DEVELOPMENT AND VALIDATION OF A MEASURE FOR ASSESSING THE PSYCHO-TECHNOLOGICAL LEARNING CAPABILITIES OF OPEN AND DISTANCE ONLINE LEARNERS.

by

CEBILE TEBELE

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SUPERVISOR: Professor M. Coetzee

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DECLARATION

I, Cebile Tebele, student number 32469268, declare that this dissertation, entitled "**Development and validation of a measure for assessing the psycho-technological learning capabilities of open and distance online learners",** is my own work. All the sources that I used or quoted have been indicated and acknowledged by means of complete references. The APA 7th edition guidelines for referencing style were applied in the dissertation.

I further declare that I submitted the dissertation to originality checking software and that it falls within the accepted requirements for originality as verified by my supervisor.

I further declare that the study has been carried out in strict accordance with the Policy for Research Ethics of the University of South Africa (Unisa). I took great care that the research was conducted with the highest integrity, taking into account Unisa's Policy for Infringement and Plagiarism.

I further declare that I have not previously submitted this work, or part of it, for examination for another qualification or at any other higher education institution.

I further declare that ethical clearance to conduct the research has been obtained from the Department of Industrial and Organisational Psychology, University of South Africa (see Appendix A). Permission to conduct the research using UNISA students has been obtained from the Research Permission Subcommittee of the UNISA Senate Research and Innovation and Higher Degrees Committee (SRIHDC) (see Appendix A and B).

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ABSTRACT/SUMMARY

DEVELOPMENT AND VALIDATION OF A MEASURE FOR ASSESSING THE PSYCHO-TECHNOLOGICAL LEARNING CAPABILITIES OF OPEN AND DISTANCE ONLINE LEARNERS

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CEBILE TEBELE

SUPERVISOR: Prof M Coetzee

DEPARTMENT: Industrial and Organisational Psychology

DEGREE: Doctor of Philosophy in Psychology (Industrial and Organisational Psychology)

This research focused on the development and validation of the Psycho-Technological Learning Capabilities Scale (PTLCS) to measure the technical and technological capabilities required by students in an open distance and online learning (ODeL) environment in higher education. The general aim of this research was to operationalise the various constructs that constitute psycho-technological learning capabilities, namely, computer skills (relabelled as technological skills) and internet self-efficacy (relabelled as technical self-efficacy), into a valid and reliable measure. The research also explored the relationship dynamics between students' psycho-technological learning capabilities, a self-directed learning orientation, socio-biographical characteristics (age, gender and ethnicity), and graduateness skills and attributes. A quantitative cross-sectional survey was conducted with a random sample of students (N = 378) who were enrolled for two compulsory first-year Industrial and Organisational Psychology modules at a higher education ODeL institution. Exploratory factor analysis and confirmatory factor analysis provided evidence of the internal consistency, reliability and construct validity of the newly developed PTLCS. Multigroup structural equivalence showed that the factor structure (configural invariance) of the PTLCS was equivalent for the gender and ethnicity groups. The results further showed that the PTLCS constructs (metric invariance) had the same meaning for the various age, gender and ethnicity groups. Scalar invariance (mean differences in the latent construct) was not evident for the groups. Multiple regression showed that technological self-efficacy, academic activity, motivation and success orientation significantly predicted higher levels of graduateness skills and attributes. Hierarchical moderated regression analysis showed that the prediction effect of psycho-technical learning capability on graduateness skills and attributes was conditional on the mean scores of the black and white ethnicity groups. Tests for significant mean differences showed that male participants scored significantly higher than female participants on graduateness skills and attributes and psycho-technical learning capability. Black and white ethnicity groups also differed significantly on these constructs. Although it requires further refinement, the newly developed PTLCS promises to provide information that would be useful for measuring the technical and technological learning capabilities of ODeL students. The study makes an original contribution to adult learning theory and ODeL research, and adds value to teaching practices focused on facilitating the graduateness and subsequent employability of students in the digital era world of work.

KEY TERMS
academic motivation, adult learning theory, digital era, graduateness skills and attributes, open distance and online learning, Psycho-Technological Learning Capabilities Scale, self-directed learning orientation, success orientation, technological skills, technical self-efficacy.

OPSOMMING

ONTWIKKELING EN GELDIGHEIDSBEPALING VAN ’N MAATSTAF VIR DIE ASSESSERING VAN DIE PSIGO-TEGNOLOGIESE LEERVERMOËNS VAN OOP EN AFSTAND- AANLYN LEERDERS

deur

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Die navorsing het gefokus op die ontwikkeling en geldigheidsbepaling van die PTLCS (Psycho-Technological Learning Capabilities Scale, of psigo-tegnologiese-leervermoëns-skaal) om die tegniese en tegnologiese vermoëns wat deur studente in ’n ODeL-omgewing (oop-afstand- en aanlyn leer) in hoër onderwys benodig word, te meet. Die algemene oogmerk van die navorsing was om die verskillende konstrukte wat psigo-tegnologiese leervermoëns – naamlik rekenaarvaardighede (herklassifiseer as tegnologiese vaardighede) en internet-selfdoeltreffendheid (herklassifiseer as tegniese selfdoeltreffendheid), te operasionaliseer tot ’n geldige en betroubare maatstaf. Die navorsing het ook die verhoudingsdinamika tussen studente se psigo-tegnologiese leervermoëns, selfgerigte leeroriëntering, sosio-biografiese eienskappe (ouderdom, geslag en etnisiteit), en gradueerbaarheidsvaardighede en -kenmerke ondersoek. ’n Kwantitatiewe deursnee-opname is gedoen met ’n ewekansige steekproef van studente (N = 378) wat ingeskryf is vir twee verpligte eerstejaarsmodules in bedryfs- en organisasiesielkunde by ’n hoëronderwys-ODeL-instelling. Verkenningsfaktorontleding en bevestigendefaktorontleding het bewys gelewer van die interne konsekwentheid, betroubaarheid en konstrukgeldigheid van die nuutontwikkelde PTLCS. Multigroep- strukturele ekwivalensie het getoon dat die faktorstruktuur (konfigurale invariansie) van die PTLCS ekwivalent was vir die geslag- en etnisiteitgroepe. Die resultate het verder aangedui dat die PTLCS-konstrukte (metriese invariansie) dieselfde betekenis vir die verskillende ouderdom-, geslag- en etnisiteitgroepe gehad het. Skalare invariansie (gemiddelde verskille in die latente konstruk) vir die groepe was nie sigbaar nie. Meervoudige regressie het getoon dat tegnologiese selfdoeltreffendheid, akademiese aktiwiteit, motivering en suksesoriëntering beduidend hoër vlakke van gradueerbaarheidsvaardighede en -kenmerke voorspel het. Hiërargies gemodereerde regressie-ontleding het getoon dat die voorspellingseffek van psigo-tegniese leervermoë op gradueerbaarheidsvaardighede en -kenmerke voorwaardelik op grond van die gemiddelde tellings van die swart en wit etnisiteitgroepe was. Toetse vir beduidende gemiddelde verskille het daarop gedui dat manlike deelnemers beduidend hoër punte as vroulike deelnemers behaal het vir gradueerbaarheidsvaardighede en -kenmerke, en psigo-tegniese leervermoë. Swart en wit etnisiteitgroepe het ook beduidend verskil ten opsigte van hierdie konstrukte. Hoewel dit verdere verfyning verg, beloof die nuutontwikkelde PTLCS om inligting te verskaf wat nuttig sal wees vir die meting van tegniese en tegnologiese leervermoëns van ODeL-studente. Die studie lewer ’n oorspronklike bydrae tot volwasseleerteorie en ODeL-navorsing, en voeg waarde toe tot onderrigpraktyke wat fokus op fasilitering van die gradueerbaarheid en gevolglike indiensneembaarheid van studente in die digitale werksera.

SLEUTELTERME

akademiese motivering, volwasseleerteorie, digitale era, gradueerbaarheidsvaardighede en-kenmerke, oop-afstand- en aanlyn leer, psigo-tegnologiese-leervermoëns-skaal, selfgerigte leeroriëntering, suksesoriëntering, tegnologiese vaardighede, tegniese selfdoeltreffendheid.

NGAMAFUPHI/KAFUSHANE

UKUTHUTHUKISWA KANYE NOKUQINISEKISWA KWESU LOKUHLOLA AMAKHONO OKUFUNDA OKUSEBENZISA INGQONDO KWEZETHEKINOLOJI KUBAFUNDI ABANGAPHANSI KOHLELO OLUVULEKILE LOKUFUNDA UKUDE KANYE NOKUFUNDA NGE-INTHANETHI (*DEVELOPMENT AND VALIDATION OF A MEASURE FOR ASSESSING THE PSYCHO- TECHNOLOGICAL LEARNING CAPABILITIES OF OPEN AND DISTANCE ONLINE LEARNERS)*

Ibhalwe ngu

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UMELULEKI: Prof M Coetzee

UMNYANGO: Industrial and Organisational Psychology

IZIQU: Doctor of Philosophy in Psychology (Industrial and Organisational Psychology)

Ucwaningo belugxile phezu kokuthuthukiswa Kanye nokuqinisekiswa kwesilinganiso esibizwa nge-*Psycho-Technological Learning Capabilities Scale (PTLCS)* ukulinganisa amakhono obuchepheshe nobuthekinikhali obudingwa abafundi sohlelo oluvulekile lokufunda ukude nokufunda nge-inthanethi (*ODeL*) esizindeni semfundo ephakeme. Inhloso yonke yalolu cwaningo kwaye kuwukuqinisekisa izakhiwo ezahlukahlukene ezakha amakhono engqondo okusebenzisa ithekinoloji, wona ngamakhono okusebenzisa ikhomphyutha (achazwa njengamakhono obuchwepheshe bethekinoloji) kanye nokuzethemba ngekhono le-inthanethi (*relabelled as technical self-efficacy*), ukuze ube yisisetshenziswa esifanele nesethembekayo. Ucwaningo futhi luye lwahlola izinguqunguquko zobudlelwano obuphakathi kwamakhono okufunda abafundi okusebenzisa ithekinoloji, uhlelo lokufunda olulawulwa nguwe, izimpawu zebhayografi yabantu (enjengeminyaka, ubulili kanye nobuhlanga), kanye namakhono owatholayo kange namakhakhazela kwiziqu oziphothulayo. Isaveyi ebizwa nge-*quantitative cross-sectional survey* yenziwa ngohlelo lwesampuli yabafundi ebizwa nge-*random sample* (N = 378) okungabafundi ababebhalisele omojuli ababili abaphoqelelayo bonyaka wokuqala kwi-*industrial and organisational psychology* ezikweni lezefundo ye (*ODeL*) eliphakeme. Uhlelo lokuhlaziya (Exploratory factor analysis) kanye nohlelo lokuqinisekisa (*confirmatory factor analysis*) kunikeze ubufakazi bangaphakathi obungaguquki, obethembekayo kanye ne-*construct validity* yohlelo olusha olusanda kwakhiwa PTLCS. Uhlelo lwe-*Multigroup structural equivalence* lukhombise ukuthi isakhiwo somthelela (configural invariance) lwe PTLCS besifana ngokwamaqembu obulili

kanye namaqembu obuhlanga. Imiphumela iqhubeke nokukhombisa ukuthi izakhiwo ze-PTLCS (metric invariance) bezinencazelo efanayo ngokweminyaka, ubulili kanye namaqembu ezinhlanga zabantu. Uhlelo lwe-*Scalar invariance* (luchaza imehluko kwizakhiwo *latent construct*) aluzange lubonakale kumaqembu. Uhlelo lwe-*Multiple regression* lukhombise ukuthi ukuzethemba ngekhono lwethekinoloji, umsebenzi wemfundo, ugqozi kanye nempumelelo kukhombise ukubikezela kakhulu amazinga aphezulu wamakhono eziqu eziphothulwayo kanye namakhakhazela. Ucwaningo lwe-*Hierarchical moderated regression analysis* lukhombise ukuthi umthelela wokubikezela mayelana nekhono lokufunda ukusebenzisa ingqondo kwezethekinoloji phezu kwamakhono namagalelo zokuphothulwa kwezifundo kwakukhombisa kwencike phezu kwesimo ngokwamaphuzu alingene (*mean scores)* ezinhlanga zabamnyama nabamhlophe. Izinhlelo zokuhlola umehluko i-*mean differences* zikhombise ukuthi abadlalindima abesilisa bathole amaphuzu aphezulu ukwedlula abadlaindima abesifazane ngokwamakhono namagalelo, kanye nekhono lokufunda ukusebenzisa ithekinoloji. Amaqembu ezinhlanga zabamnyama nabamhlophe nazo zehluke kakhulu ngalezi zakhiwo. Yize, lokhu kufuna ukuthi kuhluzwe kabanzi, uhlelo olusha olwakhiwe lwe-PTLCS luthembise ukunikeza ulwazi oluzobaluleka ukulinganisa amakhono okufunda kwizinto ezithekinikhali kanye nasekusetshenzisweni kwengqondo kwithekinoloji kubafundi bohlelo lwe-*ODeL.* Ucwaningo lukhombisa igalelo langempela kwithiyori yokufunda kwabantu abadala (*adult learning theory)* kanye nocwaningo lwe-*ODeL*, futhi lukhulisa izinga lokubaluleka kwemisebenzi yokufundisa egxile ekuhleleni izinga lokuphothula izimfundo kanye nezinga lokuqhasheka kwabafundi esikhathini somhlaba sokusebenzisa idijithali.

AMAGAMA ASEMQOKA

Ukukhuthazeka kwezemfundo,ithiyori yokufunda komuntu omdala, isikhathi sedijithali, amakhono namagalelo okuphothula izimfundo, uhlelo lokufunda ukude Kanye nokufunda nge-inthanethi, isilinganiso sokulinganisa amakhono okusebenzisa ingqondo kwithekinoloji, imfundo ehlose ukuzilawula ngokwakho, okuhlose impumelelo, amakhono ethekinoloji, ukuzethemba kwezobuthekinikhali.

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CHAPTER 1: SCIENTIFIC OVERVIEW OF THE RESEARCH

This research focused on the development and validation of a scale to measure the psycho-technological learning capabilities required by students in the higher education (HE) distance and online learning environment. The current research involves the research setting of a single open and distance learning HE institution. The constructs relevant to this study are psycho-technological learning capabilities (computer skills and internet self-efficacy), adult self-directed learning orientation, and graduateness skills and attributes. The aim of this chapter is to provide a background to the study by alluding to the motivation for the current study, the problem statement and the research hypothesis. The paradigms and models underpinning the definitive empirical boundary of the study are presented, while the research design and methodological process are presented in support of the research. In conclusion, the chapter provides a layout of the chapters followed by a summary of the pertinent issues highlighted in the chapter.

1.1 BACKGROUND AND MOTIVATION FOR THE RESEARCH

The context of the research was the graduateness and subsequent employability of adult learners who pursue further studies in an open and distance e-learning (ODeL) higher education (HE) environment. The general aim of the research was to develop and validate a scale to measure the psycho-technological learning capabilities (as measured by the newly developed Psycho-Technological Learning Capabilities Scale (PTLCS)) of adult learners in their role as students as critical aspects of their graduateness and employability. Essentially, the research examined the technical and psychological (computer skills and internet self-efficacy as measured by the newly developed PTLCS) and the self-directed learning capabilities of adult learners, as measured by the Adult Learners Self Directed Scale (ALSDS) in relation to their graduateness, as measured by the Graduateness Skills and Attributes Scale (GSAS) in the South African higher education and ODeL environment.

The study constructs are highly relevant due to the shift from national to global markets and the structural transitions that have occurred within and around organisations, as seen in the 21st century (Daniels & Brooker, 2014), as well as the emergence of industry 4.0 (Mian et al., 2020; Peters & Romero, 2019). Scholars suggest that environmental changes, such as increased globalisation, rapid technological advancements, increased workforce diversity, and the expanding use of outsourcing and part-time and temporary employees, have altered traditional organisational structures, employer–employee relationships and the work context, resulting in individuals becoming proactive in managing their careers, which often involves pursuing further studies at ODeL institutions (Baruch, 2004; Halili et al., 2015; Hsia et al., 2014; Mian et al., 2020; Romero Martinez et al., 2020; Schreuder & Coetzee, 2016; Sinclair, 2009; Sullivan & Baruch, 2009).

Furthermore, with technological advancements on the increase, especially since the start of the Covid-19 pandemic in 2020, organisations have become “learning organisations” in that there is a convergence between the learning of the individual and that of the organisation (Botha, 2014; Mian et al., 2020). Lifelong learning involves the employee, as an adult learner, engaging in planned and/or unplanned learning and continued professional development to further their tertiary education in order to remain relevant in terms of theoretical knowledge and skills (Billet, 2010; Botha, 2014; Botha et al., 2015; Candy, 2000; Peters & Romero, 2019; Tchamyou, 2020; Walsh & Kotzee, 2010). With the rise in boundaryless organisations and careers, and the increase in technological advancements, the employee who engages in life-wide learning has becomes more relevant and employable. Employees not only develop their skills on a continuous basis (lifelong learning), but also acquire skills and knowledge across their professional and traditional theoretical boundaries, hence the rise in the importance of the graduateness and employability agenda in the contemporary world of work (Botha, 2014; Coetzee, 2014a; Ma & Bennett, 2021; Nyoni, 2014; Steur et al., 2012; Tchamyou, 2020; Washer, 2007).

Adult learners’ employability, as denoted by their graduateness, has become increasingly important as a result of “vocationalisation, mass education, marketisation and increased competition between universities”, both locally and abroad (Green et al., 2009; Ma & Bennett, 2021). Steur et al. (2012) describe the essence of graduateness as being closely related to the formative function of universities, in that both adult learners’ graduateness and universities themselves contribute to the personal and professional growth of students. Smith and Bauling (2013) suggest that the inherent power of education to improve the lives of others and uplift societies is universally accepted. Therefore, education offered at universities should ensure that the graduates produced become the most skilled and prepared citizens not only for their society but also for their professions. The demand for employable graduates, as denoted by their graduateness, forces universities to determine the unique characteristics, qualities and attributes that contribute to making their graduates (1) employable; (2) prepared for society and (3) unique from graduates from other universities (Metcalfe et al., 2020; Smith & Bauling, 2013).

As a consequence, the employability and graduateness agenda has resulted in universities not only focusing on the quality of their graduates but also on encompassing the needs of employers in the development of employable graduates. Although the formal degree qualification provides the body of knowledge that a graduate needs in specific fields of study, the qualities employers expect of graduates, as well as employer expectations, are dependent on the context within which the graduate will operate (Harvey & Knight, 1996; Metcalfe et al., 2020). Griesel and Parker (2009) and Metcalfe et al. (2020) confirm this and highlight that although employers value the conceptual foundation, knowledge and intellectual approach to teaching and learning at universities or HE institutions, there is a need to address the gaps between employer expectations and HE outcomes. Generally, employers expect graduates to display important non-discipline-specific transferable skills and attributes which are a combination of personal qualities, understandings and practices, and to possess the ability to reflect critically on experiences (Metcalfe et al., 2020; Mtebula, 2014; Stevenson & Clegg, 2011). The general employer expectations noted above culminate in benefits for employers when recruiting gradates. Such benefits include, ambition, flexibility, logical thinking, analysis, creativity, innovation, ability to learn quickly and independently, well-developed communication skills and specialist knowledge, as well as intelligence (De Jager, 2004; Ismail, 2017; Tomlinson & Anderson, 2020).

According to Smith and Bauling (2013), there are three properties underpinning graduateness, namely field-specific, shared and generic skills. *Field specific properties* prepare graduates for the theory requirements of their chosen degree programme and industry. However, this knowledge quickly becomes outdated and irrelevant due to the unstable and complex changing nature of work (Washer, 2007). Along with field-specific skills and knowledge, graduates should have more generally relevant and *shared skills* unique to their chosen profession. These would include, for instance, report writing, listening and research skills, and profession-specific language, to name just a few. However, field-specific and shared skills are insufficient in a volatile world of work that require students who are job-ready with the skills applicable to their jobs (Heang et al., 2019). Graduates are also expected to develop *generic skills* which are not unique to any field of study or discipline and which influence their employability. These skills are an outcome of a student going through the ordinary process of university education. Such generic skills include reflective thinking, scholarship, moral citizenship, a capacity for life-wide learning, cognitive skills, communication and interpersonal skills, self-motivation and the ability to work independently (Heang et al., 2019; Ismail, 2017). Coetzee (2014a) defines graduateness as the “transformation” in students seen through their intellectual development from first year students to graduates.

Coetzee (2014) further describes graduateness as referring to the quality of personal growth and the intellectual development of graduates produced by HE institutions and the relevance of the skills and attributes these graduates take to the workplace.

There are varying views on the classification of the domains of graduateness (Kreber, 2014; Smith & Bauling, 2013; Steur et al., 2012). Coetzee (2014a) provides a consolidated and detailed description of the graduateness domains, skills and attributes. Coetzee (2012a, 2014a) proposes four main domains, namely, reflective thinking, scholarship, moral citizenship and lifelong learning, as well as eight core skills, namely, problem-solving and decision-making skills; analytical thinking skills; enterprising skills; ethical and responsible behaviour; presenting and applying information; interactive skills; goal-directed behaviour; and a continuous learning orientation. The eight core skills conceptualised by Coetzee (2012a) are pertinent to this study. Coetzee (2012a) clusters the eight core skills under three attitudinal domains, namely scholarship, global and moral citizenship, and lifelong learning.

In addition to graduateness, the technological learning capabilities of ODeL students have received a lot of attention. From a review of the literature in the ODeL context, numerous studies have focused on the technological capabilities (computer and internet self-efficacy) of students (İşman & Çelikli, 2009; Kuo et al., 2014; Liebenberg et al., 2012; Otter et al., 2013; Seymour & Fourie, 2004) with very few linking these with students graduateness skills and attributes (Coetzee, 2012a, 2012b, 2014a; Smith & Bauling, 2013; Steur et al., 2012; Washer, 2007) and employability (Botha, 2014).The current study focuses on the development of a scale that will measure adult learners' psychological and technological learning capabilities (computer and internet self-efficacy) (as measured by the PTLCS) in relation to their self-directed learning orientation (as measured by the ALSDS) and subsequent employability. The newly developed PTLCS can be used by students, academics and training providers to assess adult learners' psychological and technological capability to pursue HE in an ODeL environment, with the aim of successfully completing their studies and increasing their key employability skills as underpinned by their graduateness skills and attributes.

The focus on psychological and technological learning capabilities is highly relevant owing to the emergence of Industry 4.0, also known as the Fourth Industrial Revolution (4IR) (Mian et al., 2020) and the rise in the utilisation of virtual learning environments (Moncada et al., 2020; Sagnier et al., 2020). Notably, the rapid technological advancement in workplaces and globalisation has resulted in an increase in knowledge workers (Briscoe et al., 2006; Donnelly, 2009; Jarrahi & Thomson, 2017; Powell & Snellman, 2004). Technological advancements have also resulted in adult learners who prefer to engage in further learning (Botha, 2014; Coetzee, 2014b) via online technology modes such a computers, mobile phones, tablets and other gadgets that allow for online learning to occur (Kuo et al., 2013; Mian et al., 2020; Nyoni, 2014). Pivotal to the current study is the increased use of computers and the internet in education. Hsia et al. (2014) further emphasise how e-learning systems encompass a broad set of applications and processes for computer-based learning, online learning, virtual classrooms and digital collaboration. In support of Hsia et al. (2014), Firat and Yuzer (2016) confirm that computers began being used in education over 25 years ago and that computers and improved e-learning tools and platforms like Dropbox, presentation software such as Prezi, and office packages such as Microsoft Office, Adobe Connect, Blackboard, WebCT, and Moodle have resulted in increased e-learning opportunities being offered by universities to adult and online learners (Firat & Yuzer, 2016). The development of a scale that not only combines computer and internet self-efficacy, but also sensitises adult learners to the basic technical skills required in ODeL is very important. Studies have been conducted in South Africa to assess the computer skills of online learners (Nyoni, 2014; Prinsloo & Van Rooyen, 2007) however, these studies have neither been based on the self-efficacy beliefs of adult learners nor have they combined both computer and internet self-efficacy instruments.

The use of the internet for educational purposes has been adopted by many colleges, schools and universities around the world, resulting in the internet becoming an essential platform for delivering education (Firat & Yuzer, 2016; Gong et al., 2014; Madu et al., 2011; Otter et al., 2013). Essentially, online and distance education allows a university to reach as many adult learners as possible, providing an opportunity for these students to complete a university qualification without attending classes (Otter et al., 2013). Information and communication technology (ICT) provides a means of overcoming traditional barriers to education as experienced in face-to-face learning environments. Mbatha and Naidoo (2010) confirm that the internet provides opportunities for developing distance teaching, with private training providers and university lecturers delivering an entire programme through this medium. Mbatha and Naidoo (2010) further suggest that the unlimited access to information and global communication offered by ICT gives life-wide learning a new dimension. As a result of this unlimited access to information and to new developments in all fields of knowledge, students have an opportunity to control and direct their own learning while renewing and updating their skills (Mbatha & Naidoo, 2010; Nyoni, 2014). This means that students benefit from online learning in that they develop skills in self-directedness (Kim et al.,

2013) which are essential to their graduateness and continued employability. The use of the internet in education therefore increases opportunities to access education, as well as flexibility in education and training, by overcoming the restrictions imposed by time, geographical location and socioeconomic factors (Müller et al., 2010; Smothers et al., 2020).

The research setting relevant to the present study is an ODeL HE institution which is the fifth largest university in the world (Müller et al., 2010). The research institution is one of the mega universities in the world (Letseka, 2021; Liebenberg et al., 2012), with over 300 000 students (Letseka, 2021) and is the largest dedicated ODeL university in South Africa (Pityana, 2009) and the continent of Africa (Letseka, 2021). The mega university realised an enrolment figure of over 376 000 students for formal qualifications in 2021 (UNISA HEDA dashboard, 2021). As with all South African HE Institutions, the research institution under study is plagued by high dropout rates and low success rates. Poor success rates not only have an impact on the institutional reputation but also on the HE funding formula and the subsequent employability and graduateness of students (Davis & Venter, 2011; Shikulo & Lekhetho, 2020). According to Kim et al. (2013), the following may explain why student academic performance is low in ODeL institutions: a lack of motivation, self-discipline, initiative and cognitive strategies, as well as time-management and organisational skills. Other explanations that have received growing interest, specifically in the context of HE, are self-directed learning (Kim et al., 2013; Song & Hill, 2007; Valencia-Vallejo et al., 2019), self-management (Kuo et al., 2014; Rabin et al., 2020) and internet self-efficacy (Keshavarz, 2020; Kuo et al., 2014; Lin et al., 2020; Madu et al., 2011).

In the context of ODeL, it is imperative to explore students' access to skills and their confidence in using a computer and the internet, referred to as computer and intent self-efficacy in this study. Students' self-efficacy in using computers and the internet to successfully complete their studies is important, especially in an ODeL context. Self-efficacy refers to the belief that a student has in his or her own capabilities to implement and organise the course of action necessary to achieve a particular goal (İşman & Çelikli, 2009; Jeong et al., 2019; Rabin et al., 2020). Self-efficacy is underpinned by the well-known social cognitive learning theory conceptualised by Albert Bandura (1982). Bandura (1982) suggested that a person's behaviour is the outcome of the process of interaction between the person, the environment and the behaviour itself (Bandura, 1982). The psycho-technological capabilities of interest in the current study refer to adult learners' beliefs in using a computer and the internet to explore further studies within an ODeL environment. Computer self-efficacy and internet self-efficacy are deemed relevant to the current study, as the study is positioned to assess adult learners' skills in using both a computer and the internet for their online studies.

Computer self-efficacy is the belief that one has in one's capability to perform a specific task using a computer, while *internet self-efficacy* refers to an individual's confidence in their ability to perform certain internet-related tasks (Keshavarz, 2020; Kuo et al., 2014; Porter & Donthu, 2006). These two attributes involve the capability to organise and execute internet-related actions to accomplish online tasks and/or assignments (Eastin & LaRose, 2000). The more a student cannot efficiently use or benefit from a computer, the more he or she will find the use of a computer to be an extra task (İşman & Çelikli, 2009; Thongsri et al., 2020; Vimalkumar et al., 2021). Students' internet self-efficacy and beliefs about online learning are therefore critical determinants of students' attitudes towards online learning (Kuo et al., 2020; Madu et al., 2011; Porter & Donthu, 2006). Internet self-efficacy is positively related to previous internet experience and internet use, but negatively related to internet stress (Eastin & LaRose, 2000; Kuo et al., 2020). People with positive attitudes toward technologies are likely to have higher internet self-efficacy compared to those with negative attitudes toward technologies. Positive attitudes towards technologies and self-directed learning not only increase self-efficacy but result in higher success rates for students and a continued commitment to their graduateness and employability (Eastin & LaRose, 2000; Valencia-Vallejo et al., 2019).

Studies that have been conducted to explain the poor performance of students in ODeL institutions have used the Technology Acceptance Model (TAM) (Francom et al., 2021; Lee et al., 2003), in an attempt to explain why students may not interact as much with the online platform as compared to traditional face-to-face tuition (Kuo et al., 2014; Otter et al., 2013). Notably, there has been a shift in focus to consider online technology capabilities, self-efficacy (computer and internet) and self-management skills (Francom et al., 2021; Kuo et al., 2014, 2020; Liebenberg et al., 2012). In their study, Liebenberg et al. (2012) concluded that students at the higher education institution (HEI) relevant to the current study are not proficient in using ICT. Thongsri et al. (2020) reported that computer self-efficacy highly influenced students' acceptance of technology. In their study, Thongsri et al. (2020) found that the greater the beliefs learners have that they are competent in using computers to help them with the learning process, the more likely they are to accept online learning or e-learning. İşman and Çelikli (2009) argue that projects and assignments, at university level, require further research on the academic content of the assignments or projects, hence a computer has to be used to do literature searches. In addition, students need to use a computer to type up their project or assignment. Therefore, adult learners, in their capacity as students, need basic technology skills or literacy in order to complete university assignments. These skills include, for instance, knowing how to work on a computer, being able to download material from the internet, being able to search for literature on the internet and being able to hold group discussions using software packages like Blackboard, SharePoint etc, to name just a few (Goh & Wen, 2021; Seymour & Fourie, 2004).

İşman and Çelikli (2009) conducted a study amongst education students at the Eastern Mediterranean University (EMU). The aim of the study was to ascertain the self-efficacy of students to use computers. The researchers (İşman & Çelikli, 2009) found that many students at the EMU had poor computer abilities, regardless of the fact that all departments offered computer courses, mostly in students' first years of study. Most of the students who participated in the research indicated that they had difficulties preparing presentations and typing up their assignments and projects efficiently using a computer. İşman and Çelikli (2009) conclude that students have problems with their computer self-efficacy because they spend too much time on acquiring content or field-specific knowledge and spend much less time and effort on developing their computer skills (computer self-efficacy). This, inevitably, leads to most students lacking personal agency in their computer usage knowledge and poor ability to use a computer as a tool for their assignments and online learning.

In a study conducted by Geduld (2013), participants' responses alluded to personal agency (self-efficacy) in the choices they made over how, when, where and with whom they study. The findings indicated that most adult learners have the ability and means to organise and manage a suitable learning environment. The study results further highlighted students' autonomy in relation to when they study. The study found that students have the ability to choose a suitable time to study that does not clash with their family and work responsibilities. In most cases, the suitable study time would be at awkward times; however, the students made the sacrifices in order to succeed. The findings reported by Geduld (2013) are consistent with the notion of adult learning in ODeL institutions. Adult learning describes formal and informal learning undertaken by an adult after they have left their initial education and training for various reasons, including professional and/or private purposes (Muñoz et al., 2013). Adult learners have different challenges compared to traditional (younger) learners. These challenges include time constraints; differing expectations and ambitions; family responsibilities; and the influence of previous experiences. All these play a role in directing the learning of adult learners for career-related or personal goals (Muñoz et al., 2013).

