensitive digital content is	1	2	3	4	5	☐
4.9. maintain secure user id and passwords is	1	2	3	4	5	☐
4.10. protect digital content against accidental damage is	1	2	3	4	5	☐
4.11. protect unauthorized use and modification of digital content is	1	2	3	4	5	☐
4.12. comply with legal issues regarding digital content is	1	2	3	4	5	☐
4.13. determine the trustworthiness of digital sources is	1	2	3	4	5	☐
4.14. identify digital frauds, suspicious activity and cyber crimes is	1	2	3	4	5	☐
4.15. practice safe online behaviour is	1	2	3	4	5	☐
4.16. secure personal information against identity threats is	1	2	3	4	5	☐
4.17. maintain a secure digital footprint is	1	2	3	4	5	☐
4.18. report suspicious online activity is	1	2	3	4	5	☐
4.19. report breaches in security is	1	2	3	4	5	☐
4.20. comply with digital policy is	1	2	3	4	5	☐

Thank you for completing this questionnaire!

Appendix G – Phase 3 Interview Questions

UNIVERSITY OF KWAZULU-NATAL
School of Management, IT and Governance

Dear Respondent,

Research Project

Researcher: Surika Civilcharran (Telephone number: 033 260 6210) (Email: civilcharran@ukzn.ac.za)
Supervisor: Prof. M.S. Maharaj (Telephone number: 031 260 8023) (Email: maharajms@ukzn.ac.za)
Research Office: Humanities & Social Sciences Research Ethics Administration, Govan Mbeki Building, Westville Campus, Tel: + 27 (0)31 260 8350, Email: hssrechms@ukzn.ac.za

I, Surika Civilcharran am a PhD student in the School of Management, IT and Governance, at the University of KwaZulu-Natal. You are invited to participate in a research project entitled:
Digital skills preparedness of higher education students for the "Real Estate, Finance and Business" sector in South Africa

South African institutions of higher education need to ensure that their graduates possess the digital intelligence necessary for the workplace, in order to ensure a thriving economy. Consequently, the aim of this study is to determine if South African universities sufficiently equip their students with the core digital skills that is required by industry.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence. There will be no monetary gain from participating in this research project. Confidentiality and anonymity of records will be maintained by the researcher and the School of Management, IT and Governance, UKZN. All collected data will be used solely for research purposes and will be destroyed after 5 years.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number HSS/1594/018D).

The interview should take about 15 minutes to complete. Thank you for your time.

Sincerely,

_____ Date_____

Surika Civilcharran

This page is to be retained by participant

UNIVERSITY OF KWAZULU-NATAL
School of Management, IT and Governance

Research Project

Researcher: Surika Civilcharran (Telephone number: 033 260 6210) (Email: civilcharran@ukzn.ac.za)
Supervisor: Prof. M.S. Maharaj (Telephone number: 031 260 8023) (Email: maharajms@ukzn.ac.za)
Research Office: **Humanities & Social Sciences Research Ethics Administration, Govan Mbeki Building, Westville Campus, Tel: 27 31 2604557, Email: HSSREC@ukzn.ac.za**

CONSENT

I_____(full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project. I understand that I am at liberty to withdraw from the project at any time, should I so desire.

Additional consent, where applicable

I hereby provide consent to:

Audio-record my interview YES / NO

_____ _____

Signature of Participant Date

This page is to be retained by researcher

Preamble

Information and Communications Technology (ICT) plays a fundamental role in the educational system, so the learning process requires several skills to present digital information. Additionally, the effective use of the digital technology requires students to possess digital skills and talents, which will primarily help them to become prolific in the 21st century globalized trades, professions and occupations.

It is necessary to meet with you, in order to understand how your institution prepares students with digital skills of their respective professions in the workplace.

Interview Questions

1. Do you believe that it is necessary to align your institution's curriculum to the digital skills requirements of the "Real Estate, Finance and Business" sector in South Africa (i.e. industry)?

<u>If YES to Question 1</u>

1.1. What policies and/or procedures does your institution employ with the intention of aligning the institution's curriculum to the digital skills requirements of industry?

1.2. Are there any challenges faced by your institution that reduces/impedes the alignment of students' digital skills to the industry requirements?
   1.2.1. If so, what are these challenges?
   1.2.2. If not, move to question 1.3.