With the many roles that adult learners have to fulfil in their daily lives, aspects of self-management, management of others and tasks are essential in order to balance the demands of each role. These principles of self-management in an individual's daily life conform to those proposed by Bennett et al. (1999) in their conceptualisation of self-directedness.

Self-directed learning refers to any form of learning where the student is primarily responsible for the planning, implementation and evaluation of his or her own learning (De Bruin, 2007; Hiemstra, 1993; Lee et al., 2020). De Bruin (2007) further explains that self-directedness is the tendency of individuals to take responsibility for their own learning to achieve quality learning. Briede and Popova (2020) and Ghost Bear (2012) contextualise self-directed learning in that this concept applies to learning events in the information age (Ghost Bear, 2012) and has become significant in HE as people must learn to adapt flexibly to the volatile labour market conditions in the 4IR (Briede & Popova, 2020). With the increase in adult learners participating in online tuition, Ghost Bear (2012) suggests that these learners use a variety of skills and strategies to seize the opportunity for furthering their studies. Essentially, self-directed learning has become an area of interest, specifically with the increase in adult learners entering the education system (Briede & Popova, 2020; Knowles, 1990; Long, 1992). Wichadee (2011) concurs with these assertions and further suggests that self-directed learning will be seen more in HEIs than in primary and secondary education because university students have the freedom to choose their subjects and study time.

Sato et al. (2017) and Wang et al. (2008) suggest that students in ODeL institutions need to manage their learning, hence they are expected to be self-directed and to monitor their own thinking and actions. This suggestion is in agreement with Zimmerman (2002) who proposed that learning motivation, learning strategy, self-efficacy and attribution for success and failure are important psychological variables in online learning. Wichadee (2011) posits that self-directed learning is beneficial for students in that it creates awareness of their needs with regard to their learning and they are able to continue with their studies without being controlled by others. Sato et al. (2017) and Wang et al. (2008) therefore emphasise the importance of helping learners to develop self-directed learning in a distance learning environment, specifically the adult learner. Being a mature individual in the learning environment, the adult learner tends to be more independent; however, this transformation process from being a dependent to an independent learner takes place at a different pace for adults with different lifestyles.

When addressing the diverse learning needs of students in an online context, adult learners need to understand the psycho-technological learning capabilities (computer and internet self-efficacy) and self-directed learning orientation they require in order to successfully complete their studies and increase their levels graduateness and employability. Simpson (2013) proposes that the low success rate at ODeL institutions may be attributed to these institutions focusing more on teaching and learning, instead of enhancing students' motivation to learn. Access to a computer and the internet alone does not lead to effective usage. ODeL institutions need to focus their learner support on developing and enhancing the technology proficiency and self-directed learning of students in an ODeL environment (Iiyambo & Geduld, 2019; Liebenberg et al., 2012; Simpson, 2013). Students therefore need to develop the psycho-technological learning capabilities (computer and internet self-efficacy) and self-directed learning orientation required for online study so as to understand and develop the graduateness skills and competencies required for the world of work.

Considering the diverse composition of the student population within any ODeL environment, the current study explored the influence of psycho-technological learning capabilities (computer and internet self-efficacy and self-directed learning orientation) on graduateness skills and attributes. Of pertinence to the students in an ODeL environment is the role socio-biographical characteristics play, namely age, gender, and ethnicity, in this relationship.

Numerous studies have been conducted to establish differences in gender with regard to psycho-technological learning capabilities. In an internet-based learning environment, Lee (2002) found that male learners showed more positive change in behaviour and higher motivation for learning compared to female students. A study by Halili et al. (2015), investigating three modes of delivering video technology sessions (live, streaming and recording) in relation to gender, found contrary findings overall, however, with female students recording a higher mean than male students based on a comparison of the use of delivery mode. Fischer (1992) and Dimmick et al. (1994) maintain that the differences with respect to gender can also lead to differences in the use of technology between males and females in their learning processes.

Hong et al. (2011) conducted a study among faculty members to ascertain whether students both with and without disabilities need to develop self-determination and self-directed learning. The results of the study indicate that all students, especially first-year students, benefit more from developing self-regulation skills and self-directed learning. The authors conclude that programmes promoting self-directed learning should be viewed as an integral part of a student's education as a whole in preparing students for a productive life.

Porter and Donthu (2006) discuss how age, education, income and race influence beliefs about the internet. Their study, underpinned by the main assumptions of the TAM, proposed that attitudes toward internet use are differentially relevant to consumers with different demographic profiles. The study found that older and less educated consumers had a lower perceived ease in using the internet; while lower income earners and blacks/Hispanics perceived the internet to be more expensive. These findings are confirmed in the study conducted by Coetzee (2012b), where Indian female participants had significantly more positive views about their graduateness skills and attributes compared to other race groups and Africans reported lower scores on the graduateness skills and attributes generally.

Coetzee's (2012b) study sought to explore whether students' graduateness skills and attributes significantly influence their job satisfaction and optimism about their future career prospects. The study further established whether socio-biographical variables, specifically race and gender, differ significantly regarding graduateness skills and attributes, job satisfaction and optimism of the research participants. The findings of this study were found to be of paramount importance to the current study, as the context is similar in terms of ODeL, and both studies have similarities in terms of the question being investigated. Coetzee's (2012b) study found that female participants had a significantly more positive view about their graduateness skills and attributes but had significantly more negative views about their future career prospects as compared to the male participants. These findings may, in some way, confirm those reported by Lee (2002) in that male learners showed a more positive change in behaviour and higher motivation for learning than female students. As much as female students may have an overall positive view of their graduateness skills and attributes, when it comes to the motivational aspects of future career prospects or changes in behaviour and circumstance, female participants have low motivation.

As highlighted above, studies have found that socio-biographical variables influence participants' views on their self-efficacy to use a computer and the internet, their self-directed learning strategies and overall graduateness skills and attributes (Coetzee, 2010, 2012a, 2012b, 2014a; İşman & Çelikli, 2009; Kuo et al., 2014; Lee, 2002; Liebenberg et al., 2012; Otter et al., 2013; Seymour & Fourie, 2004; Simpson, 2013). The studies highlighted here have reported significant differences between age (Wang et al., 2008), gender (Coetzee, 2012b; Halili et al., 2015), race

(Coetzee, 2012b), disability (Hong et al., 2011), educational level (Porter & Donthu, 2006) and income earning groups (Porter & Donthu, 2006).

From the review of literature, it is evident that a lot of work has been done on the technological learning capabilities and self-directed learning capabilities of ODeL students in relation to their graduateness. However, there is a paucity of research exploring the psycho-technological learning capabilities of adult learners, namely computer and internet self-efficacy, in relation to their self-directed learning orientation and student graduateness. In addition, within the South African context, there is no existing valid and reliable instrument to measure the psycho-technological learning capabilities (computer and internet self-efficacy) of adult learners, as ODeL students, in relation to their self-directed learning orientation and graduateness. Existing measures that might apply include self-efficacy for self-regulated learning (Zimmerman et al., 1992); the Motivated Strategies for Learning Questionnaire (MSLQ) which measures academic self-efficacy (Pintrich, 1991); and the Computer Self-efficacy Scale (Murphy et al., 1989). However, the self-efficacy scale has limitations in that the instrument has just three items and the terminology in terms of computer language is outdated (Joo et al., 2000).

Teo et al. (2010), in an attempt to measure self-directed learning with technology, developed an instrument specifically for young students at primary and high schools. Demir and Yurdugül (2013) translated and validated the instrument for use amongst 1051 Turkish primary and high school learners. Most of the instruments that assess online learning are underpinned by the TAM, whereas the newly developed PTLCS is underpinned by social cognitive theory, conceptualised by Bandura (1977) and developed for adult learners for the multicultural populace of South Africa. Investigating the relationship between these constructs will assist in developing and validating a measure that students, academics and training providers can use to assess the computer and internet self-efficacy of adult learners pursuing further studies within ODeL environments in the multicultural South African context.

Flowing from the background presented above, the following central hypothesis is formulated:

The theoretical elements of psycho-technological learning capabilities (computer skills and internet self-efficacy) can be operationalised into a reliable and valid scale that can be used to assess whether a relationship exists between psycho-technological learning capabilities, socio-biographic characteristics (age, gender and ethnicity), self-directed learning orientation and graduateness skills and attributes. Furthermore, individuals with different socio-biographic characteristics (age, gender and ethnicity) differ significantly regarding their psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation, and graduateness skills and attributes.

1.2 PROBLEM STATEMENT

The context of the current research is the psycho-technological learning capabilities, self-directed learning orientation and graduateness skills and attributes of first-year students in an ODeL environment. Studies have focused on how online students experience online tuition (Madu et al., 2011) and the success and attrition rates of students in distance education (Davis & Venter, 2011; Kim et al., 2013; Müller et al., 2010; Risenga, 2010), with very few exploring students' skills to interface with online platforms (James, 2014; Liebenberg et al., 2012; Otter et al., 2013) in relation to their self-directedness and graduateness.

Pertinent to this research is the psycho-technological learning capabilities (self-perceived computer skills and internet self-efficacy) of first-year students attempting two of the introductory modules in the Department of Industrial and Organisational (IO) Psychology, namely Psychology in the work context (IOP1501) and Personality in the work context (IOP1601), at the research institution pertinent to the current study. The modules adopt a blended approach to online learning in that students receive their study material both online and via the postal services. Notably, most of the learner support is offered via the online learning platform in the form of key concepts and online self-assessments for each chapter of the textbook, as well as a mock examination and extensive discussion on forum topics during the course of the semester. However, the success rate of students is very low and they do not seem able to make meaning of what they are studying in the modules in relation to their overall degree programme and subsequent graduateness and employability skills. Cohen and Singh (2020) suggest that to improve the learning and ultimate success of learners, academics must get feedback from students on their learning experience and meaning-making. In 2013, an "Improvement Plan" in response to key observations and recommendations" report was drafted in response to the high attrition rate of the above-mentioned modules. During 2014–2016, a module development plan was implemented in an attempt to improve the success rate in view of the recorded examination pass rates in the following exam sessions: 56% (May/June 2011); 50% (October/November 2011) and 32% (May/June 2012).

The low student success rate for the two modules (IOP1501 and IOP1601) confirms the concerns about the high attrition rates of students (between 10 and 30%) and low student success rates (Cohen & Singh, 2020; Kim et al., 2013; Shikulo & Lekhetho, 2020) in ODeL institutions compared to the traditional HEIs with face-to-face lecturer–student interaction. Student success is one of the many strategic priorities of HEIs (Davis & Venter, 2011) and the widespread poor academic performance of students in ODeL institutions is worrying (Risenga, 2010; Shikulo & Lekhetho, 2020). Researchers suggest that if learners engage in autonomous learning (Seke Mboungu Mouyabi, 2010) and have a self-directed learning orientation (Botha, 2014; Coetzee, 2014b; Kuo et al., 2020), they actively take responsibility for their learning, resulting in the acquisition of the study skills, interests and self-assurance paramount to their success (Botha, 2014; Coetzee, 2014b; Kuo et al., 2020)

Jaggars (2014) and Shikulo and Lekhetho (2020) propose that students may be dissuaded from studying online for various reasons, for example if they or a peer has had a negative experience with an online course. Shikulo and Lekhetho (2020) also add that the higher dropout rate and lower success rates of students in ODeL institutions can be attributed to the many roles that adult learners have to juggle, such as responsibilities in the family, at work and in the community. Negative experiences may arise from technical problems possibly associated with a student's ease in using technology (İşman & Çelikli, 2009; Jaggars, 2014; Romero Martinez et al., 2020); a reduced sense of instructor and peer presence (Bambara et al., 2009); or difficulties with time management and the self-directed learning skills required (Bork & Rucks-Ahidiana, 2013). De Bruin (2007) argues that research on self-directed learning in HE contexts has focused on, for example, socio-biographical factors related to university students (Adenuga, 1991); educational achievement (Long, 1992) and learning style (McCauley & McClelland 2004); as well as a new direction pertaining to student feedback in online learning and self-directedness in learning processes (Cohen & Singh, 2020).

Reflecting on Jaggars' (2014) assertions and the concerns raised by Kim et al. (2013), Davis and Venter (2011), Risenga (2010), Seke Mboungu Mouyabi (2010) and Shikulo and Lekhetho (2020) about the low throughput rate of ODeL students, it is imperative to explore the way in which the psycho-technological learning capabilities (computer and internet self-efficacy as measured by the newly developed PTLCS) influence students' self-directedness and graduateness skills and attributes. Currently in South Africa, there is no instrument available to assess students' psycho-technological learning capabilities, specifically for online learning environments. Knowledge of the overall relationship between these constructs will allow the researcher to construct an overall psychological and technical learning instrument, specifically for adult learners who pursue studies in ODeL contexts. The learning capabilities measured by this instrument will allow the adult learner to assess their own online and life-wide learning capabilities in preparation for the contemporary world of work.

In view of the literature and the context, the following research problems are formulated:

- In the multicultural South African context, an instrument measuring the psycho-technological learning capabilities (computer skills and internet self-efficacy) of adult learners in ODeL environments is lacking.
- There is a paucity of studies that explore the combined link between the computer skills and internet self-efficacy, self-directed learning orientation and graduateness skills and attributes of online students in ODeL environment in a single study.
- Furthermore, there is a paucity of research regarding the way in which the psychological and technological capabilities of adult learners relate to their self-directed learning orientation, employability and graduateness. Developing a scale that assesses the psychological and technological capabilities, namely computer skills and internet self-efficacy, required in an ODeL environment (Kim et al., 2013) is imperative especially in the South African context.

Research that empirically investigates the relationship between psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation, and the graduateness skills and attributes of adult learners, may promote a better understanding of these concepts amongst industrial and organisational (IO) psychologists and human resource professionals in their role as trainers and academics involved in online learning design for adult learners in the HE environment. The findings of this research may assist HEIs by contributing positively to the graduateness and subsequent employability of adult learners in the contemporary world of work.

The problem statement leads to the formulation of the following general research question and subsequent research questions:

How can the various constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) be operationalised into a valid and reliable measure and what are the relationship dynamics between ODeL students' psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation, socio-biographical characteristics (i.e. age, gender, ethnicity), and their graduateness skills and attributes?

1.2.1 Research questions with regard to the literature review

In terms of the literature review, the specific questions were formulated:
Research question 1: How are employability, the graduateness of adult learners, the constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) and self-directed learning orientation conceptualised in the contemporary employment and ODeL contexts?

Research question 2: What are the theoretical relationship dynamics between psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness and how do socio-biographical characteristics (i.e. age, gender and ethnicity) influence these constructs?

Research question 3: What are the theoretical implications of the relationship between psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness for online learning and development practices that enable the graduateness of adult learners?

1.2.2 Research questions with regard to the empirical study

In terms of the empirical study, the following specific questions were formulated:

Research question 1: How can the constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) be operationalised into a valid and reliable measure?

Sub-question 1.1: What are the psychometric properties (internal consistency reliability and construct validity) of the newly developed Psycho-Technological Learning Capability Scale (PTLCS) constituting computer skills and internet self-efficacy?

Sub-question 1.2: What is the nature of the interrelationships between the subscale dimensions of the PTLCS?

Sub-question 1.3: Does the PTLCS have factorial equivalence (i.e. measurement invariance) for age, gender and ethnicity groups?

Research question 2: What is the nature, magnitude and direction of the relationship between psycho-technological learning capabilities (comprising computer skills and internet self-efficacy as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS), socio-biographical characteristics (age, gender and ethnicity) and graduateness skills and attributes (as measured by the GSAS)?

Research question 3: Do psycho-technological learning capabilities (comprising computer skills and internet self-efficacy as measured by the PTLCS) and self-directed learning orientation significantly predict graduateness skills and attributes?

Research question 4: Do socio-biographical characteristics, namely age, gender and ethnicity, significantly moderate the relationship between (1) psycho-technological learning capabilities, (2) self-directed learning orientation and graduateness skills and attributes?

Research question 5: Do students from different socio-biographical groups, namely age, gender and ethnicity, differ significantly regarding their psycho-technological learning capabilities, self-directed learning orientation, and graduateness skills and attributes?

Research question 6: What conclusions and recommendations can be formulated for future research, as well as for online learning and development practices that enable adult learners' graduateness?

1.3 AIMS OF THE RESEARCH

From the above research questions, the following aims were formulated:

1.3.1 General aims of the research

The general aim of this research is to operationalise the various constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy, as measured by the newly developed PTLCS) into a valid and reliable measure and to explore the relationship dynamics between ODeL students' psycho-technological learning capabilities, self-directed learning orientation, socio-biographical characteristics (i.e. age, gender and ethnicity) and their graduateness skills and attributes.

1.3.2 Specific aims of the research

The following specific aims were formulated for the literature review and empirical study:

1.3.2.1 Literature review

In terms of the literature review, the specific aims are as follows:
Research aim 1: To conceptualise the employability and graduateness of adult learners, the constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) and a self-directed learning orientation from a theoretical perspective.

Research aim 2: To conceptualise the theoretical relationship dynamics between psycho-technological learning capabilities (computer skills and internet self-efficacy), a self-directed learning orientation and graduateness, and how the socio-biographical characteristics (i.e. age, gender and ethnicity) influence these constructs.

Research aim 3: To conceptualise the theoretical implications of the relationship between psycho-technological learning capabilities, self-directed learning orientation and graduateness for online learning and development practices to enable adult learner graduateness and employability.

1.3.2.2 Empirical study

In terms of the empirical study, the specific aims are formulated:

Research aim 1: To operationalise the constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) into a valid and reliable measure.

Sub-aim 1.1: To assess the psychometric properties (internal consistency reliability and construct validity) of the newly developed Psycho-Technological Learning Capabilities Scale (PTLCS).

Sub-aim 1.2*:* To establish the nature of the interrelationships between the subscale dimensions (computer skills and internet self-efficacy) of the PTLCS.

Sub-aim 1.3**:** To establish the factorial equivalence (i.e. measurement invariance) of the PTLCS for the various socio-biographical groups, namely age, gender and ethnicity.

Research aim 2: To investigate the nature, magnitude and direction of the relationship between psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS), socio-biographical characteristics (age, gender and ethnicity) and graduateness skills and attributes (as measured by the GSAS).

Research aim 3: To assess whether psycho-technological learning capabilities (computer skills and internet self-efficacy) and a self-directed learning orientation significantly predict graduateness skills and attributes.

Research aim 4: To assess whether socio-biographical characteristics, namely age, gender and ethnicity, significantly moderate the relationship between (1) psycho-technological learning capabilities, (2) a self-directed learning orientation, and graduateness skills and attributes.

Research aim 5: To determine whether students from different socio-biographical groups, namely age, gender and ethnicity, differ significantly regarding their psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS) and graduateness skills and attributes (as measured by the GSAS).

Research aim 6: To formulate conclusions and recommendations for future research and online learning and development practices to enable adult learners' graduateness.

1.4 STATEMENT OF SIGNIFICANCE

Although the concepts of computer skills and internet self-efficacy, self-directed learning orientation and graduateness have been researched extensively, the studies either separated these variables or they were investigated in relation to other variables. Moreover, a measure of psycho-technological learning capabilities in the South African context does not currently exist. This research presents a starting point for exploring the relationship between computer skills and internet self-efficacy (as a set of psycho-technological learning capabilities), a self-directed learning orientation and graduateness skills and attributes, and how diverse groups of adult learners differ regarding these variables.

1.4.1 Potential contribution on a theoretical level

On a theoretical level, the contribution of this research is threefold. Firstly, the research identifies the theoretical elements of psycho-technological learning capabilities, namely computer skills and internet self-efficacy, in order to be able to construct a Psycho-Technological Learning Capabilities Scale (PTLCS). Secondly, this research identifies the theoretical relationship between psycho-technological learning capabilities and a self-directed learning orientation in relation to graduateness skills and attributes. Lastly, by exploring the way in which individual socio-biographical characteristics (i.e. age, gender, ethnicity) influence online learners' psycho-technological learning capabilities, self-directed learning orientation and graduateness skills and attributes, the research provides a better understanding of and more insight into adult learning theory, specifically in ODeL institutions in HE.

1.4.2 Potential contribution on an empirical level

On an empirical level, this research makes a valuable contribution by making recommendations based on empirically testing and operationalising the theoretical elements of psycho-technological learning capabilities (as measured by the newly developed PTLCS) into a reliable and valid measurement scale that can be used to assess the level, direction and magnitude of the statistical inter-relationship. The usefulness of these recommendations depends on the significance of the relationships that emerged between the variables in the current research.

Furthermore, the research took into account the cultural and generational diversity of the students in the HEI by empirically investigating whether individuals from different age, gender and ethnicity groups differ with regard to psycho-technological learning capabilities, self-directed learning orientation and graduateness skills and attributes. The research findings from the current study provide recommendations, as presented on chapter 7, to assist adult learners assess their psycho-technological learning capabilities and self-directed learning orientation with the aim of developing their graduateness and employability in the contemporary world of work. Additionally, the newly developed PTLCS may stimulate further research and add to knowledge creation specifically in ODeL environments.

1.4.3 Potential contribution on a practical level

On a practical level, this research study promotes a better understanding of the concepts of psycho-technological learning capabilities, self-directed learning orientation and graduateness skills and attributes as well as the relationship that exists between these concepts, for the field of Industrial and Organisational (IO) Psychology and specifically learning and development in the context of adult learning in distance and online learning environments. As such, the study contributes to learning design in the workplace and higher education environments and may eventually contribute to the success and employability of the adult learner.

The empirically tested and newly developed scale may be used for future research and will assist in providing support to students in the ODeL context at the HEI of relevant to this study. The findings of the current study also provide recommendations of how ODeL HEI’s can provide support to adult learners. The outcome of the research adds value to the existing and growing body of research on psycho-technological learning capabilities of online learners in the ODeL context and employability in the contemporary world of work.

1.5 THE RESEARCH MODEL

This research is underpinned by the seminal research model framework proposed by Mouton and Marais (1996). The model is informed by and based on five dimensions of social science research, namely, *sociological* (emphasises the importance of research as a collaborative activity); *ontological* (concerned with aspects of social reality, that is, the reality investigated in social science research); *teleological* (research is intentional and goal-directed aimed at understanding a phenomenon); *epistemological* (research seeks to understand a phenomenon and provide a valid and reliable understanding of reality) and *methodological* (emphasises the importance of research being regarded as objective because it is critical, balanced, unbiased, systematic and controlled).

The following section will provide the paradigmatic perspective of the research followed by the research model informing the current study.

1.6 PARADIGM PERSPECTIVE OF THE RESEARCH

The seminal works of Mouton and Marais (1996) and Maree (2009) describe a paradigm as a lens or viewpoint through which a researcher views the obvious and not so obvious principles of reality. Park et al. (2020) support this assertion and add that a paradigm guides scientific discoveries through assumptions and principles. Mouton and Marais (1996) assert that in the social sciences a paradigm includes accepted theories, models, body of research and the methodologies of a specific perspective. For the purpose of this research, the term "paradigm" is used to refer to the intellectual climate and its meta-theoretical values and beliefs that underpin the theories and models that inform the research (Mouton & Marais, 1996).

1.6.1 The intellectual climate

Thematically, the constructs of psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning and graduateness are relevant to this study. The literature review is presented in terms of a humanistic paradigm, and a social-cognitive paradigm, as outlined below:

1.6.1.1 Literature review

The following section provides the paradigms underpinning the literature review for the current study.

(a) The humanistic paradigm

The humanistic paradigm, as described by the seminal work of Meyer et al. (2008) and Morgan (1980), emphasises the importance of looking at an individual as an integrated whole (Meyer et al., 2008) and the role that an individual plays in actualising his or her own inherent potential. Essentially, people have the freedom and autonomy to make significant personal choices and they have the potential for creativity and growth (Hiemstra & Brockett, 1994). The basic assumptions of the humanistic perspective are as follows (Hiemstra & Brockett, 1994):

- Humans have free will and are basically good and any behaviour to the contrary can be attributed to environmental influences.
- People have the freedom and autonomy to make significant personal choices and they have the potential for creativity and growth.

The humanistic paradigm is relevant for this research as the assumption is that adult learners have the capacity and autonomy to decide whether they wish to develop their psycho-technological learning capabilities, self-directed learning orientation and graduateness skills and attributes to remain relevant and employable in the changing world of work.

(b) The social-cognitive paradigm

The social-cognitive and behaviourist theorists hold the same view in that personality and human behaviour are shaped by the influence and consequences of learning (Bergh & Geldenhuys, 2013; Tan, 2020). Contributors to this movement include Albert Bandura, Walter Mischel and Julian Rotter. The two main premises of this perspective are as follows:

- Behaviour can be as a result of other forms of learning, such as modelling.
- Human behaviour may be influenced by certain cognitive processes, for example expectations, values and motivation (Meyer et al., 2008).

Thematically, the social-cognitive paradigmatic perspective relates to psycho-technological learning capabilities, a self-directed learning orientation and graduateness skills and attributes. This theory is relevant to the current study because the behaviour and success of adult learners in an ODeL context is influenced by (1) their confidence to use both the computer and the internet,

(2) their orientation and responsibility to manage their studies, and (3) their commitment to developing the skills and attributes required in the world of work to make them employable.

1.6.1.2 The empirical study

The empirical research on scale development and the relationship between psycho-technological learning capabilities (computer skills and internet self-efficacy), a self-directed learning orientation and graduateness skills and attributes will be presented from perspective of a post-positivist research paradigm.

The post-positivist paradigm encapsulates the assumptions proposed by the positivist and constructionist paradigms. The main assumption behind this perspective is that reality is multiple, subjective and mentally constructed by individuals (Maree, 2009). Essentially, this paradigm aims to produce objective and generalisable knowledge about social patterns and seeks to affirm the presence of universal laws in relationships among predefined variables (Taylor & Medina, 2013). Maree (2009) asserts that by using a post-positivist perspective the researcher acknowledges that reality is not fixed and is, to a certain extent, created by the individuals involved in the research. To address concerns around the quality of the research in terms of objectivity, validity and reliability, the results will be compared and discussed in relation to the underpinning theories and model.

1.6.2 The market of intellectual resources

Mouton and Marais (1996) describe the market of intellectual resources as a collection of beliefs that has a direct bearing on the epistemic status of scientific statements. Theoretical beliefs about the nature and structure of phenomena, and methodological beliefs about the nature and structure of the research process, are the two main types of market of intellectual resources. For the purpose of this study the following are presented: the meta-theoretical statements and conceptual descriptions of psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning and graduateness, as well as the central hypothesis and the theoretical and methodological assumptions.

1.6.2.1 Meta-theoretical statements

Meta-theoretical statements are philosophical views that reflect the nature of the discipline and the research questions within a framework (Babbie & Mouton, 2009). Abrams and Hogg (2004) assert that these statements provide guidelines on how integration with theory can be achieved, as the researcher must adhere to the parameters as set by the theoretical framework and context. For the purpose of this study the discipline of Industrial and Organisational Psychology will be applicable.

Industrial and Organisational Psychology is the scientific study of people within a work context or environment (Coetzee et al., 2021). This discipline involves the application of psychological principles, theory and research to the work environment at the individual, group and organisational level (Bergh & Geldenhuys, 2013). Essentially, the overall goal of industrial and organisational psychologists is to establish, maintain and improve organisational functioning by understanding the interaction between people and their work environment from a psychological perspective (Bergh & Geldenhuys, 2013; Coetzee et al., 2021).

Empirically, the research is underpinned by models and theory in relation to the variables identified. Thematically, the underpinnings of industrial and organisational psychology apply to adult learning and the psychological learning capabilities and attributes needed to be successful in online learning contexts.

1.6.2.2 Conceptual descriptions

The following conceptual descriptions are relevant for this research:

(a) Psycho-technological learning capabilities

For the purpose of this study, psycho-technological learning capabilities encapsulate adult learners' computer skills and internet self-efficacy in an online environment. Pertinent to this study is the adult learner's belief that they have the psychological (self-efficacy) and technical capabilities to implement and organise the course of action necessary to achieve a particular goal (Bandura, 1978; İşman & Çelikli, 2009). This concept further differentiates between computer skills and internet self-efficacy, where c*omputer skills* describes the belief that one has the capability to perform a specific task using a computer, and *internet self-efficacy* refers to individuals' confidence in their ability to perform certain internet-related tasks (Kuo et al., 2014; Porter & Donthu, 2006). The underlying theory in the development of the PTLCS is human agency and social cognitive theory (Bandura, 1977). The psycho-technological learning capabilities were measured by the newly developed Psycho-Technological Learning Capabilities Scale (PTLCS) developed by the researcher for the purpose of the present study.

(b) Self-directed learning orientation

Self-directed learning orientation, for the purpose of this study, refers to one's ability, skill, preference or psychological predisposition to take and maintain control of one's own thinking and learning processes (Coetzee & Botha, 2013; Cohen & Singh, 2020; De Bruin, 2007; Ghost Bear, 2012; Hiemstra & Brockett, 1994; Knowles, 1990; Long, 1992). Essentially, a student exhibits personal agency in the form of *self-management* (the process of balancing lecturer and student control), *self-monitoring* (cognitive responsibility) and *motivation* (commitment to learning goals) (Andradea & Bunker, 2009; Cohen & Singh, 2020). Self-directed learning orientation is underpinned by the theory of andragogy, as postulated by Knowles (1975, 1990). This theory was deemed relevant as the sample for this study comprised adult learners who are required to use self-management skills in their studies (student driven approach), as opposed to the traditional pedagogical (teacher-driven) perspective. The current study incorporates Knowles' (1975, 1990) theory of andragogy with the model developed by Botha (2013) on self-directed learning in open distance learning settings. Self-directed learning orientation were measured by the Adult Learners self-directedness Scale (ALSDS) developed by Botha (2014). The ALSDS consists of four subscales and 35 items. The subscales include: (1) The strategic utilisation of officially provided resources, (2) Engaged academic activity, (3) Success orientation for open distance learning, and (4) Academically motivated behaviour (Botha, 2014).

(c) Graduateness skills and attributes

Graduateness, for the purpose of this study, implies a set of generic transferable meta-skills and personal attributes which are separate from the knowledge and technical skills acquired from a formal qualification (Coetzee, 2012a, 2012b; Smith & Bauling, 2013). Essentially, the education offered at universities should ensure that the graduates are skilled and prepared citizens not only for their society but also for their professions. Coetzee (2012a, 2012b) further postulates that graduateness skills and attributes are generally regarded as an indicator of students' work readiness, job satisfaction, optimism about future career prospects and subsequent employability. Models to explain graduateness, focusing on young adults, have been proposed by Bennett et al. (1999), Yorke and Knight (2006), Barrie (2006) and Steur et al. (2012). Coetzee (2012a, 2012b, 2014) provides a framework for the development of graduateness skills and attributes specifically for adult learners in an ODeL context. For the purposes of this study, the model proposed by Coetzee (2012a, 2012b, 2014) and the Graduateness Skills and Attributes Scale (GSAS) were used to measure individuals' sense of internal graduateness. The GSAS contains 64 items and eight subscales, measuring (1) interactive skills; (2) problem-solving and decision-making skills; (3) continuous learning orientation; (4) enterprising skills; (5) skills in presenting and applying information; (6) goal-directed behaviour; (7) ethical and responsible behaviour; and (8) analytical thinking skills (Coetzee, 2012a, 2012b, 2014).

1.6.2.3 Central hypothesis

The central hypothesis of the research is formulated as follows:

The theoretical elements of psycho-technological learning capabilities (computer skills and internet self-efficacy) can be operationalised into a reliable and valid scale that can be used to assess whether a relationship exists between psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation, socio-biographical characteristics (age, gender, and ethnicity) and graduateness skills and attributes. Furthermore, individuals with different socio-biographical characteristics (age, gender and ethnicity) differ significantly regarding their psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness skills and attributes.

1.6.2.4 Theoretical assumptions

Based on the literature review, the following theoretical assumptions are addressed in this research. There is a need to

- develop a scale to measure the psycho-technological learning capabilities (computer skills and internet self-efficacy) of adult learners in the ODeL context within South Africa

- clarify, from a theoretical perspective, the relationship between psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and socio-biographical characteristics (age, gender, and ethnicity) and adult learners' graduateness skills and attributes, and subsequent employability, and to explain this relationship in terms of an integrated model.

- understand how socio-biographical factors (age, gender and ethnicity) may modify the relationship between adult learners' psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and their graduateness skills and attributes.

- gain insight into how adult learners' psycho-technological learning capabilities and self-directed learning orientation may influence the graduateness skills and attributes of adult learners, as well as employability in the changing world of work.

- make recommendations, from a theoretical perspective, pertaining to the relationship between psycho-technological learning capabilities, self-directed learning orientation and graduateness skills and attributes in an ODeL environment.

1.6.2.5 Methodological assumptions

Methodological beliefs are guiding assumptions pertaining to the nature of social science and scientific research. Such beliefs describe methodological preferences, assumptions and presuppositions around methodologically sound and ethical research (Mouton & Marais, 1996). The methodological convictions that are applicable to this research are described below.

(a) Sociological dimension

According to Mouton and Marais (1996), the sociological dimension emphasises the importance of research as a collaborative activity. The social nature of research is viewed as a typical human activity, highlighting the coexistence of networks or research communities, mechanisms of social control in social research, ethical concerns in research, and the influence of ideologies and interests. In this research, human activity will be measured using quantitative methods in the form of an empirical instrument validated for use in the South African context. The analysis of the variables and concepts relevant to this study will be described in Chapters 5 (empirical research) and 6 (research results) respectively.

(b) Ontological dimension

This dimension is concerned with aspects of social reality, that is, the reality which is being investigated in social science research. Mouton and Marais (1996) explain the research domain as including human activities, characteristics, institutions, behaviour and products, to mention just a few examples. This diverse view allows for different perspectives on the nature of the research domain and, very often, a substantive degree of overlap exists between the various theoretical orientations, models and methodologies (Mouton & Marais, 1996). In support of this research domain, the current study will focus on the development of a scale to measure psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning, and the graduateness of adult learners within an online learning context.

(c) Teleological/Ideological dimension

This dimension suggests that research, as a human activity, is intentional and goal-directed and is aimed at understanding phenomena, as described by the ideology of research in the social sciences. Theoretical goals are exploratory, descriptive or explanatory and are directed at understanding human behaviour to gain insight into social reality (Mouton & Marais, 1996). The theoretical goal of this research is to provide a better understanding of psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness by examining the relationship between these constructs and subsequently contributing to existing knowledge in the field of Industrial and Organisational Psychology. The practical goal of this study is to provide valuable information that will highlight the psycho-technological learning capabilities (computer skills and internet self-efficacy) and self-directedness that adult learners need in an online environment and to improve their graduateness and employability in the changing world of work.

(d) Epistemological dimension

Mouton and Marais (1996) state that the assumption behind this dimension is that research is conducted not only to understand the phenomena but also to provide a valid and reliable understanding of the reality. In line with this dimension, the current study will produce valid and reliable results by using an empirically sound research design, as discussed in section 1.7 below.

(e) Methodological dimension

This dimension emphasises the importance of research being regarded as objective due to its critical, balanced, unbiased, systematic and controlled nature (Mouton & Marais, 1996). The present study will conduct quantitative research and, to ensure that the study is objective, questionnaires will be used to collect data.

1.7 RESEARCH DESIGN

A research design refers to the process involved in thinking about and conducting research (McGregor, 2019). As such, a research design provides a framework for the research which lays out the plan according to which data will be collected and analysed to achieve the research purpose (Daniel, 2012; McGregor, 2019). The types of research design considered most appropriate for the current study will now be presented, followed by a discussion on aspects related to validity and reliability.

The current study followed a cross-sectional quantitative research design, where the aim generally was to collect quantifiable data on predetermined variables, namely the independent and the dependent variables, on one or more cases at a single point in time in order to quantify a relationship in a population (Bryman & Bell, 2014). Spector (2019) argues that cross-sectional research design provides evidence to answer the research question, as well as statistical evidence to rule out alternative explanations. Spector (2019) further asserts that cross-sectional research designs are affordable to use, are less time-consuming for both the researcher and the participants and can adequately address many research questions. However, some of the limitations of cross-sectional designs is that they do not adequately test many hypotheses and the approach cannot provide evidence of the causality between variables that goes beyond the current investigation (Spector, 2019). In line with the arguments of Spector (2019), cross-sectional research was deemed appropriate and relevant because of the unknown associations between the newly developed scale (the PTLCS), and the self-directed learning orientation and graduateness of ODeL students.

The purpose of the research design relevant to the present research was to solve the research problem by developing a strategy for operationalising the psycho-technological learning capability constructs (computer skills and internet self-efficacy) into a valid and reliable measurement scale. This was achieved by developing a strategy for obtaining empirical data that would answer the research questions and hypotheses underpinning this study. For this purpose, age, gender and ethnicity were used as control variables and efforts were made to ensure the internal and external validity of the research design.

The following section provides an overview of the types of research that were deemed appropriate and applied to the current study.

1.7.1 Exploratory research

According to Daniel (2012) and McGregor (2019), exploratory studies aim to explore a relatively unknown area by gaining new insights into phenomena; undertaking preliminary investigations; establishing central concepts and constructs; determining future research priorities; and developing new hypotheses. For this study, an exploratory approach was deemed to be important as there is minimal research in South Africa exploring the psychological and technical skills required by adult learners in an ODeL context. The study is limited, which means that the results should be seen as a basis for future research. This research was exploratory in nature as it compared various theoretical perspectives on computer skills and internet self-efficacy with the aim of operationalising these constructs into a measure and to subsequently test the psychometric properties (internal consistency, reliability and construct validity) of the newly developed psycho-technological learning capabilities scale (PTLCS).

1.7.2 Descriptive research

Descriptive research entails describing the characteristics of existing phenomena (McGregor, 2019; Rahi, 2017; Salkind, 2012, Van Zyl, 2014) by using either narrative-type descriptions or classification, or by measuring relationships (Terre Blanche et al., 2006). Daniel (2012) and Rahi (2017) further confirm that the key aspect of descriptive studies is to collect accurate data on the phenomena in the research domain.

Descriptive research, in the current study, was applied in both the theoretical and empirical perspective. In the theoretical perspective, descriptive research applied to the conceptualisation, of the constructs, psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness skills and attributes. In the empirical study, descriptive research applied to the elements of the psycho-technological learning capabilities (computer skills and internet self-efficacy) being operationalised into a valid and reliable measure, namely the PTLCS, and the assessment of the psychometric properties (internal consistency, reliability and construct validity) of the newly developed PTLCS.

1.7.3 Explanatory research

The current study may be described as explanatory in nature in that it aimed to develop and validate the Psycho-Technological Learning Capabilities Scale (PTLCS). According to Daniel (2012) and Rahi (2017), explanatory studies aim to indicate and explain phenomena in relation to specific causes. Empirically, this study will explain the relationship dynamics between the variables psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness skills and attributes. This was achieved by examining the scores obtained by the research subjects and explaining the relationship between these variables. As the study was cross-sectional in nature, the focus was not on establishing cause and effect, but rather to establish the nature, direction and magnitude of the relationship between the variables. In addition, the current study focused on:

- Exploring and explaining the interrelationships between the subscale dimensions of the PTLCS in order to assess whether the newly developed PTLCS is a valid measurement of self-perceived computer skills and internet self-efficacy.
- Exploring and explaining the relationship among all three constructs, namely the newly developed PTLCS, the ALSDS and the GSAS.
- Assessing the factorial equivalence (or measurement invariance) of the new PTLCS for age, gender and ethnicity groups.
- Assessing whether there are substantial differences between participants from different age, gender and ethnicity groups with regard to their psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness.

1.7.4 Validity

Validity refers to the interaction between the instrument and the sample with a focus on whether the instrument assesses what needs to be measured (Foxcroft & Roodt, 2013; McGregor, 2019; Salkind, 2012). Terre Blanche et al. (2006) suggest that both internal and external validity are important and desirable for a research design. Internal validity refers to the accurate and valid findings generated on the phenomena being studied, while external validity refers to the generalisability of the research findings that may be achieved by selecting a representative sample (McGregor, 2019; Salkind, 2012; Terre Blanche et al., 2006).

1.7.4.1 Validity with regard to the literature

The validity of the literature review was ensured by presenting it in a logical and systematic manner, using the most recent sources with relevant theories and models. However, there were instances in the literature review where classical and contemporary mainstream research streams were referred to because of their relevance to the conceptualisation of the constructs relevant to this research.

1.7.4.2 Validity with regard to the empirical research

Empirically, both internal and external validity were achieved. Internal validity strives to demonstrate that the research findings are accurate and valid for the phenomena being investigated, while external validity refers to the extent to which the research results can be generalised to the wider population, cases, settings, times or situations, i.e. to the transferability of the findings from a sample to a population (McGregor, 2019; Salkind, 2012; Swank & Mullen, 2017; Terre Blanche et al., 2006).

In the empirical research, the validity of the PTLCS was ensured through face, content, construct (convergent and discriminant) and criterion validity. Construct validity refers to the extent to which the results of a test, in this case the research, are related to an underlying set of related variables (Van Zyl, 2014; Wang et al., 2015). Essentially, construct (convergent and discriminant) validity is the degree to which a measure sufficiently tests a targeted concept and has validated an important component of the research process (Streiner & Kottner, 2014; Swank & Mullen, 2017; Yue et al., 2020). As the primary focus of the current study was to develop a valid scale to measure an underlying construct, it was pertinent to begin with a clear conceptualisation of the target construct, in this case computer skills and internet self-efficacy as a set of psycho-technological learning capabilities. The study sample was determined from a random sample of students studying two first-year Industrial and Organisational Psychology modules in the research setting. This allowed the researcher to achieve external validity, as the results may be generalised to first-year Industrial and Organisational Psychology students in the research setting. Furthermore, the initial item pool should be over-inclusive and the item wording must be clear and unambiguous. After clearly formulating the item pool it must be tested, along with variables that assess closely related constructs on a heterogeneous sample representing the entire range of the target population, culminating in a selection of valid scale items. Factor analysis plays a crucial role in ensuring the unidimensionality and discriminant validity of scales (Voon et al., 2014). Chapter 6 reports the construct validity of each scale.

1.7.5 Reliability

Salkind (2012) and Mouton and Marais (1996) assert that the central consideration of validity relating to collecting data is that of reliability, which requires that the application of a valid measuring instrument for different groups and under different circumstances should yield the same observations. Foxcroft and Roodt (2013), Noble et al. (2019) and Salkind (2012) further explain reliability as concerned with stability and internal consistency, and with ascertaining whether a particular measuring technique and/or instrument, applied repeatedly to the same object, would yield the same result each time. In this study, the reliability of the literature review was ensured by using existing literature, theories and models. The reliability of the empirical study was ensured by using both a representative sample and validated and proven measures.

Furthermore, the newly developed Psycho-Technological Learning Capabilities Scale (PTLCS), and the ALSDS and GSAS, were validated by establishing the internal consistency reliability of the questionnaires by determining the composite reliability coefficient in addition to the Cronbach’s alpha coefficients, and by using appropriate statistical techniques to analyse the data congruent with the aims of this research. Chapter 6 reports the internal consistency reliability of each scale.

1.7.6 The unit of research

According to Ernest (2016), Salkind (2012) and Daniel (2012), a unit of analysis refers to the objects or things that are researched in order to formulate generalisations about these objects and to further explain the differences among them. In this study, the unit of analysis for the individual assessments is the individual, while the group will be the unit of analysis for determining the relationship between self-efficacy (computer and internet), self-directed learning and graduateness. The unit of analysis for examining the influence of socio-biographical variables (age, gender and ethnicity) on psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning and graduateness is the subgroup, with the overall analysis of data being generalised to the sample of research participants as a group.

1.7.7 The variables

Sufitrayati et al. (2020) define a variable as anything in the form determined by the researcher to be examined so as to obtain information to make conclusions. Salkind (2012) further explains that a variable is measured so as to indicate the amount of an attribute the unit of analysis has. Sufitrayati et al. (2020) and Salkind (2012) assert that an independent variable causes or explains change to the dependent variable, while an dependent variable is assumed to depend on or be caused by an independent variable (Salkind, 2012).

For the purpose of this research, the following variables were pertinent to the study:

- Computer skills and internet self-efficacy as sub-aspects of psycho-technological learning capability (independent variable) and graduateness skills and attributes (dependent variable)

- Self-directed learning orientation (independent variable) and graduateness skills and attributes (dependent variable)

- Computer skills and internet self-efficacy as sub-aspects of psycho-technological learning capability (independent variable), self-directed learning orientation (independent variables) and graduateness skills and attributes (dependent variable)

- Socio-biographical variables (age, gender, ethnicity) (moderating variables) in the relationship between (1) psycho-technological learning capability (independent variable) and (2) self-directed learning orientation (independent variables) and graduateness skills and attributes (dependent variables).

1.7.8 Delimitations

Being cross-sectional in nature, the research only sought to gather data that would answer the research questions and achieve the research aims set for this research. The focus of the current study was firstly on developing and validating a scale, and secondly, on investigating whether there was a relationship between psycho-technological learning capability (computer skills and internet self-efficacy), self-directed learning orientation and graduateness skills and attributes, and lastly, whether these constructs are influenced by age, gender and ethnicity. The study was restricted because it focused on scale development with a specific emphasis on the relationship between three core variables, psycho-technological learning capability (computer skills and internet self-efficacy), self-directed learning orientation and graduateness skills and attributes in a single research setting at a specific point in time. The research data was therefore drawn exclusively within South Africa and in a higher education institution, which limits the generalisability of the findings to other universities or institutions of higher learning.

No attempt has been made to manipulate or classify any of the information, results or data on the basis of language, marital status, family or spiritual background, or physical or psychological illness. The research is original and ground-breaking research that restricted its focus to the relationship between psycho-technological learning capability (computer skills and internet self-efficacy), self-directed learning and graduateness. The groundwork information pertaining to this relationship could be useful to future researchers to address other issues relating to the three constructs explored in the current study. As a result of the cross-sectional research approach underpinning the current study, this research is not intended to establish a cause-and-effect relationship, but merely to investigate whether such relationships do in fact exist and whether the relationship between psycho-technological learning capability (computer skills and internet self-efficacy), self-directed learning orientation and graduateness skills and attributes is influenced by variables such as age, gender and ethnicity. Chapter 7 discusses the limitations of the research design in more detail.

1.7.9 Ethical considerations

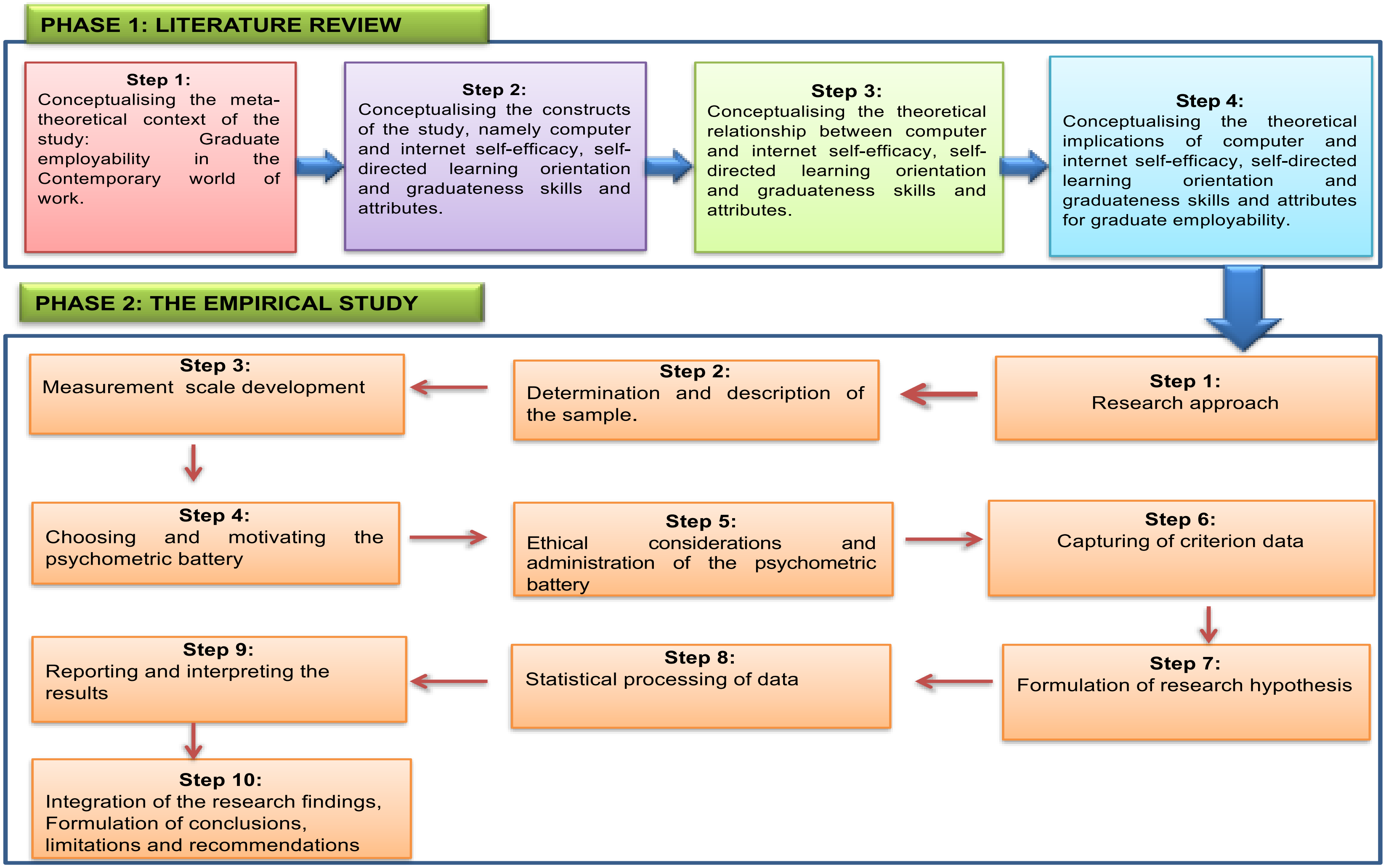
Ethics are standards of conduct underpinned by moral principles (Rallis, 2009). Ketefian (2015) and Terre Blanche et al. (2006) state that the history of ethical conduct in social research dates back to the aftermath of the atrocities committed by the Nazi medical researchers. Ketefian (2015) and Terre Blanche et al. (2006) further confirm that the purpose of research ethics is to protect the welfare of the research participants. Chapter 5 provides a detailed discussion on the procedures that were adhered to in the research to ensure alignment and compliance with the necessary ethical requirements and responsibilities.

1.8 RESEARCH METHOD

The research was conducted in two phases: the first consisted of the literature review and the second consisted of the empirical study. Figure 1.1 below gives a diagrammatic representation of the research methods underpinning the current study, which are discussed below.

Figure 1.1

Overview of the Research Approach



Source: Author's own work.

1.8.1 Phase 1: literature review

In order to achieve the research aims set for the literature review, a theoretical analysis and exploration of the research literature were conducted into the phenomenon under inquiry, namely the psycho-technological learning capabilities of adult learners. The analysis of the literature followed four steps outlined as follows:

Step 1: Graduate employability in the contemporary world of work

In Chapter 2, a conceptual overview of the graduateness and employability of adult learners in the contemporary world of work and the ODeL context is presented. Emphasis is placed on how individual personal agency allows one to develop technological and graduate skills relevant to the ever-changing employment context.

Step 2: The theoretical constructs of the study

The constructs of psycho-technological learning capabilities (computer skills and internet self-efficacy) and self-directed learning orientation are conceptualised and critically evaluated from a theoretical perspective in Chapter 3. The influence of socio-biographical characteristics on these constructs is also discussed as elicited from literature.

Step 3: The theoretical relationship between psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness skills and attributes

In Chapter 3, the theoretical elements of the Psycho-Technological Learning Capabilities Scale (PTLCS) are evaluated and the hypothetical theoretical relationship between the constructs of psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness skills and attributes is integrated and discussed.

Step 4: The implications of the relationship between psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness for graduate employability

A critical evaluation of the relationship between psycho-technological learning capability (computer skills and internet self-efficacy), self-directed learning orientation and graduateness skills and attributes is discussed in Chapter 4. An integration alluding to the implications of this relationship for graduate employability and for the discipline of Industrial and Organisational Psychology is discussed. The implications for Industrial and Organisational Psychology practices and specifically learning and assessment in the context of adult learning in distance and online learning environments, and the employability of adult learners who pursue further studies in ODeL environments and in the contemporary world of work are also discussed.

1.8.2 Phase 2: Empirical study

The outcome of Phase 1 (literature review) culminated in a draft measure for psycho-technological learning capabilities (the PTLCS). The development of the PTLCS was guided by existing scale development protocols and scientific conventions. As the current study was quantitative in nature and used survey design, the following nine steps were followed:

Step 1: Research approach

The research approach adopted for the study is discussed in Chapter 5.

Step 2: Determination and description of the sample

The determination and description of the sample is discussed in Chapter 5.

Step 3: Measurement scale development

The development of the PTLCS was underpinned by existing scale development protocols. Accordingly, Chapter 5 discusses the steps followed in developing and validating the PTLCS.

Step 4: Choosing and motivating the psychometric battery

Chapter 5 provides a motivation for the psychometric instruments. A socio-biographical questionnaire seeking to obtain data on age, gender and ethnicity was used in addition to three quantitative instruments. These instruments were the newly developed PTLCS developed by the researcher for the purposes of the research (see Appendix C), the Adult Learner Self-directedness Scale (ALSDS) measuring self-directedness (Botha, 2014), and the Graduateness Skills and Attributes Scale (GSAS) measuring individuals' sense of internal graduateness (Coetzee, 2014a).

Step 5: Administration of the psychometric battery

The administration of the psychometric battery is discussed in detail in Chapter 5.

Step 6: Capturing of criterion data

As Chapter 5 indicates, the responses from the participants on each of the items in the four questionnaires were captured in an electronic database which was converted to a statistical package (presented in Chapters 5 and 6). To ensure the security and authenticity of the data the appointed statistician was the only person who captured the data onto the SPSS platform for further statistical analysis.

Step 7: Formulation of research hypotheses

The research hypotheses that were formulated in order to achieve the objectives of the empirical study are presented in Chapter 4.

Step 8: Statistical processing of data

The statistical processing of the data is discussed in detail in Chapter 5.

Step 9: Reporting the results

Chapter 6 reports the results in detail in the form of tables, diagrams and/or graphs and the interpretation is presented in a systematic and articulate manner.

Step 10: Interpretation and integration of the research findings and the formulation of conclusions, limitations and recommendations

Chapter 7 discusses the findings relating to the literature review, thereby providing an integration of the research findings. Conclusions will be formulated based on the results elicited from the empirical research (Chapter 6). The limitations of the study are highlighted and recommendations are proposed in terms of the newly developed PTLCS and its use amongst adult learners pursuing further studies in ODeL environments

1.9 CHAPTER DIVISION

The chapters are presented as follows:

Chapter 2: Meta-theoretical context of the study: open distance learning and student graduateness

This chapter provides a conceptual discussion of the graduateness of adult learners in the contemporary world of work and the ODeL context. A critical review of the changing world of work is presented, highlighting the trends in research regarding the new demands by employers of university graduates for employability.

Chapter 3: Psycho-technological learning capabilities and self-directed learning

The literature review focuses on conceptualising the psycho-technological learning capabilities of students in an online environment. A detailed discussion of psycho-technological learning capability (computer skills and internet self-efficacy) and a self-directed learning orientation in relation to developing graduateness skills and attributes to encourage employability and life-wide learning of students is presented. Socio-biographical characteristics, namely age, gender and ethnicity, are explored in relation to online learners' psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness skills and attributes.

Chapter 4: Theoretical integration and implications

In this chapter, an integration of the psycho-technological learning capabilities (computer skills and internet self-efficacy) and self-directed learning orientation, with a specific emphasis on the influence on adult learners' graduateness and employability, is presented. The chapter concludes with a definition of psycho-technological learning capabilities (computer skills and internet self-efficacy) and their theoretical elements as they pertain to students in the online environment pertinent to this study.

Chapter 5: Research method

The purpose of this chapter is to present and describe the methodological approach to the research. The aims of the research are highlighted and the population and sampling framework of the study is presented. The measuring instruments are discussed and a justification for the choice of psychometric battery is presented. This is followed by a description of the data collection and analysis process, culminating in the formulation of the research hypotheses.

Chapter 6: Results

This chapter presents a detailed statistical analysis of the results obtained from the empirical research with the aim of developing and validating the measure for assessing the psycho-technological learning capabilities (computer skills and internet self-efficacy) of students in an online environment.

Chapter 7: Discussion, conclusions, limitations and recommendations

In this final chapter, an integrated discussion and conclusions pertaining to the results from the research are presented. Limitations experienced during the study are highlighted and recommendations are made for future research with regard to the employability and graduateness skills and attributes of adult learners in the contemporary world of work and the ODeL context.

1.10 CHAPTER SUMMARY

This chapter presented the background to and motivation for the research, the problem statement, the research questions and aims of the research, the research design, paradigmatic perspectives and the research design as well as the methodological approach. The motivation for this study is that in view of the diverse composition of the student population within any ODeL environment, there is a need explore the influence of the psycho-technological learning capabilities (computer skills and internet self-efficacy) and self-directed learning orientation in relation to graduateness skills and attributes of adult learners. On a practical level, the empirically tested and newly developed scale may be used for future research and to assist in providing support for adult learners in ODeL contexts in South Africa, as well as to support adult learners' employability in the contemporary world of work.

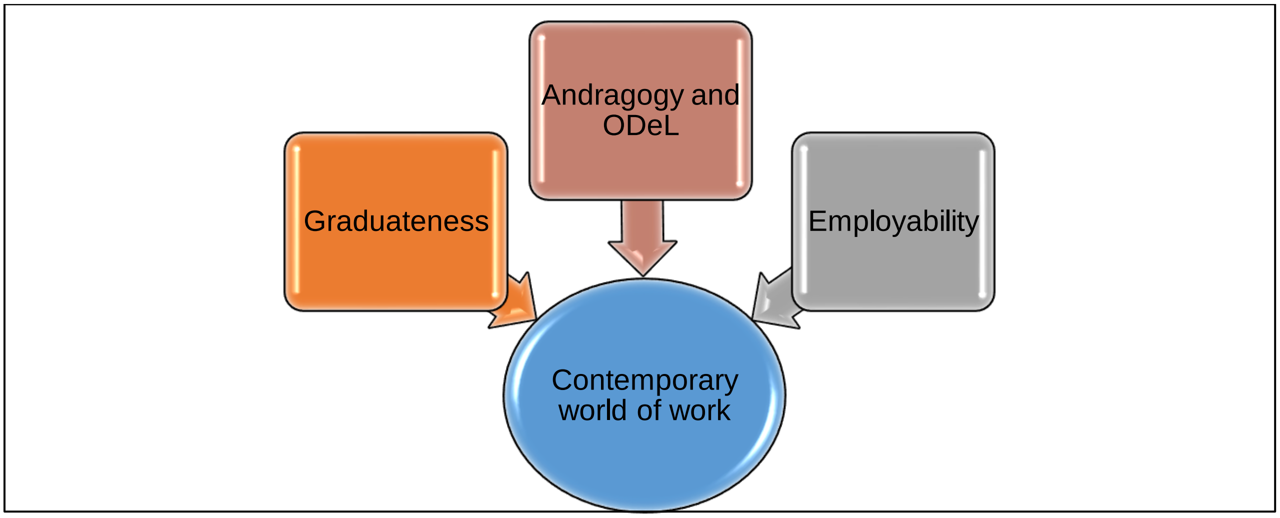
Chapter 2 addresses the first aim of the literature review, namely, to establish and conceptualise the employability and graduateness of adult learners in the contemporary employment and ODeL contexts.

CHAPTER 2: META-THEORETICAL CONTEXT: OPEN DISTANCE LEARNING AND STUDENT GRADUATENESS

This chapter addresses the first literature research aim, namely, to conceptualise the graduateness of adult learners in the contemporary employment and open distance and electronic learning (ODeL) contexts. The chapter introduces the context of adult learners in the contemporary world of work, highlighting the major implications faced by adult learners in this context. The major implications pertinent to the current study include graduateness (the skills and attributes required of learners by future employers) and employability. An overview of the factors in the contemporary world of work are summarised and presented in Figure 2.1 below. The chapter then presents the socio-biographical characteristics that influence the graduateness and employability of adult learners. The chapter concludes with an integration of the theoretical relationship between the constructs, highlighting gaps identified in the literature for future studies.

Figure 2.1

Overview of the Major Implications of the Contemporary World of Work



Source: Author's own work

2.1 ADULT LEARNERS IN THE CONTEXT OF THE CONTEMPORARY WORLD OF WORK

The continuous change in organisations and the environment has become an area of interest among managers and academics (Burger et al., 2013). The world of work is so volatile that individuals may need to not only change jobs several times, but will also have to acquire new skills and knowledge due to the continuous flow of new information (De Bruin & Cornelius, 2011; Jarrahi & Thomson, 2017). McGreevy (2008) asserts that in the context of a rapidly changing environment, people are forced to change so as to continue contributing to their organisations. Individuals are faced with changes in both the workplace and the macroenvironment; hence, the volatility of both the microenvironment and the macroenvironment comes with challenges that result in individuals reflecting on their current skills and forcing them to consider altering their behaviours (for instance pursing further education) so that they may achieve success and remain employable (McGreevy, 2008).

The digital era and world of work 2020 has brought about a shift from national to global markets and structural transitions within and around organisations, specifically with ICT being a key driver of these changes (Jarrahi & Thomson, 2017; Nolan, 2004). Mian et al. (2020) assert that the emergence of Industry 4.0 (4IR) has completely transformed the way in which industry and business function and evolve. As such, the holistic adoption of Industry 4.0 is dependent on specific requirements of the workforce, namely adaptive thinking, cognitive and computational skills, predominantly in the area of information technology and data analytics, to name just a few (Mian et al., 2020). Smith and Bauling (2013) confirm that the employment landscape has become complex and unstable, such that field-specific knowledge has become insufficient training for university graduates and adult learners in the workplace. Employers want graduates who have generic skills and attributes that complement the degree-specific knowledge gained at university, thereby aligning their academic knowledge with industry needs is an important aspect of their continued employability (Daniels & Brooker, 2014; Green et al., 2009) The digital era and world of work 2020 requires various fields of expertise, hence employees are required to work with experts from other fields and must be able to adapt to the ever-fluctuating professional environment (Jarrahi & Thomson, 2017; Saunders & Machell, 2000). Mian et al. (2020) further assert that universities have a pivotal role to play in promoting the transition to the technology-based environment required for Industry 4.0, as organisations expect to have an employee pool that has the technical competence relevant to Industry 4.0, such as IT knowledge, and the skills to interact with contemporary interfaces.

Burnes (2003) postulates that in the current turbulent environments, organisational change is one of the most critical challenges organisations need to address. Organisations are forced to adapt to factors such as increased competition, globalisation and continuous technological developments to become more competitive and sustain a competitive advantage (Burger et al., 2013). Cascio (2001) highlights additional forces in the changing world of work, namely, changes in the psychological contract, globalisation, the information revolution and the speed of change, while Hughes et al. (2021) further add job security, job role and labour markets. Additionally, environmental changes such as increased workforce diversity, and the expanding use of outsourcing and part-time and temporary employees, have also contributed to the changing landscape of work in the 4IR. These changes have not only altered traditional organisational structures, employer–employee relationships and the work context, but have also resultantly encouraged individuals to become proactive in managing their careers in order to remain employable, which often includes pursuing further studies at ODeL institutions (Baruch, 2004; Ma & Bennett, 2021; Schreuder & Coetzee, 2016; Sinclair, 2009; Sullivan & Baruch, 2009).