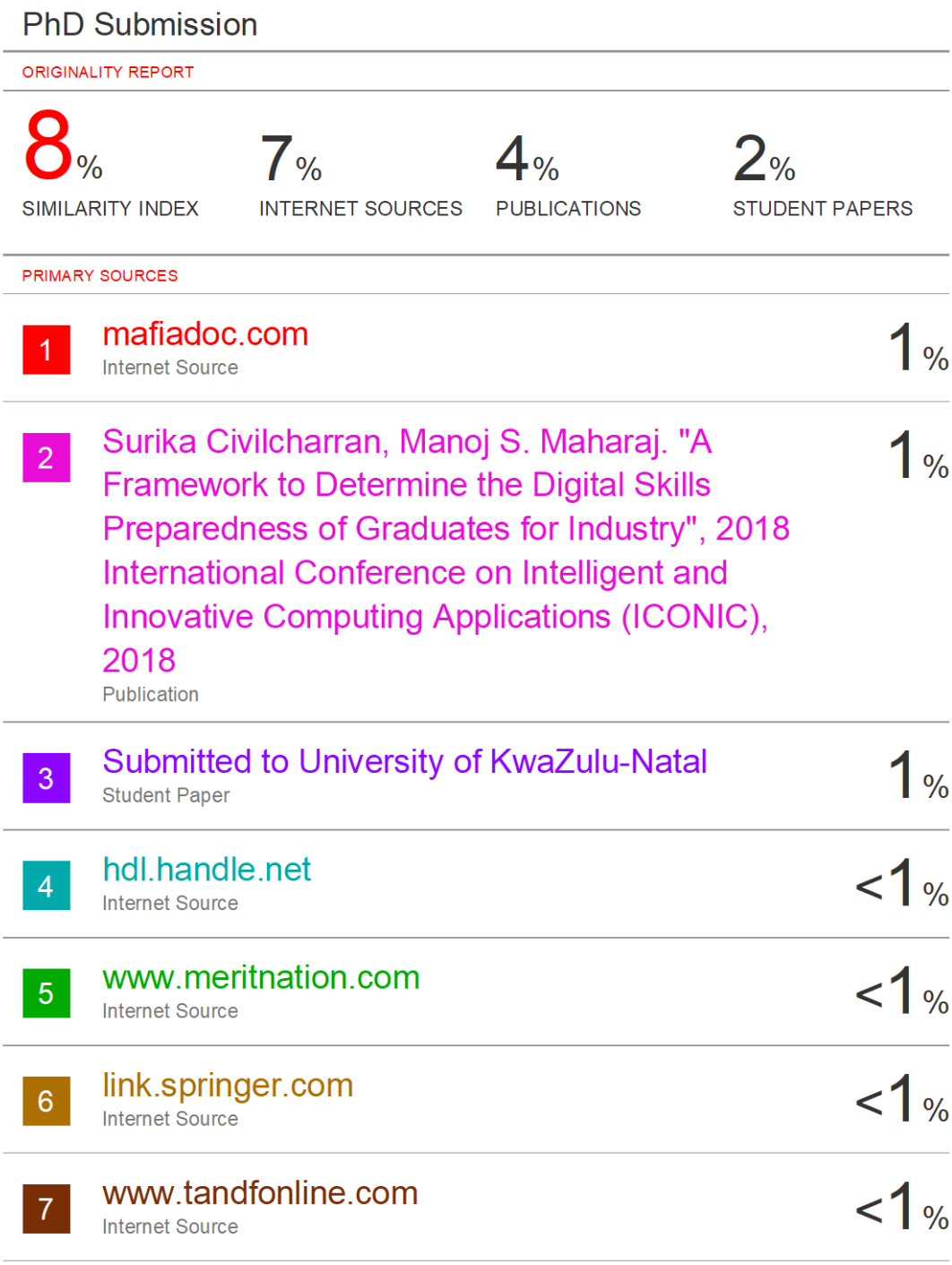
1.3. Do you believe that the digital skills of the final year students at your institution is adequately aligned to meet industry requirements?
   1.3.1. If so, move to question 1.4.
   1.3.2. If not, what changes do you believe are necessary to improve this industry alignment at your institution?

1.4. How does your institution address the digital skills requirements of industry?
   1.4.1. What methods are used to transfer the digital skills to students?
   1.4.2. Which of these methods work well and which do not?

<u>If NO to Question 1</u>

1.5. Why do you believe that an alignment of your institution's curriculum to the digital skills requirements of the "Real Estate, Finance and Business" sector is not necessary?
1.6. What are the current practices in your institution to ensure that graduates are equipped with the necessary digital skills required by the industry?
1.7. What are the challenges faced by your institution that reduces/impedes the alignment of students' digital skills to the industry requirements?
1.8. What are the policies and/or regulations, in your business sector, regarding the digital skills of graduates entering that industry?

Appendix H – Turnitin Report



PhD Submission

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2	Surika Civilcharran, Manoj S. Maharaj. "A Framework to Determine the Digital Skills Preparedness of Graduates for Industry", 2018 International Conference on Intelligent and Innovative Computing Applications (ICONIC), 2018 Publication	1%
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