Pertinent to this study is the influence of information technologies in the 4IR and 2020 world of work. Oz and Ozdamar (2020) argue that over time industrialisation and distance education have been influenced by each other, with distance education gaining importance. Information technologies bring about a continuous flow and generation of new information. This results in the expectation that many jobs may change dramatically over short periods of time. To keep up with the changing characteristics of the world of work, individuals have to constantly update their existing skills and knowledge, and in some instances acquire new skills and knowledge with regard to using computers and the internet (De Bruin & Cornelius, 2011; Guglielmino & Murdick, 1997). Essentially, individuals are forced to consider themselves as self-employed and adopt an attitude of managing their own careers (Clarke, 2008; Ma & Bennett, 2021). Employees are faced with the responsibility of finding ways to maintain and enhance their employability and attractiveness to the labour force (Clarke, 2008) by exploring opportunities to improve their qualifications and skills. Clarke (2008) explains how, even though they are actively employed by an organisation, individuals have to see themselves as self-employed just to keep up with the changing work environment.

Organisations continuously downsize, restructure and outsource, and are on the lookout for employees who have the capacity to make an immediate contribution rather than individuals who want long-term development and stable jobs. Furthermore, the easy flow of information has resulted in a knowledge economy (Burke et al., 2020; Powell & Snellman, 2004) where again organisations are looking for employees with skills and are knowledgeable about their work (Burke et al., 2020; Donnelly, 2009). These changes in the macroenvironment (knowledge sharing, globalisations, technology) have resulted in changes within the microenvironment of the organisation. These changes therefore require employees to have exceptional general skills (Tomlinson & Anderson, 2020) that will give the organisation a competitive edge over its competitors and render the employees a source of the organisation's competitive advantage (Clark, 2008; Garavan, 1999; Jaiswal et al., 2021). Acquiring exceptional skills requires employees to engage in life-wide learning, forcing them to be adult learners in ODeL contexts to improve their employability and develop their graduateness skills. Clarke (2008) confirms that organisations prefer to retain employees with highly developed generic skills as they give the organisation its competitive edge, as compared to employees who have organisation-specific skills. This alludes to the reality that employees have to be agents of their own careers and not rely on organisations for job security (Baruch, 2004; Clark, 2008; Schreuder & Coetzee, 2016).

It is evident that with the turbulent and ever-changing environments, employees are forced to remain employable and relevant to the 21st century world of work (Francis & Flanigan, 2012; Jaiswal et al., 2021). The biggest and most challenging trend for employees in the contemporary world of work is their confidence in using technology and developing their graduateness skills and attributes to remain employable (McGreevy, 2008; Francis & Flanigan, 2012; Jaiswal et al., 2021). In an attempt to remain employable in the changing world of work, individuals are exploring and taking up online tuition, especially on ODeL environments, owing to the flexibility that distance education offers (Kim & Kim, 2018; Nyoni, 2014). This has not, however, come without challenges for adult learners. Such challenges include learners navigating the course and the associated external links, as well as adapting to the self-directed and autonomous nature of the online learning environment (DeTure, 2004; Kim & Kim, 2018).

2.2 ADULT LEARNERS IN ODeL CONTEXTS

Romero Martínez et al. (2020) assert that people's lives, including their education, are constantly immersed in ICT, with advancements in technology having resulted in major changes within the field of education over recent decades, especially in distance education which is reliant on ICT. Cabi and Kalelioglu (2019) report that there is an increase in the use and importance of ICT in modern educational processes.

The emergence of the 4IR has also transformed higher education, with universities having to adapt, modernise and reshape their existing programmes, facilities and infrastructure (Briede & Popova, 2020; Mian et al., 2020). Online learning is therefore seen as a mode of effective training for adult learners, as it allows for a more flexible learning schedule which fits into their other life roles (Sato et al., 2017). As such, andragogy principles highlight the need to design learning approaches specific to the needs of adults (Sato et al., 2017). Cochran and Brown (2016) differentiate pedagogy from andragogy in that pedagogy requires students to be dependent on the teacher for knowledge and is subject centred (Sato et al., 2017). Andragogy, on the other hand, is learner focused, putting the learner first with the learning material designed to meet the interests of adult learners by involving them in the course objectives and activities while solving real-life issues (Sato et al., 2017). Essentially, adult learners are more self-directed in their approach to learning and have control over learning, are more experienced and draw upon the learning process and engage in learning for their personal development driven by their own desires or circumstances. In addition, they tend to be more intrinsically motivated and engaged in the learning process (Jeanes, 2021).

Adult learners, in the digital era and 4IR, are faced with working with the reality that technology, internet, cloud computing and social media have replaced traditional formal education systems (Oz & Ozdamar, 2020). The digital era requires adult learners to possess a 21st century skill set, which includes critical thinking, knowledge operational thinking, emotional intelligence, knowledge generation and management (Trilling & Fadel, 2009; Tseng, 2020; Tseng et al., 2020; Xing & Marwala, 2017). Oz and Ozdamar (2020) assert that both adult learners and the workforce involved in the development and delivery of distance education must possess these 21st century skills in order to be able to meet societal and work expectations.

Oke and Fernandes (2020) and Tymon (2013) argue that despite advancements in technology, the education sector has seen slow uptake in accepting and using technology to facilitate teaching and learning, although robots have been used since as far back as 1980 in education. Ng'ambi et al. (2016) assert that teaching and learning in South Africa has remained relatively stagnant despite the increased use of mobile devices and social media platforms. Ng'ambi et al. (2016) further expatiate that although the use of technology in teaching and learning has been restricted to digitisation, there is a need for the education sector to have ownership and exclusive rights to numerous technological innovations and tools in order to regulate the use of technology platforms within academic environment.

Ultimately, adult learners not only require the technical skill required for online learning environments (Kim & Kim, 2018) but they must also be technically competent in the required professional skills (Heang et al., 2019).

2.3 EMPLOYABILITY AND GRADUATENESS

In this section, employability and graduateness will be discussed. A conceptual overview of the constructs will be provided followed by a critical evaluation to conclude the discussion. Graduateness is seen as an integral facet of students' employability and work readiness.

2.3.1 Employability and work readiness

In response to the changing world of work, researchers have suggested that institutions of higher education should address the employability of graduates (Bezuidenhout et al., 2019; Coetzee et al., 2015; Kim & Kim, 2018; Pavlin & Svetlik, 2014; Tymon, 2013). Tymon (2013) defines employability as the ability for one to get graduate-level job and employment generally. Essentially, one can be employable while not being active in any form of employment.

Jackson (2012) asserts that there is a plethora of literature on the responsibilities of higher education institutions to produce graduates that are well rounded, employable and meet the needs of industry. Mian et al. (2020) assert that the emergence of the 4IR has resulted in higher education institutions having to reshape and modernise their existing programmes, facilities and infrastructure, while Kaufman and Feldman (2004) highlight that students also have an expectation that university will prepare them for their chosen profession. Graduate employability entails the clarification, development and evaluation of a variety of non-technical skills believed by industry to be critical in new graduates (Jackson, 2016).

Coetzee et al. (2015) concur with Daniels and Brooker (2014) in that employability capacities refer to sets of portable "soft" skills and attributes that are imperative in determining a graduate's work readiness and success in the workplace. However, Daniels and Brooker (2014) and Kim and Kim (2018) further emphasise that work readiness has become increasingly important in vocational and higher education institutions because graduates must be encouraged to prepare for future employment in the unpredictable and ever-evolving world of work. Work readiness relates to the preparedness and agility of a graduate to align their academic knowledge with industry needs (Daniels & Brooker, 2014; Green et al., 2009; Kim & Kim, 2018).

According to Jackson (2016), achieving enhanced states of employability can bridge prevalent and apparent skill gaps, raise organisational productivity and empower employees and graduates to be innovative in the face of intense global competitiveness. Jackson (2016) further highlights that it is widely accepted that work-ready graduates who are self-assured, technically proficient and equipped with a range of non-technical skills are better prepared for rigorous recruitment processes, have an easy transition into post-graduation employment and experience long-term career success. Although the shift in HEIs' strategic focus from the development of higher order skills, namely intellect and mastery of disciplinary content, to skilled and vocational readiness has been challenged (Pegg et al., 2012), employability still remains a strategic priority and continues to influence HE policy and curriculum reform alongside concerns of graduateness.

Work is no longer characterised by rigid tasks where graduates are exposed to a predictable and linear career progression in the organisation (Ma & Bennett, 2021; McMahon et al., 2003), but by flatter organisational structures, riddled with global job mobility and rapidly evolving work environments. The agenda of graduate employability has therefore shifted to that of "graduateness" in an attempt to equip graduates with the skills they will require to stay afloat in such volatile and challenging work environments (Jackson, 2016). Scholars have since refined the meaning of graduateness and concur that graduateness refers the "quality of personal growth and intellectual development" of graduates from universities or HEIs (Coetzee, 2012a, 2014; Metcalfe et al., 2020; Steur et al., 2012). Owing to the interdependency and closeness between employability and graduateness, with specific reference to this study, employability will be encapsulated in the discussion of graduateness.

2.3.2 Perspectives on graduateness

The discussion around graduateness has evolved from being a conversation between academics and funders regarding the quality of graduates to focusing on the needs of business (Walsh & Kotzee, 2010). The changes occurring in the broader economic and social contexts as a result of globalisation have cascaded into the education system, with universities being faced with the task of producing graduates with sought-after skills (Barrie, 2006; Daniels & Brooker, 2014; Ma & Bennett, 2021; Mian et al., 2020). Burke et al. (2020) and Daniels and Brooker (2014) further highlight that one of the notable changes in the broader economic context is the shift in markets to a more knowledge-based economy. The dawn of the knowledge economy has resulted in universities finding themselves faced with the challenge of producing skilled graduates (Daniels

& Brooker, 2014). The changing image of universities and students has influenced the expectations that students and the labour market have of university education (Bezuidenhout et al., 2019; Daniels & Brooker, 2014; Mark, 2013). In addition, in view of the increased demand for quality education in universities, students have an expectation of obtaining secure and rewarding employment (Daniels & Brooker, 2014; Tomlinson & Anderson, 2020).

The meaning of graduateness has been widely debated (Kreber, 2014) and the term lacks a straightforward definition (Helyer & Lee, 2012). Glover et al. (2002) describe graduateness as the qualities that make a person who has completed a formal degree programme at university stand out from other students. Scholars agree with this definition and further suggest that the notion of the personal and professional growth of university students is incorporated in the definition of graduateness (Green et al., 2009; Smith & Bauling, 2013; Steur et al., 2012). However, Little (2011) and Metcalfe et al. (2020) highlight the consensus among scholars that the definition of graduateness reflects a set of generic skills that graduates possess and can use to secure future employment.

In an attempt to provide clarity on the generic skills and attributes associated with graduateness, Barrie (2006) and Walsh and Kotzee (2010) explain four possible attitudes that can be considered when defining graduateness, namely, precursory, complementary, translation and enabling abilities. Walsh and Kotzee (2010) describe these abilities as follows:

- Precursory abilities refer to the skills that the student brings to university and which provide the baseline or minimum foundation for study at university level. Examples include the levels of reading, writing and numeracy of the student upon entering the university.
- Complementary abilities refer to the general functional skills that a student has which complement the discipline-specific knowledge. Complementary abilities may include attention to detail and working independently.
- Translation abilities enable the individual to apply what they have learnt at university. Based on Barrie (2006), it would seem that generic graduate attributes develop simultaneously with disciplinary knowledge. Walsh and Kotzee (2010) further explain this ability as the individual’s capacity to apply disciplinary knowledge and make it relevant not only to the work context but also to the outside world generally.

- Enabling abilities allow students to create new knowledge irrespective of the discipline. Enabling skills not only develop parallel with knowledge of the discipline, but also allow the student to develop as an independent thinker.

Coetzee (2012a) and Metcalfe et al.(2020) assert that graduateness implies that apart from obtaining the theoretical and technical skills relevant to a specific degree, graduates are able to demonstrate a set of generic transferable metaskills and personal attributes regarded as indicators of their employability. Coetzee (2014) and Ismail (2017) further add to this definition by highlighting the value of graduateness generic skills and attributes. Essentially, the cultivation of graduateness skills and attributes equips graduates as scholars, global and moral citizens, lifelong learners and valuable members of society who can act as agents of social good, change and innovation (Coetzee, 2012a, 2014; Green et al., 2009; Ismail , 2017; Steur et al., 2012).

According to Smith and Bauling (2013), there are three properties underpinning graduateness, namely field-specific properties, shared skills and generic skills. *Field-specific properties* prepare graduates for the theory requirements of their chosen degree programme and industry. However, this knowledge quickly becomes outdated and irrelevant due to the unstable and complex changing nature of work (Washer, 2007). Along with field-specific skills and knowledge, graduates should have more generally relevant and *shared skills* unique to their chosen profession, for instance report-writing and listening skills, research abilities and profession-specific language, to name just a few. *Generic skills* refer to abilities acquired by graduates that are not specific to any field of study. Notably, scholars agree that graduateness results in a "transformation" of the graduate (Coetzee, 2014) from their first year of study through to when they enter the labour market (Coetzee, 2014; Little, 2011; Scott & Ali, 2013). In view of the digital era, it would seem the generic attributes suggested by Metcalfe et al. (2020), namely, communication and numeracy skills, technology skills (e.g. computer literacy), problem-solving skills, planning and organisational skills, and lifelong-learning skills, should be considered in promoting the graduateness and employability of university graduates and adult learners.

Kreber (2014) proposed three philosophical perspectives, namely existential, critical and communitarian, in an attempt to rationalise and single out certain core graduate skills and attributes.

2.3.2.1 The existential perspective

This perspective highlights the fact that institutions of higher education have a main educational purpose, which is to encourage students' participation in meaning-giving activities and practices (Sullivan & Rosin, 2008). Higher education has a role to play in assisting students to appreciate that meaning in life cannot be found exclusively within oneself but through active participation in and identification with something larger than oneself (Kreber, 2014). Malpas (2003) and Sherman (2003) highlight that from an existential perspective, becoming authentic implies that a person becomes aware of their own unique purpose and possibilities in life, and thereby becomes the author of their own life and takes responsibility for their actions and stands by their commitments.

In applying this perspective to graduateness, Barnett (2004) and Kim and Kim (2018) explain that graduates have to become agile so as to be able to cope with the ill-defined problems and volatile environments as there are no ready-made solutions. Graduates must be willing to challenge themselves to be open to new possibilities and accept that problems are multidimensional and interdependent. In addition, graduates must understand that further research may not only simplify the problems they are faced with but may reveal additional complexities that they have to make sense of and consider in problem-solving (Kreber, 2014). The graduate not only develops research and problem-solving skills but also develops critical thinking skills. Kreber (2014) highlights that it is through critical thinking skills that graduates are able to make autonomous and rational decisions and further develop the capacity to make choices that are bound by their inner motives (Bonnett & Cuypers, 2003).

2.3.2.2 The critical perspective

The critical perspective emphasises freedom of thought (Habermas, 1985) and alludes to the fact that a graduate becomes conscious of how socially learnt truths influence the way he or she makes meaning of the world (Kreber, 2014). Essentially, this perspective puts emphasis on the need for graduates to realise how their views of the world have been shaped by the conditions inherent in the contexts within which the events are experienced. Some of these conditions may be discipline-specific, however the core assumption in this perspective is that a graduate begins to critically reflect on how certain explanatory frameworks have determined how people understand a given problem or discipline; what alternative ways of knowing are embedded in this and what are the subsequent implications of the manner in which a certain event or problem is approached (Kreber, 2014).

2.3.2.3 The communitarian perspective

According to Taylor (1991), the communitarian perspective highlights that the active participation of an individual in meaning-giving activities in any given community provides a sense of purpose in life for that individual. Taylor (1991) further explains that meaning in life is not just based on a graduate furthering their self-interests but by contributing something larger than themselves with which they identify. Scholars are in agreement in that institutions of higher education must educate graduates to function as global citizens with sensitivity and understanding (Kreber, 2014; Nussbaum, 1997; Smith & Bauling, 2013; Steur et al., 2012).

In summary, the existential dimension focuses on the graduate developing a disposition to being open to experience and one's own possibilities, and willingly seizing opportunities for change and development arising from these experiences (Barnett, 2004). The critical dimension puts great emphasis on the graduate to reflect on socially constructed assumptions of how the world should be. The communitarian dimension emphasises that the graduate must show an appreciation of the social interrelatedness associated with participating in and identifying with meaning-giving practices within any given community (Kreber, 2014). Reflecting on these perspectives it is evident that both the critical and the communitarian perspectives are intertwined in developing the qualities of moral commitment and responsible participation in activities and practices (Sullivan & Rosin, 2008).

Skills and attributes commonly associated with graduateness include critical thinking and problem-solving skills; ethical, social and professional understanding; collaboration, teamwork and leadership; and global citizenship (Metcalfe et al., 2020; Hughes & Barrie, 2010; Ismail, 2017). With the extant literature presenting differing views on the graduateness skills and attributes domains (Kreber, 2014; Smith & Bauling, 2013; Steur et al., 2012; Washer, 2007), the domains of graduateness conceptualised by Coetzee (2012a, 2014b) and validated by Ismail (2017) and Metcalfe et al. (2020) were used in this study.

2.3.3 Theoretical models of graduateness

In this section, an overview of some of the theoretical models of graduateness skills and attributes relating to young adults in the school-to-work transition phase is presented. The following models of graduateness skills and attributes are discussed in this section:

- Bennett et al.'s (1999) model of graduate employability
- Yorke and Knight's (2006) understanding, skills, efficacy beliefs and metacognition (USEM) graduate employability model
- Barrie's (2006) conceptual framework for the teaching and learning of generic graduate attributes
- Steur et al.'s (2012) model of graduateness
- Coetzee's (2012a) framework for the development of the graduateness skills and attributes scale.

The above-mentioned models are discussed in sections 2.2.3.1 to 2.2.3 5 below.

2.3.3.1 Bennett, Dunne and Carré's model of graduate employability.

In 1999, Bennett and colleagues conceptualised a model to explain graduate employability, focusing on course provision in higher education contexts. In their model, Bennett et al. (1999) distinguished between five elements of course provision, namely (1) disciplinary content knowledge, (2) disciplinary skills, (3) workplace awareness, (4) workplace experience and (5) generic skills (Pool & Sewell, 2007; Torres, 2014). Pivotal to this model is the concept of generic skills and its interrelationship with all the other elements, which culminates in a link to graduateness (Aliu & Aigbavboa, 2021). Generic skills, in this model, are divided into four categories, namely, management of self, management of others, management of information and, lastly, management of task. These skills are generic in that they can be applied to any other context and are not restricted to higher education. These four categories of generic skills are discussed as follows:

(i) Management of self

Management of self includes aspects such as time management, taking responsibility for one's own learning, developing and adapting one's learning strategies, being flexible, reflecting on one's learning and stress management. An individual who has this skill is able to manage him/herself in a manner that facilitates learning (Bennett et al., 1999).

(ii) Management of others

Individuals who have the skill to manage others should be able to work in teams, respect and value others' opinions, work with team members, in some instances assume leadership roles, and adapt to the needs of the team. In the contemporary world of work, organisations expect graduates to be able to be work in teams and understand how to use the skills of each member in the team to achieve the team objectives and to uplift themselves as well, commonly referred to as collaborative learning (Bennett et al., 1999).

(iii) Management of information

The skill categorised as management of information suggests that graduates should learn how to manage information effectively, exhibit the ability to use information technologies effectively, use the appropriate language when analysing information, and being innovative and creative in managing information (Bennett et al., 1999). This skill links in with Coetzee's (2012a) interactive skill and technological skills (as measured by the PTLCS) with regard to obtaining, categorising, storing and retrieving information for future use.

(iv) Management of task

In the category relating to management of task, the assumption is that graduates should be able to plan and manage a task from start to finish, for example planning, goal setting, prioritising tasks, developing and using strategies, and assessing the outcome of a completed task (Bennett et al., 1999).

In the model conceptualised by Bennett et al. (1999), the main argument is that although disciplinary content knowledge and skills can be viewed as two distinct domains, they are in fact interdependent. In addition, a distinction is made between disciplinary content knowledge and skills in that disciplinary content knowledge is what the learner is required to know in that academic field, while disciplinary skills are concerned with how the learner will implement the disciplinary content knowledge acquired.

Additionally, in their model, Bennett et al. (1999) explain the usefulness of workplace awareness and workplace experience in graduate employability. Workplace awareness and work experience, as applied in the model, entail universities providing simulated work scenarios to allow the learners to apply the theoretical knowledge gained in their study to a simulated work environment. Essentially, these elements of the model provide graduates with an idea of what the workplace may entail and these simulated work environments are viewed as ideal methods to develop the generic skills of learners. In response to the expectations of employers that graduates should be able to engage in workplace experiences, universities have introduced work-integrated learning in their academic courses with the aim of developing and improving the attributes that learners have acquired in order to facilitate knowledge transfer (Griesel & Parker, 2009) and an employable graduate.

In conclusion, in their model, Bennett et al. (1999) highlight the links between the elements of their model, indicating the possible connections that are dependent on the purposes and intentions of the academics and the university. Disciplinary content knowledge is acquired by the learner within the higher education institution with the intention of the same content knowledge being applied in the workplace, indicating that there is no assumption of the directionality of learning in this model. The model is thus theoretical in nature and the assumptions underpinning the model are yet to be empirically validated and operationalised.

2.3.3.2 Yorke and Knight's understanding, skills, self-efficacy beliefs and metacognition (USEM) graduate employability model

Yorke and Knight (2006) developed the Understanding, Skills, Self-Efficacy Beliefs and Metacognition (USEM) graduate employability model to explain graduate employability. In this model, they suggest that graduate employability comprises four components, namely: (1) the understanding of the subject matter and the aspects relevant to one's performance in the organisation, (2) skilful practices in context, (3) self-efficacy beliefs (relating to one's personal qualities that may influence one's success in both work and personal life) and (4) metacognition (which includes reflection and self-regulation) (Pool & Sewell, 2007; Tuononen et al., 2017).

The USEM model, therefore, emphasises the need for graduates to possess discipline-specific knowledge and have the ability to apply this knowledge in the workplace. This assumption concurs with Bennett et al. (1999) in that the scholars agree that graduates must be able to apply the discipline-specific knowledge gained at the university to the workplace in a meaningful manner. Additionally, the USEM model proposes that graduates must also have self-confidence and be able to effectively regulate themselves.

In addition, York (2006) agrees with Bennett et al. (1999) that the scholastic achievement of graduates is insufficient to warrant a graduate as employable. Graduates need to possess skills that are outside the discipline, for instance interpersonal skills, which equip graduates with the skills to relate to others within a team and organisational setting and to create networks within the organisation (Coetzee, 2012a).

2.3.3.3 Barrie's conceptual framework for the teaching and learning of generic graduate attributes

With the growing interest in graduate employability, it became evident that there were concerns around the shared understanding of graduateness skills and attributes (Clanchy & Ballard, 1995). Barrie (2006) found that there is not only a need to equip students with the graduate skills they require for the workplace, but there is a greater need to identify the various opinions and understandings of the academics responsible for equipping students with graduateness skills and attributes.

Barrie (2006) identified four complex understandings of the nature of graduate attributes and six processes of teaching and learning. The four complex understandings of the generic graduate attributes are precursor, complement, translation and enabling conception. In the model, Barrie (2006) explains that the generic graduate attributes can be regarded as precursor abilities because they present the foundation on which the discipline-specific knowledge can be added. In addition to the idea of precursor abilities, some academics perceive the generic attributes as encompassing the university-learnt, general functioning abilities and personal skills that complement the discipline-specific knowledge. In addition to these understandings, other academics understand generic attributes to be more than useful additional general skills (Tuononen et al., 2017). Generic attributes are specialised alternatives of the general skills that are vital in not only the application of discipline-specific knowledge but in the translation of university learning to unfamiliar settings (Lan, 2020; Torres, 2014; Tuononen et al., 2017). Lastly, some academics have expressed a more complex understating of the generic attributes, stating that they are enabling abilities and aptitudes and have the potential to assist the graduate to transform existing knowledge to generate new knowledge. Reflecting on the varied understandings presented by the academics, Barrie (2006) argues that the lack of a common understanding of the generic attributes may partly explain the inadequate and inconsistent implementation of graduate attributes in university courses.

In addition to the four complex understandings of graduate attributes, Barrie (2006) identifies the following six processes of teaching and learning, namely, remedial, associated, teaching content, teaching process, engagement and participatory.

Academics believe that the development of generic attributes is the responsibility of earlier education experiences and the role of the university in teaching such generic attributes is to provide remedial teaching for those students who have not already developed these skills (Cele, 2021; Lan, 2020). As much as academics agree with the notion that universities have a role to play in developing the generic attributes, they regard the teaching or development of these generic attributes as being unrelated to the teaching of disciplinary-specific content. Essentially, the teaching of generic attributes in an aid to the university curriculum for those students who need it, meaning that the process of developing generic attributes is supplementary to other university-related teaching and learning activities (Barrie, 2006).

Academics also believe that the generic attributes can be developed as part of the taught content of university courses, because the generic attribute curriculum can be included as an integral part of the teaching content of the discipline (Aliu & Aigbavboa, 2021; Cele, 2021). Furthermore, other academics understand the development of the graduate generic skills as being achieved through the teaching process of university courses (Barrie, 2007). The teaching conception is concerned with the manner in which the taught content facilitates the teaching of the generic attributes. Essentially, students develop generic graduateness attributes through the learning opportunities provided by specific teaching processes in the university (Barrie, 2007).

Another perspective shared by academics in the model by Barrie (2007) is the way in which students engage in learning during their university courses. Academics understand the development of generic attributes as being about something that is learnt, not taught, with the learner rather than the teacher owning the learning process. The engagement conception gives responsibility to the students in that the way students engage with learning the discipline-specific content culminates in the development of the generic graduate skills (Barrie, 2007).

Lastly, some academics have expressed another understanding of the development of generic graduate skills. For example, some academics believe that the development of generic attributes is facilitated by the way the student participates in the broader learning experiences of university life. Pivotal to this understanding is that the development of generic graduate skills is not restricted to the formal teaching and learning experiences in the course, but also includes the students' engagement in the learning process (Barrie, 2007).

2.3.3.4 Steur, Jansen and Hofman's (2012) model of graduateness

Steur et al. (2012) posit that a student's graduateness skills and attributes symbolise the holistic development (personal, intellectual and spiritual growth) of the student. Steur et al. (2012) proposed a theoretical model which, unlike other models for generic learning outcomes, explicitly separates graduateness skills and attributes from employability skills. Steur et al. (2012) use the ideas proposed by Stevenson (2003) to explain that the linking of different types of knowledge denotes that graduateness is not merely about expanding knowledge, but also enables the practical application of theoretical knowledge and the enhancement of globally transferrable competencies (Cele, 2021).

The model conceptualised by Steur et al. (2012) classifies graduateness skills and attributes into four main domains, namely, reflective thinking, scholarship, moral citizenship and lifelong learning. These constructs have one thing in common; they refer to the transformation in students, which is considered the essence of graduateness. Reflective thinking is the cornerstone of the model propagated by Steur et al. (2012), with the main assumption being that reflective thinking triggers the other three domains. The four domains as described by Steur et al. (2012) are presented below.

(i) Reflective thinking

Reflective thinking is about analysing a situation and reflecting on the instruments required, such as theoretical knowledge and various skills, to adequately address the situation. In essence, one must be able to assess a situation and apply the knowledge and skills one has gained, based on one's own judgement (Steur et al., 2012). Based on this notion, reflective thinking is a pivotal element of the development of a learner's graduateness and the university's role is to promote the reflective ability of students. Essentially, it is the students' role to be responsive and responsible toward developing a reflective attitude (Ismail, 2017; Steur et al., 2012).

(ii) Scholarship

Scholarship refers not only to basic research skills, which will differ between disciplines, but it is also about a scholarly attitude (Byrne & Johnstone, 1987). A learner that has a scholarly attitude not only masters research skills, but also develops a scholarly stance towards life (Ismail, 2017).

(iii) Moral citizenship

In their model, Steur et al. (2012) highlight the importance of the moral development of students and their responsibilities towards their communities and society. In liberal education, these elements are closely related and students are encouraged to reflect on their own beliefs. Students are not obliged to change their beliefs and opinions, but they need to know where their beliefs come from, and be aware that other people might hold different beliefs from theirs (Ismail, 2017).

(iv) Lifelong learning

Lifelong learning represents the ability to guide one's own learning process and a willingness to learn (Pintrich, 2000). Steur et al. (2012) use lifelong learning to highlight that learning is a continuing process and that learning at the university is not merely a means to an end (results in graduation), but also that the skills learnt empower the individual by enabling him or her to adapt when future situations require knowledge and skills that are not yet known. A graduate must therefore be able to apply the acquired knowledge and skills required to deal effectively with any give situation (Ismail, 2017).

In conclusion, Steur et al. (2012) postulate that graduateness is realised when reflective thinking is linked to any of the domains of scholarship, moral citizenship, lifelong learning or a combination of these. Essentially, reflective thinking can be achieved in any one of the three different ways; however, for reflective thinking to be considered as graduateness, there must be high-level functioning in both reflective thinking and at least one of the other domains. Cele (2021) argues that if universities cultivate domains of graduateness like scholarship, reflective thinking and moral citizenship, the student-support interventions can be more focused and informed by module scores. The model presented by Steur et al. (2012) therefore evolves around the notion that reflective thinking triggers the other three domains, namely scholarship, moral citizenship, lifelong learning (Ismail, 2017).

2.3.3.5 Coetzee's framework for the development of the graduateness skills and attributes

The framework conceptualised by Coetzee (2012a, 2012b, 2014b) for the graduateness skills and attributes underpins this study as it has been developed and validated within the South African context (Coetzee, 2014a) and focuses on distance/adult learners (Coetzee, 2012b). The framework consists of eight graduate skills and attributes that are grouped into three overarching attitudinal domains of personal and intellectual development (Coetzee, 2014b). The three overarching domains are (1) scholarship, (2) global and moral citizenship and (3) lifelong learning. The domains and respective skills and attributes are presented below.

(i) Scholarship

The scholarship domain represents graduates' attitude towards knowledge (Coetzee, 2014b). Smith and Bauling (2013) assert that this domain implies that as scholars, graduates must be capable of and aspire to be lifelong learners. Coetzee (2014b) adds that graduate employees should not only be leaders in the production and application of new knowledge and understanding but they should also be able to apply their knowledge to solving problems and to communicate their knowledge confidently and effectively. The three sets of skills that relate to scholarship include problem-solving skills, analytical-thinking skills and enterprising skills.

- *Problem-solving and decision- making* skills refer to the ability of the graduate employee to consider the complexities of the larger cultural, business and economic reality when attempting to deal with a problem or situation and to initiate the required changes in both their personal and work life (Coetzee, 2012b, 2014b).

- *Analytical thinking skills* entail being skilful in applying critical and logical reasoning and analysis in explaining information and data, drawing insightful conclusions from the numerical data (Coetzee, 2012b, 2014b).
- *Enterprising skills* involve being adventurous and applying critical thinking, initiative and proactivity when engaging in economic activities (Coetzee, 2012b, 2014b). These economic activities may be either to create or operate an enterprise of one's own or to be a substantial contributor to an entity as a graduate employee (Coetzee, 2012b, 2014b). In addition, enterprising also implies functioning autonomously, logically and in a disciplined manner when approaching problems and situations, while considering the consequences of solutions (Coetzee, 2012b, 2014b; Kreber, 2014).

(ii) Global and moral citizenship

The global and moral citizenship domain explains graduates' attitudes towards the world and their communities (Coetzee, 2014). Graduate employees must aspire to contribute to both a local and global community in a holistic, meaningful, ethical and responsible manner (Coetzee, 2014b; Jackson, 2016; Kreber, 2014; Metcalfe et al., 2020; Steur et al., 2012). The three skills set identified by Coetzee (2012b) in this domain include ethical and responsible behaviour, presenting and applying information skills, and interactive skills.

- When a graduate employee demonstrates *ethical and responsible behaviour* they take full responsibility for the consequences of their decisions and actions, and uphold the ethical code and values of the profession, community and workplace. Embedded in this skill set is the willingness to lead in providing direction to others, while motivating and empowering them to behave in an ethical manner towards the community and environment, while accepting responsibility for the consequences of the decisions and actions (Coetzee, 2012b, 2014b).
- *Presenting and applying information skills* refers to a graduate employee's ability to clearly present (verbally or written) their knowledge, facts, ideas and opinions in order to convince their audience. Coetzee (2014b) further explains that the graduate employee should be able to quickly commit information to memory, and use the same information to offer solutions for the benefit of the larger community, or workplace or even at a personal level.

- *Interactive skills* refer to the graduate employee exhibiting the effective and efficient use of language and technology when communicating and interacting with people from diverse cultures, backgrounds and authority levels and building social networks (Coetzee, 2012b, 2014b).

(iii) Lifelong learning

Lifelong learning relates to graduates' attitude towards themselves as lifelong learners. Being a lifelong learner entails the graduate employee being committed and showing a capability to engage in continuous learning in order to further their understanding of the world and their place in it (Barrie, 2006; Coetzee, 2014b). There are two skillsets associated with lifelong learning, namely goal-directed behaviour and continuous learning orientation.

- *Goal-directed behaviour* relates to the graduate employee setting realistic goals, developing plans and taking action to achieve their goals, accomplishing tasks and meeting deadlines (Coetzee, 2014b). This skillset also implies that the graduate employee is able to access the information required to solve problems or make decisions and use technology-based resources (internet) to find new information (Coetzee, 2012b).
- *Continuous learning orientation* refers to graduates' cognitive meta-awareness of and openness to their own learning, their willingness to proactively engage in acquiring new knowledge, skills and abilities throughout their lives and career in reaction to, and in anticipation of, changing technology and performance criteria (Coetzee, 2012b, 2014b).

In summary, the model by Coetzee (2012a) compares well with international frameworks highlighting problem-solving and decision-making, critical thinking, writing and speaking (communication skills), proficiency in English, teamwork, interpersonal skills, research skills, information literacy and ethical awareness as pivotal generic graduate capabilities across various disciplines (Coetzee, 2014b). Additionally the model is cutting edge as it was developed specifically for adult learners pursing online education in an ODeL environment (Coetzee, 2012a, 2014b). Metcalfe et al. (2020) explored the generic graduateness attributes required by food science and technology students using a web-based questionnaire for graduateness. They accordingly noted in particular attributes related to general employability skills, general communication skills, leadership and management skills, and diversity management skills. Ismail (2017) explored the interaction effect between individuals' graduateness skills and attributes (overall graduateness, scholarship, global/moral citizenship and life-long learning) and self-esteem in moderating their career adaptability. Ismail (2017) reported a positive relationship between the self-esteem and graduateness skills of young emerging adults in the school-to-work transition phase, and further observed that individuals with low scores on career adaptability also achieved low scores on overall graduateness skills and attributes, global/moral citizenship and lifelong learning

Based on the models presented above, the following section provides an evaluation of the models and decisions regarding their applicability to the current study.

2.4 EVALUATION OF THE GRADUATENESS MODELS

The following section provides an overview of the models, highlighting the basic premise of each. Furthermore, reasons for why the models that have been either included or excluded from the study are presented.

2.4.1 Models excluded from the empirical study

Bennett et al. (1999) presented a model of graduate employability in which they distinguished between five elements of course provision in HE, namely, disciplinary content knowledge, disciplinary skills, workplace awareness, workplace experience and generic skills. This model was however excluded from the study because the constructs have not been operationalised and, hence, they cannot be empirically measured.

Yorke and Knight (2006) developed a model encompassing four broad yet interrelated components, namely, 1) the understating of the subject matter and the aspects relevant to one’s performance in the organisation, (2) skilful practices in context, (3) self-efficacy beliefs (relating to one’s personal qualities that may influence one’s success in both work and personal life), and (4) metacognition (which include reflection and self-regulation). The model was not, however, included in the current study as it was designed for the United Kingdom (UK) and has not been validated for use in multicultural contexts.

Barrie (2007) provides a framework that focused on highlighting the differing perceptions of academics on the development of graduateness skill and attributes. Although the model provides insights on how the differing views on the development of the generic graduateness skills have influenced the implementation of the graduateness agenda, the constructs in the model cannot be operationalised and empirically validated. Moreover, the model was developed for the Australian higher education context and is yet to be validated in the multicultural South African context.

2.4.2 Models included in the empirical study

In their model, Steur et al. (2012) distinguish graduateness from employability. The model highlights the importance of reflective thinking, scholarship, citizenship and lifelong learning as the elements of graduateness. The domains identified by Steur et al. (2012) are closely related with those identified by Coetzee (2012a), therefore the model was included in the current study.

Coetzee (2012a) identified eight core skills and attributes categorised into three overarching attitudinal domains, namely scholarship, global and moral citizenship and lifelong learning, which are based on the work of Barrie (2006) and Steur et al. (2012). This model was included in the current study and underpins the study. Coetzee's (2012a) model was designed and validated for use in the multicultural South African context specifically in an ODeL context. The model is therefore applicable for use in the current study, as it was developed and validated using a sample comprising adult learners pursuing further education in an ODeL environment within the multicultural South African context. The instrument was further validated with a final sample of 1102 undergraduate ODL adult students (Coetzee, 2014). Coetzee (2014) reported that the empirical evidence supported the eight-factor theoretical framework as conceptualised by Coetzee (2012a), and further confirmed the measurement accuracy, validity and usefulness of the GSAS in assessing students' graduateness skills and attributes.

The following section presents the socio-biographical variables pertinent to this study. These variables are important as they influence the way adult learners perceive and develop their graduateness skills and attributes within an ODeL environment.

2.5 INFLUENCE OF SOCIO-BIOGRAPHICAL VARIABLES

In this section, a discussion and integration of the socio-biographical variables influencing the employability and graduateness of adult learners in the contemporary employment and ODeL contexts will be presented. Gaining insight and understanding into how these socio-biographical variables influence the development and perception of student graduateness may give insight on the aspects that academics and higher education institutions, especially ODeL institutions, consider with regard to developing the graduateness skills and attributes of ODeL learners.

2.5.1 Age

Porter and Donthu (2006) discuss how age, education, income and race influence beliefs about the internet and online learning. Their study found that older and less educated consumers had lower perceived ease of use of the internet and would therefore be less inclined to engage in online learning. Boeren (2011) found that older low-skilled blue-collar workers showed much lower levels of interest in pursuing further education, while younger high-skilled white-collar workers showed higher levels of interest and a propensity to engage in further education.

Participants below the age of 50 years scored significantly higher than the other age groups on success orientation and self-efficacy. Botha and Coetzee (2017) also note that with regard to success orientation, the mean scores increase with age, indicating that older participants have acquired experience, confidence and self-belief, resulting in them being more success oriented as compared to younger participants (18–25 years) who are yet to master the necessary life skills. Additionally, Botha and Coetzee (2017) found that participants in the age group 41–50 years scored significantly lower than the other age groups on self-efficacy.

The current study aims to provide insight on how people from different age groups, with different technological abilities, perceive their graduateness in an ODeL context.

2.5.2 Gender

Lee (2002) found that male learners showed a more positive change in behaviour and higher motivation for learning than female students. Chuang and Tsai (2005) confirm these findings as they found that male students preferred online study at university level more than females. However, other scholars have reported findings that contradict those presented by Lee (2002). Boeren (2011) found that women did not take up work-related learning opportunities, as they are generally less employed in demanding jobs that require them to engage in the continuous upgrade of their knowledge and skills compared to males. This results in women not taking up the opportunities to participate in work-related learning. Coetzee (2012b) confirms these findings in that female participants expressed more positive views about their graduateness skills and attributes, but they had significantly more negative views about future career prospects. Coetzee (2012b) and Oosthuizen and Naidoo (2010) try to explain this as being attributed to female participants still experiencing limited career advancement opportunities in a historically male-dominated work environment. Goodman and Tredway (2016) reported contradictory findings as their female participants saw themselves as more attractive to prospective employers compared to their male counterparts. Goodman and Tredway (2016) attribute this to South Africa's employment equity legislation and that in many industries women remain under-represented relative to men. Botha and Coetzee (2017) found that males scored higher than females on success orientation and engaged activity.

Casillas et al. (2017) conducted a study among 580 education students in Spain to evaluate their digital competence on three dimensions: knowledge, use of and attitudes toward ICT. Female students were reported to have a more favourable attitude towards ICT, although male students showed higher levels of knowledge and use of technology. In contrast, Rhema and Miliszewska (2014) evaluated the attitudes of 348 engineering students at the University of Tripoli (Libya) regarding their access to technology, use of technology for learning, skill in technology and satisfaction with technology. No differences were reported on these measures by gender or geographical location regarding their attitude toward ICT. Kar et al. (2014) also reported similar biographical findings to those reported by Rhema and Miliszewska (2014). Kar et al. (2014) measured the attitude of 308 university students toward e-learning and found no differences with respect to gender, place of birth or study discipline in relation to ICT

The findings from this study may add to the existing knowledge base on how females and males view their graduateness and employability.

2.5.3 Ethnicity

Ethnicity relates to shared characteristics based on cultures, traditions and national origins, while race is a socially constructed concept pertaining to a group pf people with observed or attributed shared characteristics (Rao et al., 2021). However, the term "race" has been manipulated within systems to classify groups of people, unjustly affecting their access to services, policies and institutions (Delgado & Stefancic, 2012; Rao et al., 2021). For the purpose of this study, ethnicity will be used to describe groups of participants with shared cultures, traditions and origin.

Coetzee (2012b) found that Indian female participants had significantly more positive views about their graduateness skills and attributes compared to other race groups and Africans reported lower scores on the graduateness skills and attributes generally. In their study, Botha and Coetzee (2017) found that their Indian participants scored significantly higher than the other race groups on the strategic utilisation of officially provided resources and engaged academic activity. Moreover, the white participants scored significantly higher than the other race groups on success orientation, while the coloured participants scored significantly lower than the other race groups on strategic utilisation of officially provided resources. Additionally, Botha and Coetzee (2017) report that their African participants obtained significantly lower scores than the other race groups on success orientation and engaged academic activity. From a review of the literature, it is evident that there is a paucity of studies exploring how various ethnicity groups perceive their graduateness skills and attributes. Considering the multicultural South African context, it will be beneficial to gain an understanding on how adult learners from different race groups perceive their graduateness and employability.

2.6 SYNTHESIS AND EVALUATION

A synopsis of the contemporary world of work highlights the opportunities and challenges faced by employees. In a volatile world of work, employees are faced with the challenge of staying employable (Francis & Flanigan, 2012; Helyer & Lee, 2012). The 4IR has not only changed the way organisations function but has also transformed module offerings at universities (Briede & Popova, 2020; Mian et al., 2020). Organisations are also faced with the challenge of maintaining a competitive edge over other organisations and are forced to adapt to the challenges brought about by globalisation and continuous technological developments (Burger et al., 2013; Cascio, 2001). Additionally, adult learners in the digital era must equip themselves with the 21st century skillset (Trilling & Fadel, 2009; Tseng et al., 2020) in order to meet societal and work expectations (Oz & Ozdamar, 2020).

None of the most notable changes in the broader economic context includes the shift in markets to a more knowledge-based economy. The dawn of the knowledge economy has resulted in universities finding themselves faced with the challenge of producing skilled graduates (Daniels & Brooker, 2014). Mark (2013) and Daniels and Brooker (2014) assert that the changing image of universities and students has influenced the expectations that students and the labour market have of university education. Daniels and Brooker (2014) further add that with the increased demand for quality education in universities, students have an expectation of attaining secure and rewarding employment.

The 4IR and ICT have taken over people's everyday lives (Briede & Popova, 2020; Mian et al., 2020), with major changes being introduced in education (Martínez et al., 2020) and the increased use of in within modern-day educational processes (Cabi & Kalelioglu, 2019). Advancements in technology have seen online learning being acclaimed as the most effective mode of training for adult learners, as it provides flexible learning schedules which can be incorporated into the life role of adult learners generally (Sato et al., 2017). Trilling and Fadel (2009), Tseng (2020), Tseng et al. (2020) and Xing and Marwala (2017) highlight that adult learners in the digital era need to possess critical thinking, knowledge operational thinking, emotional intelligence, knowledge generation and management, which are the skillset required in the 21st century. Oz and Ozdamar (2020) concur with scholars on the 21st century skillset and further opine that adult learners need to be able to meet societal and work expectations as postulated by Tomlinson and Anderson (2020).

Tomlinson and Anderson (2020) emphasise how important it is for graduates to develop and enact their employability identity so that when they enter the labour market they will present themselves to possible employers as suitable for employment. As such, adult learners are faced with the challenge of not only acquiring the technical skills required for online learning environments (Kim & Kim, 2018) but also with the even bigger task of becoming and remaining technically competent in the required professional skills in order to remain employable (Heang et al., 2019).

This chapter provided insight on the graduateness agenda. with various models being discussed, culminating in the following definition of graduateness. Based on the assumptions discussed in the chapter it can be argued that a student's graduateness skills and attributes symbolise the holistic development of personal, intellectual and spiritual growth within the student (Demir & Yurdugül, 2013; Steur et al., 2012). Graduateness also reflects the holistic transformation of the student while engaging with his or her learning in the HEI (Barrie, 2007), and the relevance of the skills and attributes these graduates bring to the workplace (Coetzee, 2012a; Steur et al., 2012). Holistically, the graduateness skills and attributes of current and prospective employees are imperative in creating the type of workplace that allows innovation, adaptability and flexibility to thrive (Ismail, 2017; Thompson et al., 2008).

Based on the review of literature, the models promulgated by Steur et al. (2012) and Coetzee (2012a) were applied to the current study. However, in the vast discussion on student graduateness, Daniels and Brooker (2014) highlight a concern relating to the lack of student involvement in the approach to developing their graduateness skills and attributes. Essentially, graduateness skills and attributes require students who are shaped to fit into an institutionally defined concept of work readiness (Daniels & Brooker, 2014) with little to no emphasis on how the student develops their own identity as an employable, work-ready graduate. Additionally, the increased prevalence of ICT-based services requires that adult learners succinctly formulate their employability identity so as to present themselves as relevant to both employers and to society (Tomlinson & Anderson, 2020). Notably, the roles that students play in gaining the graduateness skills and attributes is not explored and is an area worth exploring in future studies, specifically around the ideology of student graduateness and employability (Tomlinson & Anderson, 2020).

2.7 CHAPTER SUMMARY

This chapter addressed the first research aim, namely, to conceptualise the employability and graduateness of adult learners in the contemporary employment and ODeL contexts. Models of graduateness and employability were presented with decisions made on the relevance of some of the models for the current empirical study. The influence of the socio-biographic characteristics of age, gender and ethnicity were explained in relation to graduateness and employability. A synthesis and evaluation of graduateness was presented, culminating in a summary of the chapter.

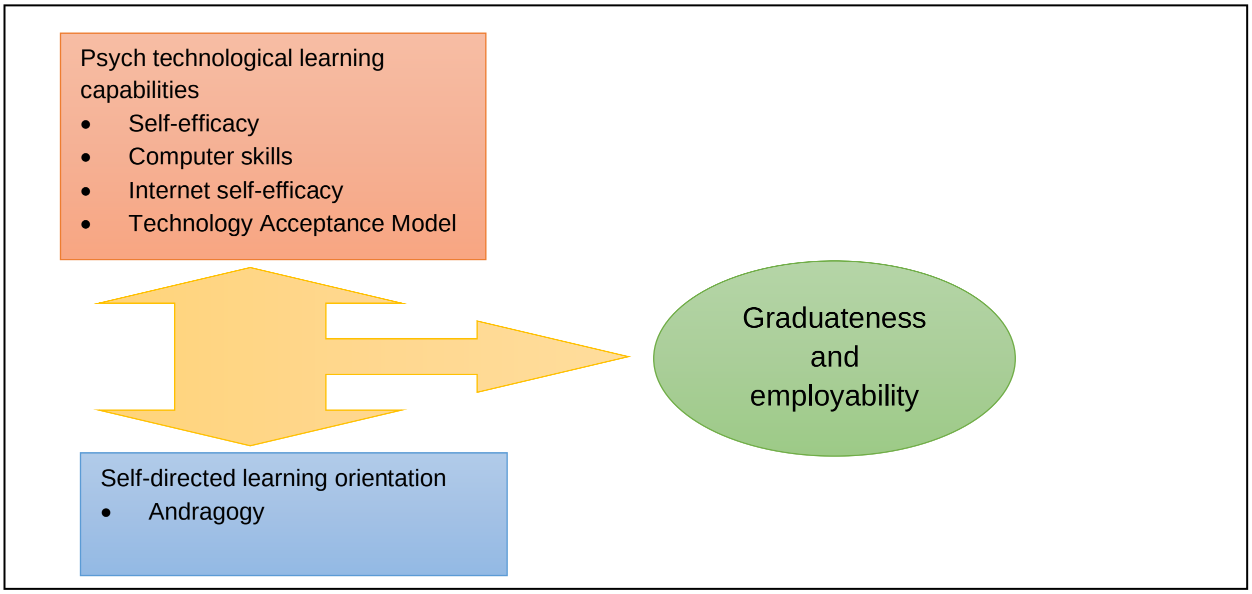
Chapter 3 discusses the questions pertaining to the conceptualisation the constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) and self-directed learning orientation from a theoretical perspective.

CHAPTER 3: PSYCHO-TECHNOLOGICAL LEARNING CAPABILITIES AND SELF-DIRECTED LEARNING

This chapter focuses on the conceptualisation of psycho-technological learning capabilities and the self-directed learning of students in an ODeL environment. A detailed discussion of the psycho-technological learning capabilities (computer skills and technical self-efficacy) and self-directed learning orientation in relation to developing graduateness skills and attributes and to encourage the employability and life-wide learning of students is presented. Socio-biographical characteristics, namely, age, gender and ethnicity, are explored in relation to online learners' psycho-technological learning capabilities and self-directedness. In conclusion, an integration of the psycho-technological learning capabilities and self-directedness of ODeL students, with a specific emphasis on the influence these have on student performance and success in their in online studies, is presented. In addition, a definition of the concept of psycho-technological learning capabilities (computer skills and technical self-efficacy) and its theoretical elements in regard to students in an online environment, pertinent to this study, is also provided. An overview of the major constructs of psycho-technological learning capabilities and self-directed learning orientations are summarised in Figure 3.1 below.

Figure 3.1

Overview of the Major Constructs of Psycho-Technological Learning Capabilities and Self-Directed Learning Orientation



Source: Author's own work

3.1 PSYCHO-TECHNOLOGICAL LEARNING CAPABILITIES

In this section, the two facets of psycho technological learning capabilities of ODeL learners are presented, namely computer skills and technical self-efficacy. In addition, the theories and models underpinning the conceptualisation of psych-technological learning capabilities are given.

The concept of psycho-technological learning capabilities encapsulates adult learners' computer skills and internet self-efficacy in an online learning environment. Pertinent to this is the adult learner's belief that they have the psychological and technical capabilities (skills to use a computer and self-efficacy in using the internet) to implement and organise the course of action necessary to achieve a particular goal. The conceptualisation of this construct is based on human agency and social cognitive Theory (Bandura, 1977, 1982). Therefore, the relevance of self-efficacy in this construct is based on the assumption that learners pursuing online tuition must, in addition to self-perceived skills, have a self-perceived confidence in their ability to use a computer (Hayashi et al., 2004; Kuo et al., 2020). They should also believe that they are capable of executing tasks that require the internet (Eastin & LaRose, 2000; Kuo et al., 2013, 2014, 2020; Romero Martinez et al., 2020; Porter & Donthu, 2006).

The following section provides a definition and discussion of self-efficacy, culminating in a conceptualisation of computer skills and internet self-efficacy. The section will conclude with a motivation for the relevance of both computer skills and internet self-efficacy for the current study.

3.1.1 Self-efficacy

Bandura (1977) conceptualised self-efficacy as people's beliefs about their capabilities to perform activities that have influence over their lives (Aslan, 2021; Bandura, 1977; Bandura & Adams, 1977; Coetzee & Oosthuizen, 2012; Keshavarz, 2020; Kuo et al., 2020). Essentially, self-efficacy beliefs determine how people feel, think, motivate themselves and behave. Such beliefs produce diverse effects through four major processes, namely, cognitive, motivational, affective and selection processes (Bandura, 1977, 1982). Puzziferro (2008) further suggests that perceived self-efficacy has a mediating influence on an individual's behaviour, especially if a behavioural task is attempted, and the associated effort to persist in the task. In their definition of self-efficacy, Lent et al. (2017) assert that the expected outcomes are central motivators for a behaviour, thereby enabling the individual to engage in a so called "goal-action-outcome" process. Kuo et al.

(2020) contextualise self-efficacy, maintaining that it is pivotal in predicting student learning and is important to consider when exploring online learning environments (Hodges, 2008).

In social learning theory, Bandura (1977) postulated that changes in behaviour produced by different methods of treatment are informed by a common cognitive mechanism. Essentially, psychological processes, in whatever form, serve as ways of creating and strengthening expectations of one's personal effectiveness (Bandura & Adams, 1977). The stronger the self-efficacy the more active the coping efforts (Bandura & Adams, 1977).

Bandura (1989) describes cognitive functioning as a holistic view on obtaining specialised knowledge and possessing the cognitive skills for operationalising and using specialised knowledge. From this description it is apparent that an individual must have either general knowledge or specialised knowledge on what they want to do, so as to achieve their desired goal (Bandura, 1989; Lin et al., 2020). Wood and Bandura (1989) further refine the definition of self-efficacy to refer to the belief in one's capabilities to use the motivation, cognitive resources and courses of action needed to meet the given demands of a situation.

Social cognitive theory, as conceptualised by Bandura (1989), is underpinned by the model of emergent interactive agency, in terms of which people are viewed as contributing to their own motivation and actions (Mozahem, 2020), hence, the notion of "reciprocal causation" (Bandura, 1989; Mozahem, 2020). This model presents three elements as being pivotal to motivating an individual to engage in a particular action. These elements relate to (1) actions; (2) cognitive, affective, and other personal factors; and (3) environmental events as interacting determinants. Bandura (1989) focused more on the mechanisms that influence human agency, and not the three elements of emergent interactive agency (Mozahem, 2020). The application of emergent interactive theory culminates in the conceptualisation of self-efficacy – a person's belief about their capabilities to control events that affect their lives (Bandura, 1989). Self-efficacy is central to human motivation and subsequent actions are built on three assumptions, namely (1) cognitive, (2) motivational, (3) affective, and (4) selective intervening processes (Bandura, 1977, 1989). Bandura began the debate on the principles in 1977, culminating in these assumptions being scientifically interrogated and conceptualised in 1989. For the purposes of the current study, the three foundational assumptions of self-efficacy, as proposed by Bandura (1989), will underpin the discussion around the conceptualisation of the construct of self-efficacy.

3.1.1.1 Cognitive processes

Bandura (1989) postulates that one's belief in one's capabilities can influence how one sets personal goals. The higher the perceived self-efficacy, the higher the personal goals an individual will plan to pursue and achieve. Essentially, this self-evaluation, along with self-aiding thoughts, inevitably results in an affirmed commitment to achieve the planned or set personal goals. Bandura (1989) further argues that the role of cognitive processes (thoughts) is to empower the individual to predict how events will unfold and to mentally formulate possible courses of action to control the events. This happens on a daily basis as well as for future planned activities. However, Bandura (1989) explains that in the face of possible failures, an individual must possess a high level of self-efficacy to remain focused on the task and the resultant goal. People who strongly believe in their problem-solving capabilities tend to have higher analytical thinking skills which subsequently allows them to apply these skills in complex decision-making processes. In conclusion Bandura (1977, 1989) asserts that an individual's perceived self-efficacy influences the types of anticipated scenario they construct and plays a role in the way the individual envisages their successes.

3.1.1.2 Motivational processes

An individual's perceived self-efficacy beliefs determine their level of motivation, as evident from how much effort they exert and how long they preserve a particular action. Essentially, the stronger the belief in one's capabilities to overcome obstacles, the more persistent the efforts in achieving one's personal goals (Bandura, 1989).

3.1.1.3 Affective processes

Affective processes relate to individuals' emotional responses when faced with stressful and anxiety provoking situations. Bandura (1989) explains that the levels of stress and anxiety that people experience in a situation affect their beliefs in their capabilities and levels of motivation. The emotional reactions associated with the anxiety and stress experienced can either directly or indirectly affect an individual's planned actions, resulting in him or her altering their thoughts around or envisaged success at a particular task (Bandura, 1989). The essence of this assumption is that if an individual believes that he or she can exercise control over potential threats or setbacks, they do not become apprehensive about the task but preserve and achieve their planned goals. Bandura (1989) further states that a person who believes they cannot manage or cope with potential threats and challenges experiences high levels of stress and anxiety and, subsequently, withdraws from continuing with planned tasks or activities. The important aspect emphasised by Bandura in his argument is the role of coping with and internal locus of control in an individual when faced with unexpected challenges, hence the notion of human agency as explained by Bandura (1989).

3.1.1.4 Selection processes

Bandura (1989) asserts that people exert some influence over life by choosing or selecting environments or even creating their ideal environment. Evaluations of one's self-efficacy are important here in that people tend to avoid activities and situations they believe exceed their coping abilities (Bandura, 1989). Essentially, people take on activities and select social environments where they feel they will be capable of exerting control. Bandura (1989) further suggests that factors that influence the choice of behaviour have a high impact on the direction of an individual's personal development, as he or she is most likely to select social influences in the immediate environment that promote certain competencies, values and interests for reinforcing the chosen behaviour.

In summary, it is evident from the discussion above that self-efficacy is a culmination of complex processes entailing self-persuasion based on the critical evaluation of information from an array of sources readily available to an individual (Kuo et al., 2020; Lin et al. 2020). The sources of self-efficacy, as conceptualised by Bandura (1989), include performance mastery; vicarious experiences of judging one's capabilities in comparison with how others perform; verbal persuasion; and lastly, physiological states from which one may judge or evaluate one's own capabilities, strengths and vulnerability. Understanding self-efficacy (computer and internet) in conjunction with the self-directed learning orientation of adult learners is important, and culminates in the development of adult learners' graduateness skills and attributes and subsequent employability.

3.1.2 Self-perceived computer skills

Gong et al. (2014) and Keshavarz (2020) define self-perceived computer skills as the self-efficacious self-perceived judgement of an individual's capability to use a computer. Hsia et al.

(2014) suggest that the notion of self-perceived computer skills is embedded in self-efficacy and refers to the individual's confidence level in regard to having the skills to control their behaviours and outcomes within the technology environment. Hayashi et al. (2004) further define self-perceived computer skills as a person's' judgement of their own capability to use a computer, with specific reference to what one can do on a computer in the future. Bao et al. (2013) support the definition proposed by Hayashi et al. (2004), stating that self-perceived computer skills refers to an individual's confidence to apply specific skills in using a computer. Keshavarz (2020) further emphasises that computer self-efficacy can be applied to both the level of computer-based behaviour and computer use, especially in the enrolment of computer courses and uptake of technology-based learning.

Hsia et al. (2014) acknowledge that despite the recognised individual differences in e-learning, personality variables influence how an individual accepts and uses technology. Personality variables considered by Hsia et al. (2014) to influence an individual's acceptance and use of technology in e-learning include locus of control, internet self-efficacy and efficient computer skills. Individuals with high computer self-efficacy believe they are capable of performing well when using a computer and online systems. These students tend to be more willing to pursue online learning and are more willing to attempt various e-learning systems and more persistent in figuring out how things work. The emphasis here is not on what the person has achieved when working with a computer, but rather the perceived ability to apply learnt skills to broader and more complex tasks in the future (Hayashi et al., 2004). Hsia et al. (2014) agree with Hayashi et al. (2004) that computer self-efficacy refers to an individual's judgement of their capability to use a computer in performing simple tasks like copying or restoring data. Hsia et al. (2014) further suggest that computer self-efficacy refers to an individual's assessment of their capability to accomplish complex tasks on a computer, for instance using software to analyse data.

For the purposes of this study, self-perceived computer skills will refer to the belief that online learners have about their skills to execute more complex computer-related tasks within the online learning environment. Pertinent to this study is how adult learners assess their technical skills (basic computer literacy) and how their basic knowledge and self-perceived beliefs in using a computer assist them in successfully attempting further studies in ODeL environments. Prinsloo and Van Rooyen (2007) explored the basic computer literacy skills of adult learners in an ODeL environment, along with their access to a computer, in an attempt to understand how introducing a range of technologies and other support mechanisms can minimise the impact of geographical separation and transactional distance between students and lecturing staff. Transactional distance refers to the amount of interaction and dialogue between students and lecturers (Kuo et al., 2020; Prinsloo & Van Rooyen, 2007). Essentially, the higher the amount of interaction and dialogue, the less “distance” there is in the pedagogical “transaction” between the lecturer and the student (Prinsloo & Van Rooyen, 2007). Incorporating self-perceived computer skills in this study provided insight into whether adult learners have access to computers, as well as their technical skills and self-perceived beliefs that they can perform basic tasks on a computer related to their online studies. Thongsri et al. (2020) assert that if a person has positive perceptions about their confidence in using a computer (computer self-efficacy) they are more likely to view e-learning with equanimity and further view their interaction with a computer system as requiring minimal effort.

In their study, Thongsri et al. (2020) found that computer self-efficacy influences students' acceptance of technology. Additionally, it was reported that if learners are competent in using computers to help with their learning process, they are more likely to accept online learning compared to students who perceived their ability to use a computer to be low (Thongsri et al., 2020). He and Freeman (2019) reported that female students felt less confident with computers as they had learnt less and had minimal practical exposure to using computers compared to their male counterparts.

3.1.3 Internet self-efficacy

The rise in internet-based learning has resulted in adult students having access to education opportunities (Chu & Tsai, 2009). Eastin and LaRose (2000) and Kuo et al. (2014) define internet self-efficacy as an individual's self-perceived confidence in their ability to plan and perform internet-based tasks in order to accomplish an online assignment. Keshavarz (2020) provides a more detailed definition of internet self-efficacy which includes the ability to send files, create presentation files, work with software and use computers for problem-solving, decision-making, information searching and programming.

Kuo et al. (2014) and Eastin and LaRose (2000) further highlight that internet self-efficacy is positively related to internet experience and use. Essentially, the more an individual uses the internet and gains experience in navigating their way on the internet, the more likely their confidence levels will rise with regard to using the internet. Additionally, people with a positive attitude towards technologies are more likely to have higher internet self-efficacy compared to those who have a negative attitude towards technologies (Kuo et al., 2014; Rafiola et al., 2020). Eastin and LaRose (2000) affirm this and suggest that a learner's confidence level in performing internet-related tasks may subsequently influence their interaction with, amongst other things, the course content of an online programme. Chang et al. (2014) explored the internet self-efficacy of college students attempting an online course and found that male students showed a higher level of intent self-efficacy than the female students. Kuo et al. (2020) voice their concern at the paucity of studies that investigate the influence of age and gender on levels of internet self-efficacy. In their study, Kuo et al. (2020) found that gender and age did not significantly influence internet self-efficacy, although female students appeared to be more confident in using the internet to perform required tasks.

In conclusion, self-perceived computer skills and internet self-efficacy are deemed relevant to the current study, as the focus of the study is on assessing adult learners' skills in using both a computer and the internet for their online studies. These two attributes involve the capability to organise and execute internet-related actions to accomplish online tasks and/or assignments (Eastin & LaRose, 2000; Huo et al., 2014). The more a student cannot efficiently use or benefit from a computer, the more they find the use of a computer to be an extra task (İşman & Çelikli, 2009). Students' internet self-efficacy and beliefs about online learning are critical determinants of their attitudes towards online learning (Madu et al., 2011; Nyoni, 2014; Porter & Donthu, 2006). The higher the learner's confidence levels in using both a computer and the internet in their studies and the more self-directed they are, the more likely it is that they will develop graduateness skills and attributes, resulting in increased chances of being employable (Jackson, 2016).

3.1.4 Technology Acceptance Model

The Technology Acceptance Model (TAM) was developed by Davis in 1989 based on two theories used to predict and explain behaviour, namely, the theory of reasoned action conceptualised by Fishbein and Ajzen in 1975 and the theory of planned behaviour conceptualised by Azjen in 1975 (Francom et al., 2021; Sagnier et al., 2020). Mehta et al. (2021) assert that the TAM is a widespread framework for consumer behaviour when using e-technologies and systems generally. Sagnier et al. (2020) explain that the TAM suggests that a person's intention to use any given technology is based on two perceptions, namely, its perceived usefulness and its perceived ease of use. Perceived usefulness refers to the belief that a technology tool or resource will assist in enhancing a job or task performance (Francom et al., 2021; Sagnier et al., 2020). Perceived ease of use refers to the belief a person has that the use a technology tool or resource will require low effort (Sagnier et al., 2020). Rabin et al. (2020) reported that learners in the early adulthood stage (20–35 years) and mid-life stage (36–50 years) experienced external barriers such as work and family issues. Pertinent to the current study is the construct of perceived ease of use, it is believed that the more a student perceives technology to require low effort the more likely the student will accept online learning (Lazim et al., 2021).

3.2. CONCEPTUALISING THE CONTENT DOMAINS OF THE PSYCHO-TECHNOLOGICAL LEARNING CAPABILITIES SCALE

Based on the above review of the literature, the theoretical underpinning of the psycho-technological learning capabilities of open and distance online learners is constructed as follows:

The previous section explained that the construct of psycho-technological learning capabilities encapsulates self-perceived computer skills and internet self-efficacy. These two constructs reflect the dynamics between psychological aspects such as self-evaluations of skills and sense of confidence, as applied to the use or interface with technology in the ODeL learning environment; hence, the reference to psycho-technological learning capabilities. For the purposes of developing items for the measurement scale, the construct *self-perceived computer skills* was regarded as referring to online learners' evaluation of their own capability to use a computer, with specific reference to what one can do on a computer in the future (Hayashi et al., 2004; Kuo et al., 2020). In addition, the construct assessed online learners' confidence to apply specific skills related to using a computer and the belief they have that they are capable of performing well when using a computer and online systems (Bao et al., 2013). *Internet self-efficacy,* on the other hand, was regarded as referring to online learners' capability to arrange and perform the required internet-related tasks to produce an output (Kuo et al., 2014, 2020). The assumption and basis for the measurement of the internet self-efficacy construct is that the more an online learner uses the internet and gains experience at navigating their way on the internet, the more likely their confidence levels will rise with regard to using the internet (Kuo et al., 2014) and in performing complex tasks using the internet (Eastin & LaRose, 2000). Based on the theoretical backdrop, psycho-technological learning capabilities are defined as the self-perceived efficacy beliefs of adult learners in an ODeL context in relation to the use of a computer and performing internet-related tasks in order to complete their online studies.

The Psycho-Technological Learning Capabilities Scale (PTLCS) is a newly developed scale, which was developed for the purposes of this research study. To the researcher's knowledge, currently no South African instrument exists for measuring the psycho-technological learning capabilities (computer skills and internet self-efficacy) of adult learners in ODeL contexts and, thus, the researcher developed an instrument for this study. The PTLCS is based on the theoretical foundations discussed in this section (section 3.2).

In the ODeL context, adult learners' psycho-technological learning capabilities are defined as the self-perceived efficacy beliefs of adult learners in an ODeL context in relation to using a computer and performing internet-related tasks in order to complete their online studies (Bao et al., 2013; Eastin & LaRose, 2000; Kuo et al., 2014, 2020; Nyoni, 2014; Prinsloo & Van Rooyen, 2007).

The questionnaire items for the PTLCS were developed based on extensive reading of the literature (published research articles, published dissertations and textbooks on the topic of self-efficacy (computer and internet), as well as the researcher's personal experience with adult learner behaviour in an ODeL environment.

The development of the PTLCS was underpinned by Bandura's (1989) human agency perspective on social cognitive theory, Eastin and LaRose's (2000) internet self-efficacy scale and Prinsloo and Van Rooyen's (2007) research on computer skills and internet literacy. It is imperative to assess how adult learners' psycho-technological learning capabilities (computer skills and internet self-efficacy) relates to their self-directed learning orientation and graduateness. The research findings on technical self-efficacy (computer and internet), with specific reference to HE and the open distance learning environment, were analysed and assimilated in order to determine the relevance of various concepts to the open distance, HE milieu. Particular areas of interest that were studied included the concepts of self-efficacy, andragogy and learner self-directedness (Bandura, 1977, 1989; Knowles, 1984; Merriam, 2001; Steur et al., 2012).

In the formulation of the constructs and items to measure the psycho-technological learning capabilities of open and distance online learners, it is assumed that learners with high beliefs in their abilities to use a computer and the internet, and have a positive outlook on technologies, are more likely to succeed in open and distance (Nyoni, 2014) and online learning (Kuo et al., 2014, Vimalkumar et al., 2021).

The PTLCS is divided into three dimensions, namely access, computer skills and internet self-efficacy beliefs. Items for the PTLCS were developed to assess general access and skills in using a computer and the internet; and beliefs that online learners have of their ability (self-efficacy) to perform complex tasks on a computer and on the internet. The work done by Prinsloo and Van Rooyen (2007) was used to guide the development of the PTLCS items measuring self-perceived efficacy in the use of computer skills. Additionally, the internet self-efficacy scale proposed by Eastin and LaRose (2000) was used as a foundation to develop the items to assess the internet self-efficacy skills on the PTLCS.

Regarding the wording of the items for the PTLCS, Haladyna and Rodriguez (2013) advise that all items should be simple, concise, and written to the reading level of the intended participants, to avoid interference with the content being measured. Lambie et al. (2017) further suggest that Kline’s (2005) nine rules be adhered to in the development of sound scale items, namely (1) deal with one central thought per item; (2) be precise; (3) be brief; (4) avoid difficult wording; (5) avoid irrelevant information; (6) avoid terms like *all* or *none*; (7) present item in positive language; (8) avoid double negatives; and (9) avoid unspecified terms like *sometimes* or *frequently*. These aspects were taken into consideration in the development of the items for the PTLCS.

The work done by Eastin and LaRose (2000) was deemed relevant in that these scholars indicate that the instruments used to measure computer and internet self-efficacy were based on the TAM (Erasmus et al., 2013; Gokcearlsan, 2017; Hayashi et al., 2004; Saadé & Kira, 2009; Venter & Prinsloo, 2011) and measured self-efficacy for overall internet usage (Kuo et al., 2014). Eastin and LaRose (2000) found that there was no existing measure to assess internet self-efficacy on specific internet-related tasks, for instance using a browser, writing HTML (Kuo et al., 2014). Additionally, the TAM has been used an underpinning theoretical model to assess computer skills self-efficacy and also used to measure the technology usage satisfaction, acceptance and adoption (Francom et al., 2021; Mehta et al., 2021; Saadé & Kira, 2009). The only instrument found that measured internet self-efficacy, focusing on specific internet-related tasks and not just internet usage generally, was the instrument developed by Eastin and LaRose (2000).

The TAM informed the development of the PTLCS, more specifically the construct of "perceived ease of use" of technology tools and resources (Sagnier et al., 2020). Sagnier et al. (2020) describe perceived ease of use as the belief a person has that the use of a technology tool or resource will require low effort. Taat and Francis (2020) found that students' level of acceptance of e-learning was significantly influenced by the perceived ease of use of technology tools and resources and where e-learning could provide them with good, detailed, timely and accurate information. Essentially, the more a student perceives technology to require low effort the more likely the student will be to accept online learning and ultimately develop the intention to use technology tools and resources (Lazim et al., 2021).

Table 3.1 below provides a summary of the dimensions and items comprising the PTLCS (see Annexure C for the scale items). The table further indicates the theoretical underpinning informing each item on the instrument. It is important to note that the dimension of access was not regarded as a factor, merely as a control variable to monitor whether access to a computer and the internet influenced the responses on the factors computer self-efficacy and internet self-efficacy. In summary, a two-factor structure for the PTLCS was hypothesised.

Table 3.1

Subscale Contents of the PTLCS.

	Question number	**Questionnaire items**	**Theoretical underpinning**
Psycho-technological learning capabilities **Definition:** The self-perceived efficacy beliefs of adult learners in an ODeL context to use a computer and perform internet-related tasks in order to complete their online studies.			
Control variable: Access (2 items) **Definition:** Describes the students' general access to a computer and internet connectivity for study purposes.			

Question number	Questionnaire items	Theoretical underpinning
Q1	I have access to a computer for my studies.	Adapted from Prinsloo and Van Rooyen (2007).
Q2	I have access to the internet for my studies.	Self-developed based on the work done by Prinsloo and Van Rooyen (2007).
Factor 1: Self-perceived computer skills (7 items) **Definition:** Measure the student's ability to save and transfer files on electronic platforms, to use electronic search engines to find information and to unilaterally download software for a computer.		
Q3	I can download software for my computer without assistance.	Self-developed based on the work done by Eastin and LaRose (2000).
Q4	I can create folders to save my documents.	Self-developed based on the work done by Prinsloo and Van Rooyen (2007).
Q5	I can use search engines to find additional resources on the internet	Self-developed based on the work by Eastin and LaRose (2000) and Prinsloo and Van Rooyen (2007).
Q6	I back up my files every week to safeguard my work.	Self-developed based on the work done by Prinsloo and Van Rooyen (2007).
Q7	I back-up my files on devices such as an external hard drive to safeguard my work.	Self-developed based on the work done by Prinsloo and Van Rooyen (2007).
Q8	I can update the security software on my computer without assistance from the ICT department.	Self-developed based on the work done by Eastin and LaRose (2000) and Prinsloo and Van Rooyen (2007).
Q9	I can transfer files from other devices, for example camera, smartphone, external hard drive, to the hard drive on my computer.	Self-developed based on the work done by Prinsloo and Van Rooyen (2007).

Question number	Questionnaire items	Theoretical underpinning
Factor 2: Internet self-efficacy (7 items) **Definition:** Measures the student's confidence in searching, downloading and sharing information using electronic platforms, as well as typing and uploading documents on electronic submission portals.		
Q10	I am confident in sending emails generally	Self-developed based on the work by Prinsloo and Van Rooyen (2007).
Q11	I feel confident in typing all my written assignments.	Self-developed based on the work done by Prinsloo and Van Rooyen (2007).
Q12	I feel confident in downloading official study material from the module site on myUnisa.	Self-developed based on the work done by Prinsloo and Van Rooyen (2007).
Q13	I feel confident in downloading additional resources from the module site on myUnisa.	Self-developed based on the work by Prinsloo and Van Rooyen (2007).
Q14	I feel confident in downloading information from the internet for my studies	Self-developed based on the work by Eastin and LaRose (2000).
Q15	I feel confident in downloading information from the internet for my assignments	Self-developed based on the work by Eastin and LaRose (2000).
Q16	I feel confident in uploading my assignments on the online submission platform (myUnisa).	Self-developed based on the work by Prinsloo and Van Rooyen (2007).

Source: Author's own work

The following section provides a synthesis of the discussion and a critical evaluation of the implications for adult learners' graduateness and subsequent employability.

Table 3.2 below provides a summary of the content domains of the use of technology measurements underpinning the current study. A description of each measuring instrument is presented below.

Table 3.2

Comparison of Content Domains of Use of Technology Measurement

PTLCS	Eastin and LaRose (2000)	Prinsloo & Van Rooyen (2007)
The 16-item instrument focuses on the confidence levels of adult learners in ODeL environments regarding the use of a computer and executing internet-related tasks to successfully complete their studies in an online environment.	The 8-item instrument measured internet self-efficacy with a focus on assessing the participants' confidence levels in perform internet-related tasks.	The 25-item instrument focuses on the access of adult learners in ODeL environments to technologies and strategies applied in blended learning environments. The instrument also explores the nature of access to technology in the event that a student has access to technology.

Source: Author's own work

Eastin and LaRose (2000) developed an 8-item instrument to measure the confidence levels of undergraduate students in performing internet-related tasks. The Internet Self-Efficacy Scale (Eastin & LaRose, 2000) presents items that allow the research participants to judge their ability to use the internet to produce overall outcomes as opposed to achieving specific sub-tasks. Some of the items on the instrument include:

> I feel confident to … (1) … understanding terms/words relating to internet hardware, (3) … describing functions of internet hardware, (4) … trouble shooting internet problems, (6) … using the internet to gather information, (7) … learning advanced skills within a specific internet program.

Pivotal to the study was exploring the digital divide to also assess the racial and class divide of internet users (Eastin & LaRose, 2000).

Prinsloo and Van Rooyen (2007) developed a 25-item instrument to measure students' access to computers, computer literacy, online environments, video conferencing and tutor services support in blended learning environment. The study participants were students at Unisa, which was also the context for the current study. Items included:

> Q10. Do you have access to a computer? ... Q.11. Where do you have access to a computer? … Q.16. Are you capable of doing word processing (typing) in a computer, using a word processing package? .... Q.18. Can you access email? Q19. Can you send email? .... Q.20. Can you access the internet? .... Q25. If Unisa offered video conferencing to students at the learning centres, which ONE of the following would be applicable to you? (Prinsloo & Van Rooyen, 2007, pp 67-69).

Prinsloo and Van Rooyen (2007) assert that their study found that access was a determining factor for the provision of blended learning, and further recommend that biographical variables such as race, gender and economic strata be explored to assess the effectiveness of blended learning.

The PTLCS was developed by the researcher to measure the psychological (self-efficacy) and technical learning capabilities of adult learners in an ODeL learning environment. The newly developed PTLCS encapsulated internet self-efficacy; i.e. computer skills, with general access to a computer and internet as control variables. As such, the PTLCS is similar to Eastin and LaRose's (2000) and Prinsloo and Van Rooyen's (2007) instruments, in that students' self-perceived ability to use a computer (Prinsloo & Van Rooyen, 2007) and the internet (Eastin & LaRose, 2000) are assessed. Additionally, the PTLCS is similar to the instrument developed by Prinsloo and Van Rooyen (2007) because general access to a computer and the internet are assessed in both instruments.

The PTLCS, however, offers a new perspective on the skills required by adult learners in online learning environments:

1. The self-perceived computer skills and internet self-efficacy are evaluated jointly in the one instrument, with general access to a computer and the internet as control variables. Adult learners using this instrument will be able to evaluate the psychological and basic

technical skills required to perform academic-related activities when pursing online modules at the HEI under discussion.

2. The PTLCS, to a certain extent, encapsulates aspects of graduateness in that adult learners will have to assess their information-searching skills within an online learning environment. In the technical self-efficacy construct, the PTLCS evaluates students' confidence with regard to downloading information from the internet for their assignments (Q14).

The PTLCS is not without limitations. It focuses on the perceived psychological ability of the research participants to use a computer and the internet for academic purposes. Variables such as learner motivation (Rafiola et al., 2020), learner intention to complete an online course (Rabin et al., 2020) and critical thinking (Lin et al., 2020), which are of interest in online learning within the 4IR, were not included in the current study. The empirical aspects of the scale development for the PTLCS are presented in Chapters 5 (research method) and 6 (research results), while the limitations are elaborated on in Chapter 7 (discussions, conclusions, limitations and recommendations).

Based on the discussion presented above in section 3.2, the following hypothesis was partly achieved in terms of its conceptual operationalisation:

Research hypothesis H1: Students' psycho-technological learning capabilities (computer skills and technical self-efficacy) can be operationalised into a valid and reliable measure.

The next section presents a discussion on adult learning, referred to as andragogy, as well as adult learners' ability to plan, implement and evaluate their learning experiences, referred to as self-directed learning.

3.3 SELF-DIRECTEDNESS

In this section, the theories and models underpinning self-directedness are presented. The section will briefly discuss the concept of learning, culminating in the development and definition of andragogy. The section will then explain the link between andragogy and self-directedness leading to an overview of the models underpinning self-directedness.

3.3.1 Conceptualisation of andragogy and self-directed learning

Scholars argue that there is no generally recognised definition of learning (Botha, 2014; Botha & Coetzee, 2016; Coetzee et al., 2013) however Botha and Coetzee (2017) posit that learning is simply about growing. Erasmus et al. (2013) suggest that for learning to take place, the involvement of the individual in the learning process is important to nurture the development of innovative knowledge by shaping and restructuring knowledge scaffolds. Essentially, learning is the product of both a physical action and a psychological construct (Botha, 2014).

Huang and Shih (2011) argue that factors influencing learning include communication, teamwork between people, and the environmental and cultural contexts. Adult learners study better when there is interconnection and meaning, hence self-directed learning and active participation in the construction of learning events are important. Botha and Coetzee (2017) and Nyoni (2014) concur with Huang and Shih (2011), and add that in the adult working world, networking, collaboration and adaptation are some of the preferred practices in information sharing, growth and development.

Reflecting on the foundational understanding of learning as presented above, the basic assumptions of learning can be translated to adult learning, pedagogically known as andragogy. Knowles (1975) provides a distinct difference between andragogy and pedagogy in that andragogy refers to the art and science of helping adults to learn, while pedagogy refers to the art and science of helping children to learn (Knowles, 1975, Merriam, 2001).

Merriam (2001) provides the historical background relating to when adult learning gained momentum. In the early twentieth century, scholars began to ponder on whether adults could learn, sparking research into this topic. In 1928, the scholars Thorndike, Bregman, Tilton and Woodyard published a book on their assumptions on adult learning. Various perspectives were suggested in an attempt to assess whether adults can learn; however the focus of their research was more on learning and memory tasks (Merriam, 2001).

Merriam (2001) asserts that in 1968, Malcom Knowles proposed a new way of distinguishing adult learning from pre-adult schooling, namely andragogy. Andragogy describes an adult learner in terms of five foundational principles (Cochrane & Brown, 2016). An adult learner (1) has an independent self-concept and can direct his or her own learning, (2) has accumulated a pool of life experiences that is a valuable resource for learning, (3) has learning needs closely related to changing social roles, (4) is problem-centred and is interested in immediate application of any knowledge gained, and (5) is motivated to learn by internal rather than external factors (Botha, 2012; Cochrane & Brown, 2016; Jeanes, 2021; Knowles, 1975; Merriam, 2001).

Blaschke (2012) further expands on the definition and principles of andragogy to highlight how andragogy translates to self-directed learning. The goals of self-directed learning include helping adult learners to develop the capacity for self-direction, supporting transformational learning and promoting "emancipatory learning and social action" (Merriam, 2001). Within a transformational learning environment, learning occurs along a self-directed path, where the learner matures and reflects on his or her reservoir of life experiences in relation to his or her self-perception, beliefs, and lifestyle (Blaschke, 2012; Cochrane & Brown, 2016; Mezirow, 1981; Sato et al., 2017). This culminates in the learner's perspective being adjusted and the resultant transformative learning taking place (Mezirow, 1981).

Andradea and Bunker (2009) agree with other scholars that autonomy, in a learning environment, refers to involvement and choice in learning, self-direction, the capacity to learn in terms of self-awareness and the willingness to be an active learner, acting independently and making decisions about what and how to learn, setting goals, and measuring progress. Andradea and Bunker (2009) further postulate that central to the notion of autonomy is freedom of choice – learners choose what, where and how to learn. Essentially, autonomy focuses on how adult learners can take control of the learning process in an ODeL context (Sato et al., 2017). Garrison (2003) supports the notion presented by Andradea and Bunker (2009) and advances the concept of self-directed learning to include three dimensions, namely self-management (the process of balancing teacher and student control), self-monitoring (cognitive responsibility), and motivation (commitment to learning goals).

Botha and Coetzee (2016) and Yamagata-Lynch et al. (2015) highlight another aspect of self-directed learning, namely that adult learners feel empowered to take responsibility for deciding what and how to explore a topic of their choice (Knowles, 1975). In addition, within the self-directed learning environment, the instructor takes on the role of a facilitator (Brockett & Hiemstra, 1985; Nyoni, 2014), thereby becoming a contributing member of the collaborative learning process (Garrison, 2003). Sato et al. (2017) and Yamagata-Lynch et al. (2015) further highlight that with the flexibilities that online environments afford learners in terms of time, space and pacing themselves in their studies, online learners are tasked with taking initiative and responsibility for their online studies.

Iiyambo and Geduld (2019), King et al. (2000), Landrum (2020) and Puzziferro (2008) agree that the self-regulation of learning is more important in the open distance and online learning environment than in the traditional classroom context. Bandura and Schunk (1981) expand the definition of self-efficacy to highlight the importance of a cognitively based self-motivational attitude. A well-developed cognitively based self-motivation depends on goal setting and self-evaluative reactions to one's own behaviour (Bandura & Schunk, 1981; Mozahem, 2020). The interwoven process of goal setting and self-evaluation culminates in self-directedness, a state in which learners feel empowered to take responsibility for deciding what and how to explore a topic of their choice (Knowles, 1975; Sato et al., 2017; Yamagata-Lynch et al., 2015). With the rapid growth in online formal and informal learning opportunities as a result of the 4IR and digital era (Mian et al., 2020), adult learners have more opportunities to explore the options available to further their educational levels (Mclean, 2016. With the increase in adult learners taking up online education, research on adult learning has gained momentum with a specific focus on adults' self-directed learning orientation (Garrison, 2003; Iiyambo & Geduld, 2019; Mclean, 2016; Rabin et al., 2020; Yamagata-Lynch et al., 2015).

Various perspectives and discussions have been presented around self-directed learning. Andradea and Bunker (2009) introduced the concept of self-directed learning by discussing it from one of the foundational theories in distance education, namely, Moore's (1972, 2007) theory of transactional distance. This theory discusses three key variables in distance learning, namely (1) *dialogue,* which refers to the communication between the distance learner and the lecturer; (2) *structure,* which is the degree to which the course accommodates learners' preferences and needs in terms of course objectives, goals and evaluation, and (3) *learner autonomy,* which involves the learner's ability to create a learning plan, find resources that support study, and self-evaluate. Autonomy specifically focuses on the choices the learner makes and can include the learner's choice of study material and activities; goal-setting; self-pacing; and self-evaluation (Andradea & Bunker, 2009). Andradea and Bunker (2009) conclude their discussion by proposing three dimensions, namely, self-management (the process of balancing lecturer and student control), self-monitoring (cognitive responsibility) and motivation (commitment to learning goals). Vanijdee (2003) provides a broader conceptualisation of learner autonomy in that this variable focuses on the learner's capacity, or attitudes and abilities that empower and encourage learners to take responsibility for their learning process. Knowles (1990) refocuses the conceptualisation of this concept into two pillars of self-directed learning, namely, (1) self-teaching and (2) personal autonomy. *Self-teaching* relates to the power the learner has over the mechanisms and strategies used to in his or her learning process, while *personal autonomy* refers to the learner taking control and ownership of the goals and purpose of his or her own learning (Ghost Bear, 2012; Knowles, 1990).

Knowles (1990) defines self-directed learning as the process whereby an individual takes the initiative, either assisted or unassisted, in assessing their learning needs. From this initial assessment the individual formulates learning goals, identifies the resources (human and material) required to assist him or her in their learning, chooses and implements the appropriate learning strategies, then subsequently evaluates the outcome of their learning experience. In a nutshell, the individual becomes their own development agent and takes ownership of their learning (Mozahem, 2020).

Self-directed learning has four cornerstones, namely, the adult learner's willingness to (1) engage in individually identified and defined learning-related activities; (2) be autonomous and independently search for information; (3) interrogate the information found by searching and probing the information for facts; and (4) engage in self-managed, autonomous study (Ainoda et al., 2005; Botha, 2012). Coetzee and Botha (2013) agree with the four cornerstones of self-directed learning and affirm that self-directed learners are eager to participate in learning opportunities, are innovative, resourceful and future driven.

Firat et al. (2016) argue that despite the absence of a universal definition, self-directed learning is used instead of self-learning, which is a concept that indicates that the learner is responsible for his or her own learning experiences. Self-learning refers to an individual learning approach where the learners plan their own learning experiences, implement their plans and evaluate their own learning experiences (Firat et al., 2016). In an attempt to contextualise self-directed learning, Firat et al. (2016) postulate that self-directed learning is the culmination of an integration of self-direction (contextual control), cognitive self-control in terms of self-monitoring (cognitive responsibility) and motivation (willingness to learn). Andradea and Bunker (2009) conclude their discussion by proposing three dimensions, namely, self-management (the process of balancing lecturer and student control), self-monitoring (cognitive responsibility), and motivation (commitment to learning goals).

When online learners are empowered to be in charge of their own learning, they are more likely to overcome the challenges presented by the transactional distance (feeling isolated as a result of the physical and social distance from the instructor and other participants) (Kim et al., 2013; Moore, 1993, 2013; Mozahem, 2020). Therefore, self-directed learning plays a vital role in the success of adult learners pursuing online learning (Botha, 2014; Garrison, 2003; Nyoni, 2014; Sato et al., 2017; Yamagata-Lynch et al., 2015). There is a plethora of research on the self-efficacy levels of online learners (Bao et al., 2013; Chu & Tsai, 2009; Eastin & LaRose, 2000; Hayashi et al., 2004; Hsia et al., 2014; Kuo et al., 2014) and the self-directed learning orientation of online learners (Andradea & Bunker, 2009; Blaschke, 2012; Botha, 2014; Garrison, 2003; Knowles, 1975, 1990; Mclean, 2016; Yamagata-Lynch et al., 2015). Botha (2014) addressed the gap in research by developing an instrument to measure the self-directed learning orientation of online students in an ODeL institution in South Africa.

In the context of online learning, various views have been presented on the importance of self-directed learning in these learning environments (Gokcearslan, 2017). Some scholars believe that the level of self-directed learning influences the uptake of technology-assisted learning (Jung, 2014; Kim et al., 2013; Lai et al., 2016; Lee et al., 2014), while others believe that self-directed learning is a predictor for the integrating technology in online learning (Kirk, 2012) and mobile learning (Jung, 2014). Botha (2014) and Coetzee and Botha (2013) suggest four cognitive-behavioural dimensions that can be used to conceptualise a self-directedness learning orientation in the higher education and ODeL context. For the purpose of this study, self-directedness will be discussed from the theoretical foundation promulgated by Knowles (1984), and as further refined and contextualised by Coetzee and Botha (2013) for adult learners in online learning environments. The following section provides an overview of the models that underpin self-directedness.

3.3.2 Theoretical models underpinning self-directedness

The following models of self-directedness will be discussed in this section:

- Classical model of assumptions of adult learning (Knowles, 1984)
- Self-directed learning in educational settings (Garrison, 1997)
- The adult learner self-directedness in open-distance learning settings model (Botha, 2014).

3.3.2.1 *Classical model of assumptions of adult learning (Knowles): andragogy*

Knowles (1984) developed six principles of adult learning (andragogy) as an approach to learning that would support adult learners in their mastery of new competencies. The core principles of andragogy describe adult learners in terms of a variety of interrelated cognitive, affective and psychological conditions that affect the learning process and should, therefore, be taken into account in the design and delivery of adult learning interventions (Botha, 2014; Coetzee et al., 2013). Table 3.3 below presents a summary of the six principles.

Table 3.3

Principles of Andragogy by Knowles (1984)

Principle	**Description**
Principle 1: Adult learners are self-directed	An adult learner must see the need to learn, and they are able to learn in a self-directed environment.
Principle 2: Learner as a resource	Adult learners can be a resource for their own learning and that of others.
Principle 3: Learning as developmental	Instructors must choose strategies that will enable adult learners to achieve their learning goals.
Principle 4: Learning as an application to the real world	Adult learners need immediate application of theory to practise and to focus on the problems as opposed to course content.
Principle 5: Learner orientation to learning	Adult learners are motivated to learn when they are given authentic activities that drive them to become competent in a specified area.
Principle 6: Learner's motivation	Learners are intrinsically motivated to learn, and they require learning environments that will engage and encourage them to actively participate in their learning experience.

*Sources: Botha (2014); Cochrane and Brown (2016).

The six core principles of andragogy conceptualised by Knowles (1984) are as follows:

Principle 1: Adult learners are self-directed. According to Knowles (1984), the psychological description of the state of adulthood is that a person has grown to realise and accept that they are in charge of and manage their own life (Botha, 2014). Botha (2014) and Coetzee et al.

(2013) assert that an adult who has achieved the awareness of self-directedness has the desire to be regarded and treated by others as an individual capable of being autonomous.

Principle 2: Adult learners are a resource as they are responsible for their decisions and their lives. Cochrane and Brown (2016) assert that adult learners have experienced life differently and as such they feel responsible for their own decisions and lives. An instructor may consider incorporating an adult's life experiences into class activities since such experiences are a valuable resource. Botha (2014) and Coetzee et al. (2013) assert that adult learners are rich in life experiences and require personalised learning experiences.

Principle 3: Adult learners view learning as developmental, and as such they need to know why they should learn something new (Botha, 2014). Essentially, adult learners need to know why they are engaging in a learning intervention and why they should participate in the learning experience (Botha, 2014).

Principle 4: Adult learners view learning as an application of the real world because they desire to learn when they are confronted with a real-life problem which they need to solve (Botha, 2014). Cochrane and Brown (2016) assert that adult learners' readiness to learn is aligned with their need for learning, which has to be addressed quickly to ensure success in online learning.

Principle 5: Learner orientation to learning is linked to adult learners' reason for learning (Botha, 2014; Coetzee et al., 2013). Botha (2014) asserts that adult learners' readiness to learn is informed by their need to be competent in specific areas of their lives. Cochrane and Brown (2016) further suggest that instructors can include authentic learning activities, such as case studies, team problem-solving activities and conducting interviews.

Principle 6: Adult learners may be intrinsically motivated to learn (Cochrane & Brown, 2016). Coetzee et al. (2013) and Botha (2014) further add that adult learners may also be extrinsically motivated to learn. Intrinsic sources of motivation include self-actualisation, realisation of life ambitions, building self-confidence and the need to achieve a better quality of life (Botha, 2014).

Though widely accepted, criticisms levelled at andragogy include the following: it cannot be considered a theory, as the principles ignore the reality of the adult learners' cultural environments and value systems, and not all successful adult learners are self-directed (Botha, 2014; Caffarella, 1993; De Bruin & De Bruin, 2011). However, most of the principles of this approach are used in workplace learning, which is one of the environments in which many adults learn (Botha, 2014; De Bruin & De Bruin, 2011; Knowles, 1984).

3.3.2.2 Self-directed learning in educational settings (Garrison)

Garrison's (1997) model of self-directed learning in educational settings provides a comprehensive description of three interrelated facets, namely, external management or contextual control (self-supervision), internal monitoring or cognitive responsibility (self-observation) and individual motivation. Individual motivation comprises two states, namely, entering motivation (where the decision is taken to register at a tertiary education institution) and task motivation (where there are further and ongoing decisions to engage with the academic material and persevere with the learning behaviours) (Botha, 2014; Garrison, 1997; Lai & Smith, 2017).

Self-supervision focuses on monitoring and assessing the visible activities (behavioural actions) which are involved in learning (Botha, 2014). This process therefore entails the learner embarking on the learning journey in order to achieve personal and learning objectives, by engaging with the learning materials and utilising the officially provided learning facilities and resources (Bergamin et al., 2012; Garrison, 1997; Kasworm, 2011). The model therefore integrates the facet of self-supervision of the physical learning activities and responsibilities with the individual motivational aspects that drive the adult learner to enrol for a course and persist in its activities. It also includes the internal scrutiny of learning that is necessary for individual growth in thought processes (Bergamin et al., 2012; Botha, 2014; Garrison, 1997; Lai & Smith, 2017).

Self-observation refers to the adult learner knowing about his or her own behaviours, thoughts and beliefs (metacognition) in order to amend or even transform the thought processes to fit a specific educational context (Garrison, 1997; Kasworm, 2011). Self-observation results in meaning creation (Garrison, 1997; Kasworm, 2011) in that an adult learner critically analyses both new information and existing knowledge and then works collaboratively with others to authenticate existing self-constructed knowledge frameworks (Botha, 2014). Therefore, adult learners who take responsibility for their own learning also possess the capacity to self-observe their own learning processes, activities and actions.

According to Garrison (1997), learning and the construction of meaning are present in an external learning environment but may interfere with successful learning. Individual motivation is an important facet in successful adult learner learning (Garrison et al., 2001; Taipjutorus et al., 2012). Although the link between motivation and cognitive activities is not clearly understood (Botha, 2014), motivation does play a role in the initial decision to enrol for a programme and continues to play a significant part in the adult learner's decisions to engage with the learning materials in order to achieve success in learning (Botha, 2014; Bergamin et al., 2012; Garrison, 1997).

In conclusion, as adult learners continue to develop their capacity for taking control of their learning activities and behaviours, they will become increasingly responsible for managing the learning process and constructing their personal knowledge scaffolds (Bergamin et al., 2012; Botha, 2014; Garrison, 1997; Kasworm, 2011). Ideally, when adult learners assume greater control of their own learning, they should become more aware of the need for meaningful learning and this, in turn, will lead to self-evaluation of the overall learning process.

3.3.2.3 Adult learner self-directedness in open-distance learning settings model (Botha)

Adult learner self-directedness in ODL settings model conceptualised by Botha (2014) is relevant to the present study. The model attempts to integrate the contextual, behavioural and psychological foundations of adult learner self-directedness in order to position learners in ODL environments on a development path of self-directedness (Botha, 2014; Coetzee & Botha, 2013; Botha et al., 2015).

According to Botha (2014), adult learner self-directedness is assumed to comprise four psycho-social behavioural facets that are interrelated and draw upon psychological (dispositional orientations or attitudes), social (behavioural interactions with the learning context) and behavioural (self-directed activities) components of the construct of self-directedness (Botha, 2014; Botha et al., 2015; Coetzee & Botha, 2013). Botha's (2014) model comprises four facets, namely, the strategic utilisation of officially provided resources; engaged academic activity; success orientation for ODL; and academically motivated behaviour, as presented in Table 3.4 below.

Table 3.4

The Adult Learner Self-Directedness in ODL Model by Botha (2014)

Dimension	**Description**
Strategic utilisation of officially provided resources	Relates to when and how adult learners utilise the official resources provided by the university as they progress with their studies.
Engaged academic activity	Describes the intentional activity of an adult learner to engage in academic activity that is directly related either to them furthering their studies or improving their knowledge and skill.
Success orientation for ODL	Refers to the internal dispositions of adult learners that facilitate success.
Academically motivated behaviour	Describes the observable behaviour of adult learners that confirms the presence of at least some of the personal dispositions described by success orientation for ODeL

Source: Botha (2014)

The four facets are discussed in detail as follows:

- *Strategic utilisation of officially provided resources.* This construct relates to when and how adult learners utilise the official resources provided by the university as they progress with their studies (Botha, 2014; Botha & Coetzee, 2016; Fowler, 2008). This facet clarifies for which purpose and at what time in their academic journey, adult learners utilise officially provided resources like study material and feedback from assessments (Botha, 2014; Botha et al., 2015). The element of strategic utilisation of officially provided resources provides an overview of the learning scenario created by the university and how adult learners choose to voluntarily interact with the learning situation (Botha, 2014). Essentially, the resources provided by the university are generally indicative of how the university defines and manages the learning scenario. (Botha, 2014).

- *Engaged academic activity* describes the intentional, purposeful learning actions in which adult learners engage and that are directly related either to furthering their studies or to improving their knowledge and skills (Botha, 2014; Botha & Coetzee, 2016; Coetzee & Botha, 2013; Van den Bogaard, 2012). Engaged academic activity depicts the manner in which adult learners immerse themselves in the learning material, highlighting how adult learners construct and subsequently implement learning strategies (Botha, 2014; Coetzee et al., 2015). This facet also describes the amount of effort, in the form of time spent per module, which the adult learner dedicates to his or her studies. Essentially, engaged academic activity provides evidence of the academic maturity of an adult learner because it indicates their ability to realise the amount of effort they should invest in their academic career in order to succeed (Botha, 2014; Van den Bogaard, 2012).

- *Success orientation for ODL* describes the self-reported cognitive processes of adult learners that display their level of self-confidence in their ability to be successful in their studies (Botha, 2014; Botha & Coetzee, 2016; Coetzee et al., 2015). In the context of ODeL, success orientation indicates the mental toolkit adult learners possess which contributes to the self-perceived beliefs, resilience, persistence and innovative problem-solving attitudes related to their academic activities (Botha, 2014; Coetzee & Botha, 2013). Coetzee et al. (2015) succinctly describe success orientation in ODL contexts as the psychological toolkit that adult learners possess to facilitate success in their academic endeavours.

- The last facet of this model is *academically motivated behaviour*, which refers to the source of adult learners' motivation concerning their academic activities as well as their resilience and problem-solving behaviours (Botha, 2014; Botha & Coetzee, 2016). This construct evolves around whether adult learners attempting distance learning possess the requisite characteristics and/or attitude of resilience to find innovative solutions to academic problems (Botha, 2014). Pivotal to this construct is the behaviours that universities and lecturing staff may expect from adult learners in a distance learning environment (Botha, 2014; Garrison et al., 2001). Based on the conceptualised definition of this facet, it may be assumed that academically motivated behaviour is essential to the success of adult learners pursuing open distance learning. In conclusion, Botha (2014) asserts that academically motivated behaviour is the behavioural cornerstone of success orientation for open distance learning.

In Botha's (2014) open distance learning model, adult learner self-directedness attempts to amalgamate the contextual (pedagogical), behavioural and psychological elements of the self-directedness of adult learners who are engaged in open distance learning experiences. The university setting, by definition and purpose, administers a measure of control in adult learner learning (Botha, 2014). It is clear that, theoretically, the four facets of self-directedness in the model are interrelated and influence each other. Essentially, an adult learner who displays a positive success orientation to open distance learning is more likely to engage in activities that represent academically motivated behaviour and will probably utilise the officially provided resources strategically, culminating in behaviours associated with engaged academic activity (Botha, 2014). Botha and Coetzee (2016) report that individuals from different gender, race and age groups differ significantly regarding self-directedness. In their study, Botha and Coetzee (2016) suggest that ODeL institutions should design and offer qualifications that incorporate the unique needs, abilities and preferences of the various gender, race and age groups to which adult learners belong.

The following section provides an evaluation of the self-directedness models, alluding to the models excluded and included in the empirical study.

3.3.3 Evaluation of the self-directedness models

The following section provides an overview of the models, highlighting the basic premise of each. In addition, the reasons why models have been either included or excluded from the study are presented.

3.3.3.1 Models excluded from the empirical study

Garrison (1997) presented a model of self-directed learning in educational settings and explained how external management or contextual control (self-supervision), internal monitoring or cognitive responsibility (self-observation) and individual motivation influence the self-directed learning orientation of adult learners. Garrison (1997) further highlights that adult learners continually develop their capacity to take control of their learning activities and behaviours. Though relevant, this model was not developed in an ODeL context and does not highlight the complexities faced by a university dealing a multicultural population.

Knowles (1984) developed six principles in an attempt to contextualise adult learning as an approach to learning. Pivotal to the principles is the interrelatedness of cognitive, affective and psychological conditions in the learning process and their influence on the design and delivery of adult learning interventions (Botha, 2014). Though credible and widely accepted, the principles cannot be considered as a theory and the cultural reality of adult learners is not considered in the principles (Botha, 2014).

3.3.3.2 Models included in the empirical study

Botha (2014) conceptualised the adult learner self-directedness in ODL settings model. The model describes how contextual, behavioural and psychological factors influence adult learner self-directedness, specifically in ODL environments. The model was deemed relevant to the current study as it is positioned within the ODeL context in South Africa. Additionally, Botha's (2014) model was developed and validated for use in the multicultural South African context (Botha, 2014; Botha et al., 2015). Coetzee (2014) and Botha and Coetzee (2016) further validated the model developed by Botha (2014) within a South African multicultural context.

3.4 SYNTHESIS AND EVALUATION

The following section provides a synthesis and evaluation of the major constructs of psycho-technological learning capabilities and self-directed learning orientation. Core insights will be presented and evaluated in relation to student graduateness and employability.

Psycho-technological learning capabilities encapsulate adult learners' computer skills and internet self-efficacy in an online learning environment. Pivotal to the current study is the perceived psychological and technical capabilities (skills to use a computer and self-efficacy in using the internet) that adult learners have to successfully achieve in order to attain their academic goals in e-learning environments. Human agency theory and social cognitive theory (Bandura, 1977, 1982) were deemed appropriate for underpinning the conceptualisation of adult learners' self-perceived computer skills and internet self-efficacy, as explained by the concept of self-efficacy. Adult learners pursuing e-learning must have a belief in their ability to use a computer (Hayashi et al., 2004; Kuo et al., 2020) and believe that they can execute internet-related tasks (Eastin & LaRose, 2000; Kuo et al., 2013, 2014, 2020; Romero Martinez et al., 2020).

Based on Bandura's (1989) human agency perspective on social cognitive theory and Knowles' (1975) theory on andragogy and subsequent self-directed learning orientation (Botha, 2014), it is imperative to assess how adult learners' psycho-technological learning capabilities and self-directedness influence the graduateness of open and distance learners pursuing further education in ODeL contexts. As elicited from the literature, for online learners to be successful in ODeL environments, they must have high beliefs in their skills to use a computer and using the internet, be able to work autonomously, take the initiative and take responsibility for their studies

(Andradea & Bunker, 2009; Blaschke, 2012; Botha, 2014; Knowles, 1975, 1990; Lin et al., 2020; Mclean, 2016).

Self-perceived computer skills refer to the self-perceived judgement of an individual's capability to use a computer (Gong et al., 2014; Keshavarz, 2020), while internet self-efficacy is the self-perceived confidence in an individual's ability to plan and perform internet-based tasks (Chu & Tsai, 2009; Eastin & LaRose, 2000; Keshavarz, 2020; Kuo et al., 2014). Individuals who have a positive attitude towards technologies are more likely to have higher internet self-efficacy compared to those who have a negative attitude towards technologies (Kuo et al., 2014; Rafiola et al., 2020). Additionally, if an individual has a positive evaluation of their confidence in using a computer (computer self-efficacy) they are more likely to view e-learning with ease and perceive their interaction with a computer system as low effort (Thongsri et al., 2020). Jackson (2016) expatiates that the higher the confidence levels in using both a computer and the internet in one's studies and the more self-directed one is, the more likely one is to develop one's graduateness skills and attributes, resulting in increased chances of being employable.

The 4IR and digital age has resulted in ICTs playing a major role in people's lives (Mian et al., 2020). The increase in the use of ICTs has cascaded down to the education environment with adult learners having to be agile in embracing technology in their learning processes (Sagnier et al., 2020). As such, the principles of the TAM, as conceptualised by Davis in 1989, are relevant to the current study. Perceived usefulness refers to is the belief that a technology tool or resource will assist in enhancing a job or task performance (Francom et al., 2021; Sagnier et al., 2020), while perceived ease of use is the belief that a person has that the use a technology tool or resource will require low effort (Sagnier et al., 2020). Taat and Francis (2020) reported that students' level of acceptance of e-learning was significantly influenced by perceived ease of use of technology tools and resources. Pertinent to the current study was the construct of "perceived ease of use", as adult learners need to perceive technology to be low effort in order to embrace it and successfully engage in e-learning (Lazim et al., 2021).

As the current study focuses on adult learners it was deemed appropriate to review literature on self-directedness and the principles of andragogy. In the context of online learning, there are a plethora of views on the importance of self-directed learning (Gokcearslan, 2017). Some scholars believe that the level of self-directed learning influences the uptake of technology-assisted learning (Jung, 2014; Kim et al., 2013; Lai et al., 2016; Lee et al., 2014), while others postulate that self-directed learning predicts the integration of technology in online learning (Kirk, 2012) and mobile learning (Jung, 2014). Botha (2014) and Coetzee and Botha (2013) developed a model based on four cognitive-behavioural dimensions that can be used to conceptualise a self-directedness learning orientation in the higher education and ODeL context within the multicultural South African context. For the purpose of this study, the adult learner self-directedness in ODL settings model developed by Botha (2014) was deemed to be appropriate from a contextual and theoretical perspective, as it was informed by the principles of andragogy conceptualised by Knowles (1984).

Scholars have presented compelling arguments on the importance of self-directedness in adult learners (Blaschke, 2012; Botha, 2014; Knowles, 1980, 1989; Merriam, 2001; Yamagata-Lynch et al., 2015) in open distance environments (Botha, 2014; Coetzee & Botha, 2013; Coetzee et al., 2015). Pivotal to this study is the influence of self-efficacy beliefs in adult learners' ability to use a computer and the internet (Bao et al., 2013; Eastin & LaRose, 2000; Gokcearslan, 2017; Hayashi et al., 2004; Kuo et al., 2014; Saadé & Kira, 2009; Venter & Prinsloo, 2011), and how they plan, implement and evaluate their learning experience (Botha, 2014; Botha et al., 2015).

From the literature it is evident that learners must be cognisant of their psycho-technological learning capabilities (computer skills and internet self-efficacy) for online study so as to succeed and complete their online studies (Cheng, 2014; Kuo et al., 2020; Landrum, 2020; Nyoni, 2014; Sagnier et al., 2020; Taat & Francis, 2020). This results in learners developing the graduateness skills and attributes required in the changing world of work (Coetzee, 2014; Green at el., 2009; Kreber, 2014; Metcalfe et al., 2020; Osborne et al., 2014), and the 4IR and the technology-driven era (Briede & Popova, 2020; Cabi & Kalelioglu, 2019; Mian et al., 2020), in order to become more work ready (Daniels & Brooker, 2014), optimistic about future career prospects (Coetzee, 2012a; Ma & Bennett, 2021), as well as skilled and employable for the volatile world of work (Archer & Chetty, 2013; Jackson, 2016; Tomlinson & Anderson, 2020; Tymon, 2013).

From the review of literature, it is evident that there is a need to develop an instrument that measures both computer and internet self-efficacy. Eastin and LaRose (2000) identified the need to develop a computer self-efficacy scale that was not solely based on the TAM, while Prinsloo and Van Rooyen (2007) explored students' access to computers, computer literacy, online environments, video conferencing and tutor services support in a blended learning environment. Accordingly, the newly developed PTLCS encapsulated constructs of self-perceived computer skills and internet self-efficacy adapted from Eastin and LaRose (2000) and Prinsloo and Van Rooyen (2007), as well as the “perceived ease of use of technology as conceptualised in the TAM. The PTLCS is not without limitations, however, which present areas for future studies and validation. The instrument focuses on the perceived psychological ability of the research participants to use a computer and the internet for academic purposes and variables such as learner motivation (Rafiola et al., 2020), learner intention to complete an online course (Rabin et al., 2020), and critical thinking (Lin et al., 2020), which have become of interest in online learning in the 4IR, were not included in its formulation.

Based on the discussion presented above, the literature review research aim 1 has been achieved:

Literature review research aim 1: To conceptualise the employability and graduateness of adult learners, the constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) and self-directed learning orientation from a theoretical perspective.

3.5 CHAPTER SUMMARY

This chapter presented the overarching constructs of psycho-technological learning capabilities and self-directed learning orientation of students in an online environment, highlighting the theoretical elements of students in an online environment pertinent to this study. A detailed discussion of the psycho-technological learning capabilities, namely self-efficacy, self-perceived computer skills and internet self-efficacy and influences from the TAM. This culminated in the conceptualisation of the PTLCS, with the work done by Eastin and LaRose (2000) and Prinsloo and Van Rooyen (2007) being presented and adapted to inform the conceptualisation of items for this instrument. Flowing from the conceptualisation of the PTLCS, a discussion on self-directedness and the principles of andragogy was presented to further support and highlight the relevance of the PTLCS within an adult learning environment.

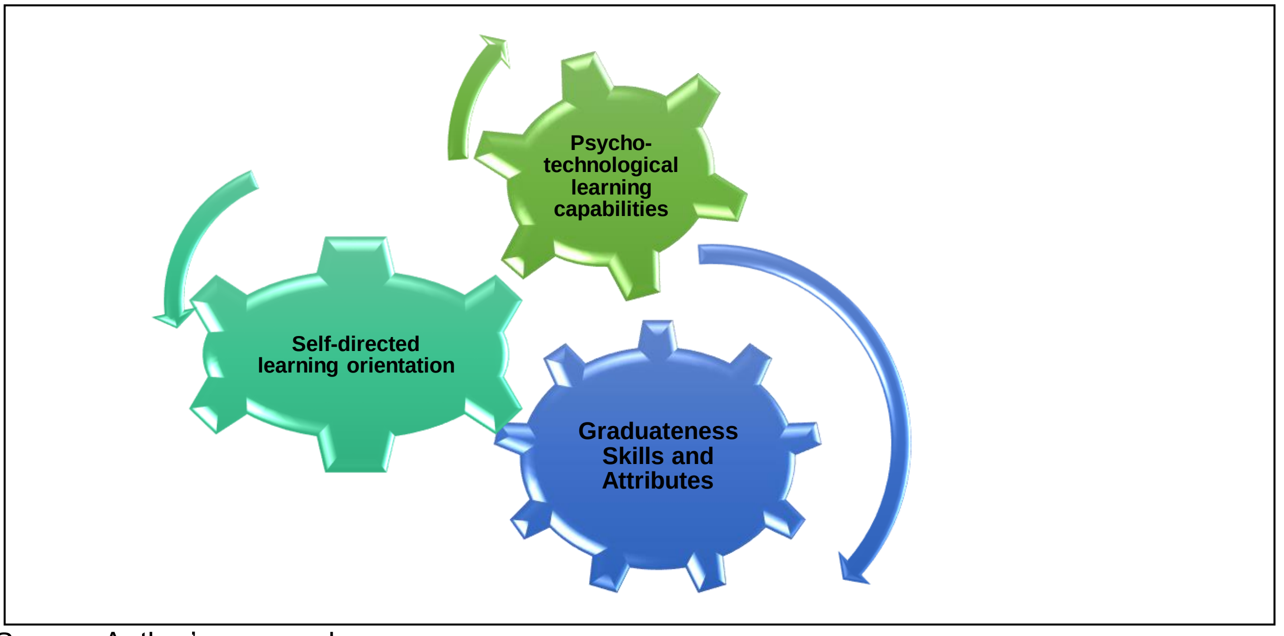
Chapter 4 presents the theoretical relationship dynamics between psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness and how the socio-biographical characteristics influence these constructs. The discussion will conclude with a discussion of the implications of the theoretical relationship between the variables of student graduateness and employability.

CHAPTER 4: THEORETICAL INTEGRATION AND IMPLICATIONS

Chapter 4 provides an evaluation of the theoretical relationship between the psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness skills and attributes of adult learners pursuing online learning. An integration alluding to the implications of this relationship for graduate employability and specifically adult learning and development in the context of distance and online learning environments is also presented. The formulation of the research hypotheses is presented, culminating in the conclusion to the chapter.

Figure 4.1

Overview of the Theoretical Relationship between Psycho-Technological Learning Capabilities and Self-Directed Learning Orientation, and Graduateness Skills and Attributes



Source: Author's own work

4.1 THEORETICAL RELATIONSHIP DYNAMICS BETWEEN PSYCHO-TECHNICAL LEARNING CAPABILITIES, SELF-DIRECTED LEARNING ORIENTATION AND GRADUATENESS

Literature review research aim 1 was achieved in Chapter 2 and Chapter 3.

Literature review research aim 1: To operationalise the constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) into a valid and reliable measure.

This section addresses research aim 2.

Literature review research aim 2: To conceptualise the theoretical relationship dynamics between psycho-technological learning capabilities (computer skills and internet self-efficacy), self-directed learning orientation and graduateness, and how the socio-biographical characteristics (i.e. age, gender and ethnicity) influence these constructs.

Self-efficacy is defined as people's beliefs about their capabilities to perform activities that have an influence on their lives (Aslan, 2021; Bandura, 1977; Bandura & Adams, 1977; Coetzee & Oosthuizen, 2012; Keshavarz, 2020; Kuo et al., 2020). Pertinent to the current study is the explanation that expected outcomes are pivotal motivators for a behaviour, resulting in an individual engaging in "goal-action-outcome" process (Lent et al., 2017). In the context of online learning, it is noted that self-efficacy is important in predicting student learning and must be considered when exploring online learning environments (Hodges, 2008; Kuo et al., 2020).

In their study, Thongsri et al. (2020) reported that computer self-efficacy influences students' acceptance of technology and also found that if learners are competent in using computers they are more likely to accept online learning than students who perceived their ability to use a computer to be low (Thongsri et al., 2020). He and Freeman (2019) reported that female students felt less confident with computers as they had learnt less and had minimal practical exposure to using computers compared to their male counterparts. Vimalkumar et al. (2021) explored gender disparity with regard to computer self-efficacy in India, reporting that the more digitally literate a person is the more this is will positively affect their computer self-efficacy. In addition, Vimalkumar et al. (2021) found that married women have a significantly lower probability of computer self-efficacy and having a digitally literate woman in the house increases the computer self-efficacy of the entire household.

Kuo et al. (2020) concur with Eastin and LaRose (2000) that internet self-efficacy is the belief an individual has in their ability to organise and perform internet-related tasks to produce an outcome. Eastin and LaRose (2000) found that males had better internet skills than females. This finding was also reported by Chang et al. (2014), who found that male students showed higher confidence levels in performing internet-related tasks compared to female students. Kuo et al. (2020) investigated African-American adult students in an online learning environment and found that internet self-efficacy and self-regulation were related to student performance. In their study, Kuo et al. (2020) found that participants between the age of 18 and 45 years had higher internet self-efficacy, and that older female participants were more self-regulated than the younger male participants.

In the context of technology-based learning, Bandura (1989) reported that even though an individual may be faced with challenges they must possess a high level of self-efficacy to remain focused on the task and resultant goal. Bandura (1989) adds that people who strongly believe in their problem-solving capabilities tend to have higher analytical thinking skills which will result in them applying their skills in complex decision-making processes. In conclusion, Bandura (1977, 1989) opines that an individual's perceived self-efficacy influences the types of anticipated scenario they construct and how the individual envisages their successes.

Botha and Coetzee (2017) found that participants below the age of 50 scored significantly higher than other age groups on success orientation, indicating that the older participants had acquired experience, confidence and self-belief, resulting in them being more success oriented compared to the younger participants. Additionally, Botha and Coetzee (2017) found that participants in the age group 41–50 years scored significantly lower than the other age groups on self-efficacy.

With regard to online learning generally, Rabin et al. (2020) found that participants in the mid-life (36–50 years) faced external barriers such as family and work roles. Essentially, participants from this age group indicated that their work and family responsibilities hindered them from successfully pursuing further education in an online learning environment (Rabin et al., 2020). Additionally, Garrido et al. (2016) found that women were more likely than men to complete a MOOC or obtain certification for completing an online course. In their study, Rabin et al. (2020) also found that the levels of self-regulated learning, self-efficacy, extrinsic motivation, the initial behavioural intention and the age of the participant suggest that course designers need to assist adult learners, specifically young students, to self-regulate their learning and promote a feeling of self-efficacy in order to reduce barriers to online learning as a whole. Furthermore, they should be aware of the participants' initial behavioural intentions and pay closer attention to young participants.

Briede and Popova (2020) explored the self-directed learning orientation of 71 first-year engineering students. They (Briede & Popova, 2020) concluded that the Self-Directed Learning tool is an effective tool for adapting to the future demands of Industry 4.0, as it assesses qualities such as “purposefulness, responsibility, motivation to reach learning outcomes, interest, cognition need, understanding of knowledge and skills usage, implementation of effective learning strategies, control assessment of learning progress, critical thinking, problem solving, time management, co-operation and appropriate usage of IT” (p. 1599). They also note that average results were observed in relation to the implementation of effective learning strategies and the need for time management, a concern reported by Iiyambo and Geduld (2019). Briede and Popova (2020) conclude that instructors may need to provide first-year students with an electronic guide on learning strategies.

In their study, Botha and Coetzee (2016) reported that the Indian participants scored significantly higher than the other race groups on the strategic utilisation of officially provided resources and engaged academic activity. Additionally, the African participants obtained significantly lower scores than the other race groups on success orientation and engaged academic activity (Botha & Coetzee, 2016). The white participants scored significantly higher than the other race groups on success orientation, while the coloured participants scored significantly lower than the other race groups on the strategic utilisation of officially provided resources (Botha & Coetzee, 2016).

From this review of literature, it is evident that there is a paucity of studies exploring how various ethnicity groups perceive their graduateness skills and attributes. Coetzee (2012b) found that Indian female participants had significantly more positive views about their graduateness skills and attributes compared to other race groups, while Africans reported lower scores on the graduateness skills and attributes generally. Considering the multicultural South African context, it would be beneficial to gain an understanding on how adult learners from different socio-biographical groups perceive their graduateness and employability.

Industry 4.0 has an impact on everyone in all spheres of life (Briede & Popova, 2020; Mian et al., 2020) and has influenced the skills demands of the knowledge economy (Burke et al., 2020). Ma and Bennett (2021) found that computer skills and leadership experience were important for students' employment prospects. With an increasingly blurred graduate labour market, graduates are faced with the challenge of successfully negotiating psychological contracts, but most importantly, they have to strive to successfully navigate the volatile world of work (Burke et al., 2020). In an effort to develop graduateness and ensure the employability of university graduates in the 4IR, universities have to adapt their approach to training graduates so as to prepare them for the future industries (Mian et al., 2020).

Based on the research literature discussed in Chapters 1 to 3, the following four research hypotheses were formulated:

Research hypothesis H1: Students' psycho-technological learning capabilities (computer skills and technical self-efficacy) can be operationalised into a valid and reliable measure.

Research hypothesis H2: Students' psycho-technological learning capabilities, self-directed learning orientation and socio-biographical characteristics (age, gender and ethnicity) are significantly and positively related to their graduateness skills and attributes.

Research hypothesis H3: Students' psycho-technological learning capabilities and self-directed learning orientation significantly predict their graduateness skills and attributes.

Research hypothesis H4: The relationship between students' (1) psycho-technological learning capabilities; (2) self-directed learning orientation and their graduateness skills and attributes is moderated by their socio-biographic characteristics (age, gender and ethnicity).

4.2 THEORETICAL IMPLICATIONS

In this section the theoretical and practical implications of the current study are conceptualised and presented.

This section therefore addresses the literature review research aim 3:

Literature review research aim 3: To conceptualise the theoretical implications of the relationship between psycho-technological learning capabilities, self-directed learning orientation and graduateness for online learning and development practices that enable adult learner graduateness and employability.

The theoretical framework underpinning this study was presented in Chapter 2 and 3. A plethora of research was found on the variables underpinning the current study: employability and work readiness (Bezuidenhout et al., 2019; Coetzee et al., 2015; Kim & Kim, 2018; Pavlin & Svetlik, 2014; Tymon, 2013), graduateness skills and attributes (Aliu & Aigbavboa, 2021; Coetzee, 2012a, 2012b, 2014; Green et al., 2009; Ismail, 2017; Kreber, 2014; Metcalfe et al., 2020; Smith & Bauling, 2013; Steur et al., 2012), self-efficacy (Aslan, 2021; Bandura, 1977; Bandura & Adams, 1977; Coetzee & Oosthuizen, 2012; Keshavarz, 2020; Kuo et al., 2020), self-perceived computer skills (Gong et al., 2014; Hsia et al., 2014; Keshavarz, 2020; Thongsri et al., 2020), internet self-efficacy (Chu & Tsai, 2009; Eastin & LaRose, 2000; Kuo et al., 2014, 2020; Madu et al., 2011; Nyoni, 2014; Rafiola et al., 2020), perceived usefulness of technology and the perceived ease of use of technology (Francom et al., 2021; Lazim et al., 2021; Mehta et al., 2021; Sagnier et al., 2020), student support and throughput (Cele, 2021; Shikulo & Lekhetho, 2020; Sykes et al., 2020; Tseng et al., 2020) and andragogy and self-directedness (Andradea & Bunker, 2009; Botha, 2014; Botha & Coetzee, 2016; Cochrane & Brown, 2016; Coetzee et al., 2013; Erasmus et al., 2013; Huang & Shih, 2011; Iiyambo & Geduld, 2019; Landrum, 2020; Mozahem, 2020; Sato et al., 2017; Yamagata-Lynch et al., 2015).

The contribution of the current study is as follows:

1. The theoretical relationship of the elements of psycho-technological learning capabilities, namely computer skills and internet self-efficacy, are conceptualised in relation to self-directed learning orientation so as to construct a Psycho-Technological Learning Capabilities Scale (PTLCS). The relationship between these constructs with specific reference to the ODeL environment is highlighted in chapter 2 and 3 culminating to the conceptualisation of the PTLCS.

2. The current study identified and explained the theoretical relationship between psycho-technological learning capabilities, namely self-perceived computer skills and internet self-efficacy, in relation to adult learners' self-directed learning orientation and graduateness, which may potentially inform online learning and development practices within ODeL HEIs.

3. In Chapter 3, the socio-biographical variables, namely age, gender and ethnicity, that influence adult learners' psycho-technological learning capabilities, self-directedness and graduateness were presented. An understanding of these differences may potentially help to design tailor-made online learning support practices for online modules within ODeL HEIs.

The postulated associations between the research variables potentially have the following implications for online learning and development practices to enable adult learners' graduateness and employability:

1. *Enhanced student and learner support.* Tseng et al. (2020) assert that learners who lack autonomy find online learning challenging and stressful. Their lack of autonomy results in a lack of the necessary independent and time management skills they require to persevere and persist in their online studies. As such, ODL institutions must provide effective student support services (Shikulo & Lekhetho, 2020) to increase student success rates, focusing on both cognitive-academic deficiencies and non-cognitive life experiences (Cele, 2021). Of particular relevance to the current study is the recommendation by Cele (2021) for cognitive-academic support strategies that include e-learning support, mentoring and involvement of students in the design of interventions. Shikulo and Lekhetho (2020) add

that the shortage of computers, low levels of computer literacy and lack of access to the internet have contributed to low success rates at ODeL institutions. As such, student support strategies should be focused on these aspects as well as on promoting increased student success rates and subsequent student graduateness and employability.

2. *Enhancement of graduate skills required by employers.* Lan (2020) postulates that universities play a role in activating the transfer process from teaching and learning to transferable skills. Lan (2020) further asserts that generic graduate skills can be developed by integrating the curriculum as part of the teaching and learning activities in the discipline. For instance, students may be given activities that promote the development and interdependence of higher order generic skills such as analysis, problem solving and critical thinking.

Overall, the current study contributes to the wealth of knowledge on the constructs constituting psycho-technological learning capabilities, self-directedness and graduateness, specifically in an ODeL environment. Pertinent to the focus, the current study makes a theoretical contribution to the conceptualisation of the psycho-technological learning capabilities, culminating in the development of the PTLCS.

4.3 SYNTHESIS AND EVALUATION

Chapter 1 stated that the general aim of this research was to operationalise the various constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy, as measured by the newly developed PTLCS) into a valid and reliable measure and to explore the relationship dynamics between ODeL students' psycho-technological learning capabilities, self-directed learning orientation, socio-biographical characteristics (i.e. age, gender and ethnicity) and their graduateness skills and attributes.

The review of literature revealed a dearth of studies exploring the influence of the various socio-biographical groups on graduateness skills and attributes. Considering the multicultural South African context, it will be beneficial to gain an understanding on how adult learners from different socio-biographical groups perceive their graduateness and employability.

Although there is a plethora of research on the individual constructs underpinning the current study, research that explores the relationship of all the constructs in one study amongst adult learners in an ODeL environment is lacking. In addition, there is a paucity of research focusing on how psycho-technological learning capabilities and self-directed learning orientations influence students, graduateness and employability within an ODeL environment in South Africa.

The changes that have been brought about by Industry 4.0 have affected everyone in all spheres of life (Briede & Popova, 2020; Mian et al., 2020) and have influenced the skills demands of the knowledge economy (Burke et al., 2020). The increase in the use of technology means that graduates entering the 21st century world of work in the digital era must have the skillset required by the labour market (Burke et al., 2020). Trilling and Fadel (2009), Tseng (2020), Tseng et al. (2020), Oz and Ozdamar (2020) and Xing and Marwala (2017) highlight that adult learners in the digital era need to possess specific skillsets relevant to the digital era in order to ensure their employability. Graduates therefore have to formulate their employability identity so as to present themselves as relevant to both employers and to society (Tomlinson & Anderson, 2020).

4.4 CHAPTER SUMMARY

In this chapter, the theoretical relationship between the concepts of the psycho-technological learning capabilities (self-perceived computer and internet self-efficacy), self-directed learning orientation and graduateness skills and attributes were presented. Studies conducted in relation to these constructs were summarised, finally presenting the theoretical implications of these constructs. The theoretical contribution of the current study was presented, closing with the synthesis and conclusion of the chapter.

Chapter 5 addresses the research method applied in testing the research hypotheses.

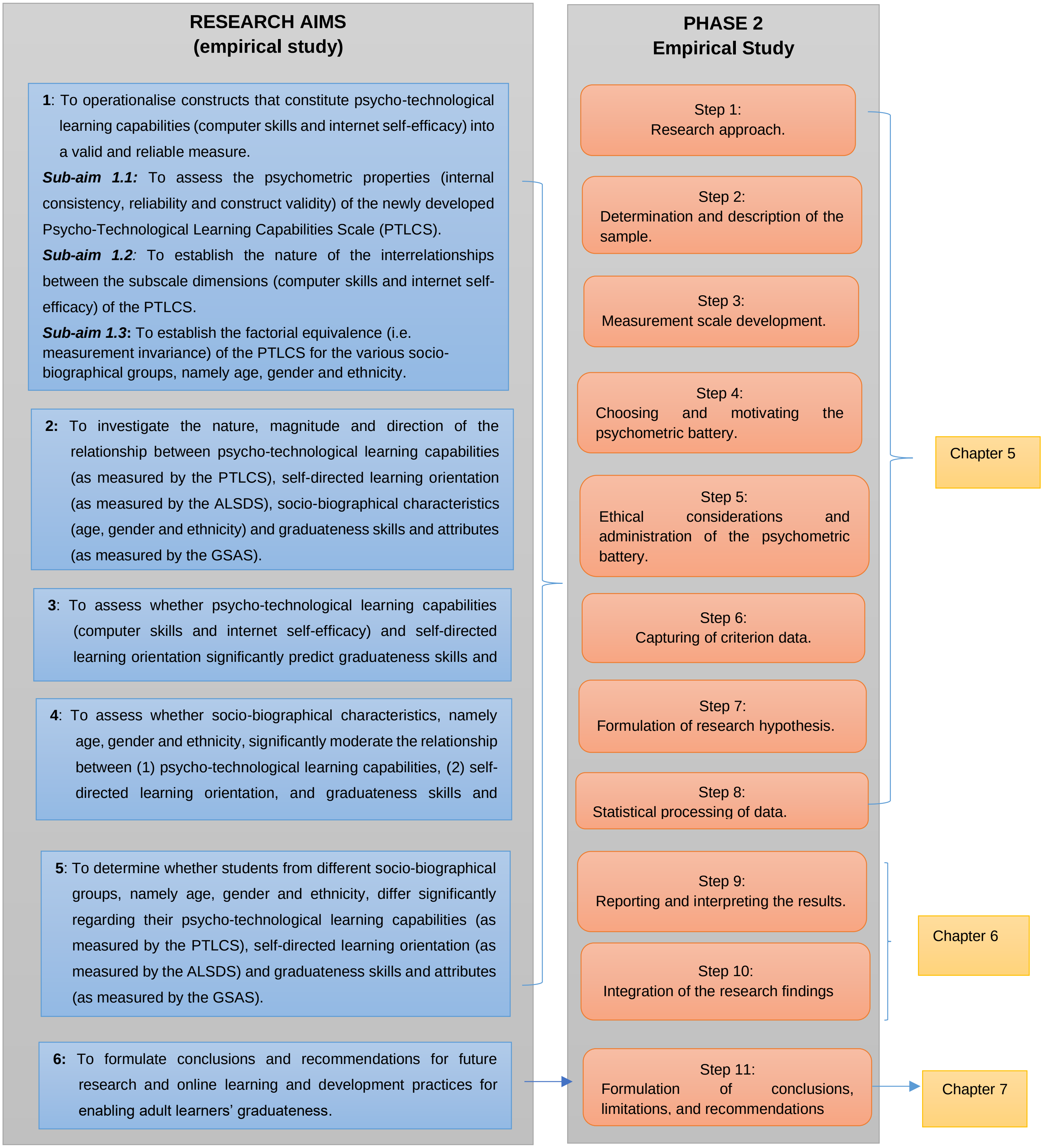
CHAPTER 5: RESEARCH METHOD

This chapter outlines the empirical approach and statistical strategies that were employed to determine whether the measure for psycho-technological learning capabilities could be constructed. As indicated in Chapter 1 (see section 1.8), the empirical research phase consisted of eleven steps aimed at addressing the empirical research aims (see Figure 5.1 below).

The main purpose of this chapter is to explain and describe the empirical research method used in this study. This chapter, therefore, serves as a starting point for addressing the empirical research aims by presenting an overview of the population and sample of the study; discussing and justifying the choice of measuring instruments; describing the methods used for data gathering and analysis; outlining the ethical considerations and how they were addressed; formulating the research hypotheses; and finally, describing the process followed in analysing the data. Steps 1 to 8 (see Figure 5.1) of the empirical study are addressed in this chapter, while the remaining steps are addressed in Chapter 6 (research results) and in Chapter 7 (discussion and integration, conclusions, limitations and recommendations).

Figure 5.1

The Empirical Study – Research Aims and Research Steps



5.1 RESEARCH APPROACH

In the current study, a cross-sectional research approach was adopted, with the main intention of gathering data that would address the research questions underpinning the study (see Chapter 1) to achieve the research aims (Spector, 2019). This research approach was deemed appropriate for the current study owing its efficiency when faced with scarce resources, its ability to provide evidence to answer the research question and its statistical credibility to rule out alternative explanations (Spector, 2019).

To achieve the research aims of the current study, the researcher relied on a cross-sectional quantitative research design. Empirical data was collected from students at an HEI in an ODeL context. The unit of analysis for the current study was the individual students in the HEI under study. The unit of analysis reflected the relationship between the constructs of psycho-technological learning capabilities (computer skills and technical self-efficacy), self-directed learning orientation and graduateness skills and attributes. Collecting primary data supported the operationalisation of the research variables in line with the theoretical conceptualisation.

According to Ernest (2016), Salkind (2012) and Daniel (2012), unit of analysis refers to the objects or things that are researched in order to formulate generalisations about these objects and to further explain the differences among them. Essentially, there are four main units of analysis in the social sciences, namely, the individual, groups, organisations, and social interaction and/or social artefacts, which are distinguished by characteristics, orientations and actions (Daniel, 2012; Terre Blanche et al., 2006).

In the current study, the unit of analysis for the individual assessments is the individual, while the group will be the unit of analysis for determining the relationship between the constructs. The unit of analysis for examining the influence of socio-biographic characteristics (age, gender and ethnicity) on psycho-technological learning capabilities (computer skills and technical self-efficacy); self-directed learning orientation and graduateness skills and attributes is the subgroup, with the overall analysis of data being generalised to the group.

5.2 DETERMINATION AND DESCRIPTION OF THE SAMPLE

Sampling refers to the selection of a subset of a population for inclusion in an empirical study (Daniel, 2012; Nishishiba et al., 2017). Sampling is conducted to obtain information that can be used to make inferences about the population under study (Nishishiba et al., 2017). The population for this research comprised students attempting the two compulsory online modules in Industrial and Organisational Psychology, namely IOP1501 (Psychological process in the work context) and IOP1601 (Personality in the work context) during 2016–2017. The following sections provide an overview of the sampling technique and sampling procedure, as well as a description of the sample.

5.2.1 Random sampling of a purposively selected target population

The empirical study (research scale development) employed a probability, simple random sampling, technique to gain access to respondents who would participate in completing the newly developed PTLCS and the ALSDS and GSAS. The respondents in this study were subjected to simple random sampling where every student of the targeted population had a chance to participate in the study. Inclusion criteria were that participants were attempting the two compulsory first-year IOP modules in the undergraduate study, namely IOP1501 (Psychological process in the work context) and IOP1601 (Personality in the work context) in the 2016 academic year. These two modules were deemed suitable for the study as both are offered online and, as such, students attempting these modules are expected to be able to successfully complete the modules. The strength of random sampling is that the results are projectable and that the technique has the greatest freedom from bias. However, some of the disadvantages include that a complete sampling frame is required; it may be a costly exercise to obtain the sample especially if the units of analysis are geographically scattered and there is no assurance of representativeness (Taherdoost, 2016).

5.2.2 Sampling procedure

The sample was randomly drawn from the total population of N = 3790 students studying either IOP1501 or IOP1601 in the year 2016, resulting in a final randomly selected study sample of 900 students. The final sample of useable questionnaires was (N = 399), with a response rate of 44%. However, after further cleaning of the data in order to exclude the missing case values, the final sample was N = 378. Therefore, the statistical analysis for the current study focused on a final sample of N = 378. The data set was randomly split into a **pilot study group** (n = 150) and a **confirmatory, validation study group** (n = 228). Scientific rigour was applied in ensuring that no participant in the pilot study (n = 150) was included in the random sample of study 2 (validation study: n = 228). The best confirmatory factor analysis (CFA) model derived from the confirmatory sample was then applied to the full sample (N = 378) for testing the predictive validity of the PTLCS.

The general rule of thumb is 10 observations per variable (StatisticsSolutions, 2021). The study explored 14 variables, implying a minimum of n = 140 participants. A good maximum sample size is usually around 10% of the population. In this study, in a population of (N = 3790) students, 10% would be n = 379, which was achieved. The final sample size was regarded as adequate because of the following considerations: the researcher (1) had limited time and money; (2) needed a general estimate of the results for PhD research purposes; (3) planned to use only three categories of subgroups (gender, age, ethnicity); (4) expected that most students would give similar answers; and (5) that conclusions and decisions that would be made based on the results do not have significant consequences because of the exploratory nature of the research (Tools4dev, 2021).

5.2.3 Characteristics of the sample

The sample (N = 378) was diverse in terms of age, gender and ethnicity, as reported below. Table 5.1 below shows the age distribution of the sample (N = 378). The majority of the research participants fell into the age groups 17–30 years (46%) and 31–45 years (45%). Participants in the middle career life stage constituted 9%, while only one research participant fell into the late career life stage (65 years and older).

The gender composition of the sample leaned more towards females, who constituted 75% of the sample, as shown in Table 5.1 below.

The race categories of the South African Employment Equity Act were applied in differentiating between ethnicity groups. The ethnicity profile of the study sample consisted of half the participants being African (50%), followed by 33% white participants. In addition, a marginal difference was found between the coloured (9%) and Indian (7%) ethnicity groups. Three participants indicated that they were other, constituting 1% of the responses gathered. Given the difference between the African and white participant groups, the sample in this research leaned more towards the African ethnic group than the other ethnicity groups. For statistical purposes, the ethnic groups were categorised as blacks (African, Indian and coloured: 66%) and whites (33%). This categorisation is in line with the Employment Equity Act. The other (1%) was excluded in the statistical analyses.

Table 5.1

Biographical Distribution of the Sample

Variable		**N**	**Percentage of sample**
Age	**Career/life stage**		
17–30	Early career life stage	175	46%
31–45		169	45%
46–65	Middle career life stage	33	9%
65 and older	Late career life stage	1	0%
Gender			
Male		93	25%
Female		285	75%
Ethnicity			
African		188	50%
Coloured		35	9%
Indian		27	7%
White		125	33%
Other		3	1%

Source: Author's own work

In summary, the sample was predominantly represented by students from a black (African, coloured, Indian) ethnic origin and female participants in the early to middle career life stage (emerging adulthood). The following section describes the process followed in the development of the measuring scale.

5.3 RESEARCH METHOD: PHASE 1 (DEVELOPMENT OF SCALE)

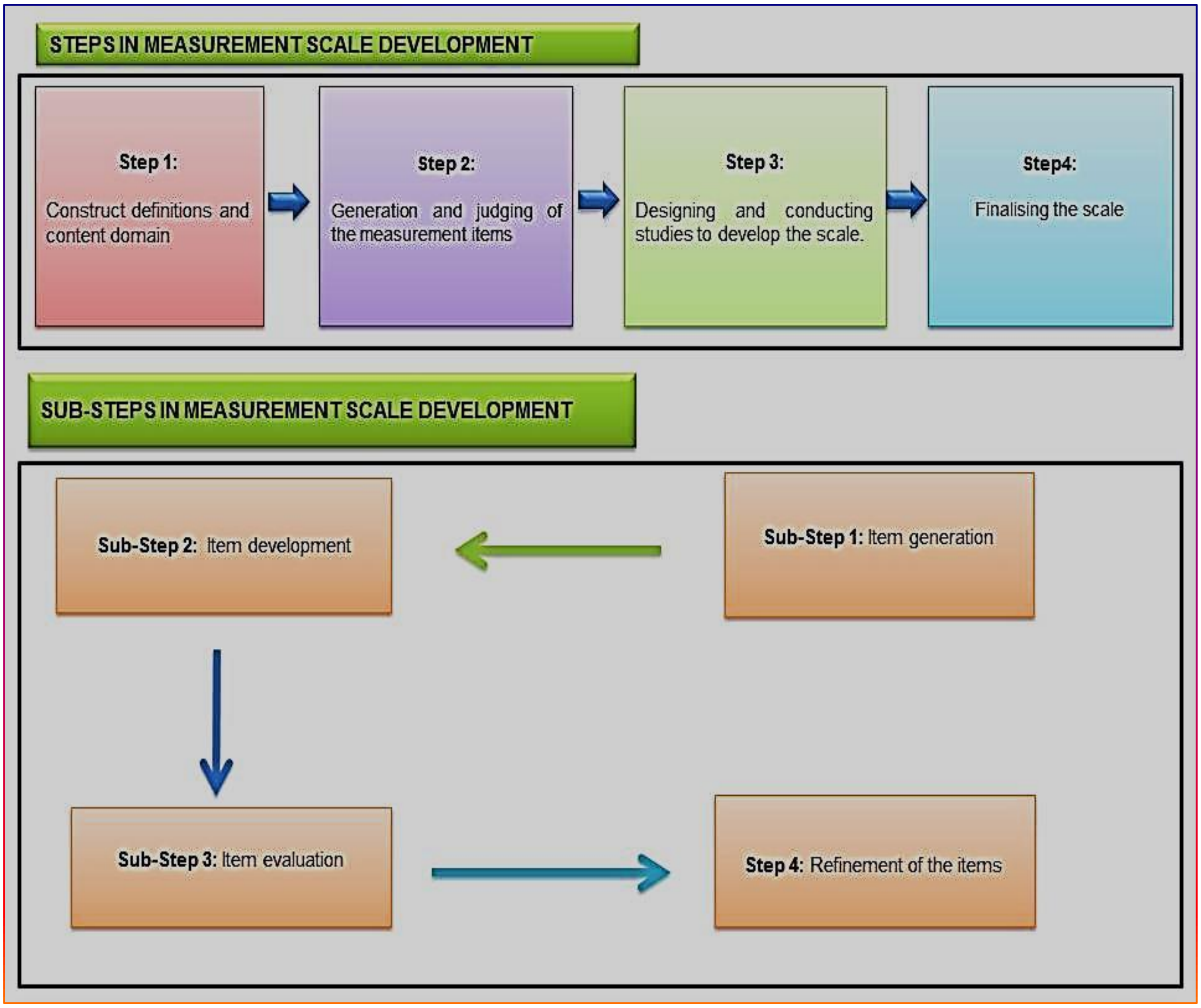
Scales are measurement instruments that reveal theoretical variables that are indirectly observed (DeVellis, 2003). The following four-step process suggested by Netemeyer et al. (2003) was applied in the current study:

- Step 1 involves defining constructs and determining their domain based on an in-depth literature review. Carpenter (2018) supports this assertion and opines that the literature review is paramount in plotting the dimensional structure of scales. Chapter 3 addressed this step of scale development.
- Step 2 involves the generation and determination of items for the research. Clauss (2017) further asserts that items can also include those that have been adapted from validated scales or from items previously used to measure the same construct in different contexts. This aspect was explained in Chapter 3.
- Step 3 consists of designing and conducting studies to develop the scale.
- Step 4, which is the final step, involves the refinement and finalisation of the scale.

The scale development protocol and the steps promulgated by Netemeyer et al. (2003) were adhered to during the development of the PTLCS. Figure 5.2 below summarises the steps in measurement scale development.

Figure 5.2

Overview of the Steps in Measurement Scale Development



Source: Author's Own work

5.3.1 Sub-step 1: Item generation

Scholars can adopt various approaches in order to generate items. As the item generation is paramount to the scale development process, it is imperative that a researcher specifies the domain and dimensionality of items (Clauss, 2017). Essentially, to establish the validity of an item, in this step a researcher must focus on the content validity of items. Additionally, Lambie et al. (2017) argue that the evidence of validity is the foundation for developing measures. In this regard, validity is operationalised in the context of content validity, which refers to the extent to which a set of items reflect the content domain (DeVellis, 2003; Lambie et al., 2017). Carpenter (2018) asserts that item generation is informed by conducting literature reviews, focus groups and interviews, pilot tests and inputs from content experts. Ultimately, this stage is important as it assists the researcher to establish the validity of the scale and its specifications, and to identify the potential limitations of the scale.

Germain (2006) posits that after items have been developed, the next step would be to refine and or replace the already generated pool of items before administering an instrument. Bichi et al. (2019) suggest that strategies that can be used in the initial item generation can be either inductive, deductive or both. Inductive strategies base item generation on subjective information about the construct, as gathered from opinions from a target audience, for instance focus group discussions and interviews. Deductive strategies focus on an extensive literature review and previously developed scales as the basis for item generation (Bichi et al., 2019; Germain, 2006).

Kumar (2015) advises that items should be developed from a theory of the construct (latent variable) so as to ensure consistency between the item and the underpinning theory. Theoretical underpinning not only allows for a construct to be succinctly defined, but also helps to predict the types of statistical relationship it will have with other constructs. In the current study, deductive scale development was adopted to generate the items. In the current study, the literature review; aims of the research and the conceptualisation of the construct and its subdimensions directed the generation of items. Furthermore, as suggested by Bichi et al. (2019) and Kumar (2015), strategies to ensure face and content validity involved the use of subject matter experts, who assisted in refining the wording and content of the items. Based on the guidelines of DeVellis (2003), the following three criteria were applied in the generation of items for the PTLCS:

- Each item had to reflect the definition of the construct domain it is intended to measure.
- Each item had to be clear and concise in terms of wording.
- The appropriate grammatical structure and word choice for each item were carefully considered.

To establish whether the newly developed items are representative of the expected subscale or factor, Kumar (2015) suggests that item and factor analysis should be conducted as part of the tool development process. Chapter 6 reports on the use of exploratory factor analysis (EFA) and Rasch modelling to examine this aspect of the newly developed PTLCS.

5.3.2 Sub-step 2: Item development

The next sub-step in scale development entails developing the items that will reflect aspects of the construct being measured. In the present study, an association was established between the generated items and their theoretical domain. This was achieved by providing a theoretical framework in Chapter 3, as well as accurately and thoroughly matching items to construct definitions.

Lambie et al. (2017) argue that the following must be considered in the development of items, namely (1) the response format and rating scales; (2) weighting items based on importance; and (3) characteristics of the potential participants such as age, gender and ethnicity. By considering these, a researcher mitigates bias in certain items which could influence participants' responses to the items on the measure. For the purpose of the present research, a six-point Likert scale (1 = strongly disagree; 6 = strongly agree) was chosen because the scale forces choice and gives better data. Kline's (2005) nine rules for the development of sound sale items were adhered to in the current study, which related to the development of the PTLCS. Chapter 3 provides a summary of these steps as applied in the current study.

5.3.3 Sub-step 3: Item evaluation

The pool of items was critically reviewed by two experts in the research subject field from the University of South Africa. The aim of the review process was to establish consensus on whether the items were clearly worded, whether the items adapted to the chosen response format, whether the response options for each item were credible, and whether the wording was appropriate for the target population. An initial pool of 16 items was generated during this stage (Table 3.1 in Chapter 3), based on the literature review. Three subject matter experts were involved in evaluating the face validity of the PTLCS and its subdomains by applying the criteria explained in section 5.3.1. Applying the criteria, each item was rated in terms of the categories of high, moderate or low. The subject experts were requested to suggest an alternative for the items that they scored as low, which were subsequently adapted where necessary. Generally, the overall outcome was the 16 items summarised in Chapter 3, Table 3.1.

Kumar (2015) also highlights the importance of validity in that it is important for a researcher to ascertain whether a tool/instrument measures what it intends to measure. Bichi et al. (2019) confirm this and highlight the importance of ascertaining the construct validity of a newly developed instrument; that is, the behaviour the instrument is intended to measure. Construct validity denotes the extent to which decisions can be made as justified by the observed scores for the hypothesised construct noted in the data.

Reliability is an integral part of scale development and refers to the amount of variance attributable to the true score of the latent construct. (Kumar, 2015). Reliability refers to the repeatability, stability or consistency of a tool and can be assessed using the Cronbach's alpha statistic. Clauss (2017) explains that statistical analysis of the data in terms of skewness, kurtosis, exploratory factor analysis and correlational analysis is used in this step to validate the items in the scale.

In the current study, the item pool was evaluated to confirm whether the items measured the construct under enquiry. Three experts in the subject field of research from the University of South Africa reviewed the pool of 16 items to evaluate the face and content validity, the relevance, significance and clarity of the items, and the item difficulty level. The outcome indicated clean ranking of each item in terms of precision, relevance, significance and difficulty.

5.3.4 Sub-step 1: Item refinement

Germain (2006) explains that construct validation is essential to ensure the quality of the new measure. Essentially, demonstration of the construct validity of a measure in the scale development process is the pinnacle objective of scale development. Lambie et al. (2017) define construct validity as the extent to which items on a measurement scale reflect the content domain. Morgado et al. (2017) posit that as part of the item development and refinement, the psychometric analysis enables the researcher to assess and establish whether the new scale has construct validity and reliability.

Yong and Pearce (2013) explain that factor analysis summarises data so that relationships and patterns can be easily extrapolated, interpreted and understood. As such, factor analysis is used to rearrange variables into a limited set of clusters based on shared variance, isolating constructs and concepts (Yong & Pearce, 2013). Factor analysis consists of two main techniques, namely exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). EFA reveals patterns by exploring the dataset and testing predictions, while CFA attempts to confirm hypotheses and uses path analysis diagrams to represent variables and factors (Kumar, 2015; Yong & Pearce, 2013).

In the current study, in order to enhance content validity, items were revised because they were not properly worded. Items were also examined to check whether they were appropriately structured, bearing in mind the target population. A six-point Likert rating response scale, ranging from (1) strongly disagree to (6) strongly Agree, was used for the instrument. All the items were categorised into the relevant dimension (Appendix C).

From the above four steps of scale development, it can be deduced that the development of the PTLCS followed scale development protocols to ensure the face validity, content validity and reliability of the scale for research purposes.

5.4 CHOOSING AND MOTIVATING THE PSYCHOMETRIC BATTERY

The psychometric properties of the measuring instruments used to measure the independent variable (psycho-technological learning capabilities) and the dependent variables (self-directed learning orientation and graduateness skills and attributes) are now discussed.

In addition to the three measuring instruments, a biographical questionnaire was compiled and used to collect information regarding the respondent's age, gender, and ethnicity. The biographical data provided significant information for the analysis of psycho-technological learning capabilities, self-directed learning orientation and graduateness skills and attributes among the three biographical groups.

5.4.1 Psycho-Technological Learning Capabilities Scale (PTLCS)

The PTLCS was used to measure the psychological and technical learning capabilities of adult learners in the current study (see Appendix C).

5.4.1.1 Development of the Psycho-Technological Learning Capabilities Scale (PTLCS)

An instrument, labelled the PTLCS, was developed by the researcher to measure the psychological and technical learning capabilities. An English questionnaire was developed because English is the current official language of the HEI from which participants were invited. The questionnaire could therefore be distributed to all students without discrimination. A deductive scale-development process was used in developing the PTLCS in line with Germain (2006), who asserts that a deductive approach relies on a thorough understanding and review of the literature to develop the scale items. The original PTLCS contained 16 items, as reflected in Chapter 3. After statistical analysis and item refinement, the final PTLCS consisted of 12 items which measured two aspects of psycho-technological learning capabilities. The two subscales for the PTLCS and their respective items are reflected in Chapter 6.

5.4.1.2 Description of the Psycho-Technological Learning Capabilities Scale (PTLCS)

Closed-ended questions were used together with a six-point Likert rating response scale: (1) strongly disagree, (2) moderately disagree, (3) slightly disagree, (4) slightly agree, (5) moderately agree, and (6) strongly agree. A six-point Likert scale (1 = strongly disagree; 6 = strongly agree) was chosen because the scale forces choice and gives better data.

The Likert rating scale, developed by Rensis Likert in 1931, is useful and reliable when measuring self-efficacy and attitudes (Croasmun & Ostrom, 2011). According to Croasmun and Ostrom (2011), a Likert-type scale requires research participants to respond to a series of statements by indicating how they strongly feel about the statements, with feelings ranging from negative to positive. For the current study, respondents were presented with a set of statements about how strongly they either agreed or disagreed with the statements relating to their technological skills and technical self-efficacy. The questions were carefully worded to avoid ambiguity and took the context of the study into consideration. After an EFA, the two relabelled subscales included technological skills and technical self-efficacy, as indicated in Chapter 6.

5.4.1.3 Administration and scoring of the Psycho-Technological Learning Capabilities Scale (PTLCS)

The final version of the PTLCS (after EFA and CFA were performed – see Chapter 6) is a self-rating questionnaire which is administered individually and takes about five to ten minutes to complete. The technological skills subscale contains seven items (e.g. *I can download software for my computer without assistance*) and the technical self-efficacy scale comprises five items (e.g. *I feel confident in typing all my written assignments*).

5.4.1.4 Interpretation of the Psycho-Technological Learning Capabilities Scale (PTLCS)

Respondents who score high on technological skills will be able to use a computer to successfully attempt their online studies. Respondents who score high on technical self-efficacy will be able to use software and online programs to successfully attempt their online studies, resulting in increased levels of overall self-efficacy regarding their online studies.

5.4.1.5 Psychometric properties of the PTLCS

Chapter 6 reports the internal consistency reliability coefficients and construct validity of the final version of the PTLCS. The overall scale obtained high internal consistency reliability (.93); the technological skills (.81) and technical self-efficacy (.94) subscales also obtained high internal consistency reliability. Chapter 6 reports evidence of construct validity for the PTLCS.

5.4.2 Adult Learner Self-Directedness Scale (ALSDS)

The ALSDS (Botha, 2014) was used for this study.

5.4.2.1 Development of the Adult Learner Self-Directedness Scale (ALSDS)

Botha (2014) developed and standardised the ALSDS to measure adult learners' ability, skill, preference and psychological predisposition to maintain control over their learning process within the South African context. It was developed to measure four subscales of self-directed learning orientation, namely, strategic utilisation of officially provided resources, engaged academic activity, success orientation for open distance learning, and academically motivated behaviour.

5.4.2.2 Description of the Adult Learner Self-Directedness Scale (ALSDS)

The ALSDS (Botha, 2014) is a self-reporting, multi-factorial measuring instrument designed for adult learners involved in open distance learning in a Southern African context. The ALSDS consists of four subscales and 35 items. Twenty-one of the questions (items 1 to 21) require single responses while multiple responses may be given to the remaining questions (items 22 to 35). The questionnaire uses a five-point, behaviourally anchored scale to measure the respondents' behaviours and/or attitudes as regards each of the items. The subscales include the following: the strategic utilisation of officially provided resources (5 items); engaged academic activity (5 items); success orientation for open distance learning (11 items) and academically motivated behaviour (14 items).

5.4.2.3 Administration and scoring of the Adult Learner Self-Directedness Scale (ALSDS)

The ALSDS is a self-reporting questionnaire which is administered individually and takes about 30 minutes to complete. Twenty-one of the questions (items 1 to 21) require single responses while multiple responses may be given to the remaining questions (items 22 to 35). The questionnaire uses a five-point, behaviourally anchored scale to measure the respondents' behaviours and/or attitudes as regards each of the items. The subscales include the following: (1) The strategic utilisation of officially provided resources (5 items) with questions such as "*When do you read your tutorial letters?" "How do you use feedback tutorial letters in your studies?*", (2) engaged academic activity (5 items) with questions such as "*How many hours per week do you devote to your studies at Unisa? How do you plan your study time? When do you submit assignments?*", (3) success orientation for open distance learning (11 items) with questions such as "*How will you use the knowledge you have gained in your studies in your work situation? How confident are you that you will understand the learning material? How confident are you that you will be able to solve problems you encounter in your learning*?" and (4) academically motivated behaviour (14 items) with questions such as "*What do you do when you find out that you have not received all the tutorial letters? What do you do when you encounter words or phrases in the prescribed book, study guide or tutorial letters that you do not understand?*". Botha et al. (2015) reported internal consistency reliability coefficients ranging from .60 (strategic utilisation of officially provided resources and engaged academic activity) to .77 (success orientation for ODL), with the overall scale obtaining a Cronbach's alpha coefficient of .91.

5.4.2.4 Interpretation of the Adult Learner Self-Directedness Scale (ALSDS)

The respondent's assessment is scored electronically. The total of the raw scores is calculated by adding all the items for each subscale. Botha (2014) advises that the scores may range from 35 to 70. Essentially, the higher the score the higher the respondents' self-directedness learning orientation for ODeL.

5.4.2.5 Psychometric properties of the Adult Learner Self-directedness Scale (ALSDS)

Botha (2014) reported the internal consistency, reliability and construct validity of the ALSDS as acceptable. The internal consistency reliability coefficients (Cronbach's alpha) noted were .60 (strategic utilisation of officially provided resources and engaged academic activity) and .77 (success orientation for ODL), while the overall scale obtained a Cronbach's alpha coefficient of .91. Botha et al. (2015) reported the following internal consistency, reliability and Cronbach's alpha coefficients: strategic utilisation of officially provided resources and success orientation for ODL (.60); academically motivated behaviour (.71) and engaged academic activity (.77).

5.4.2.6 Motivation for using the Adult Learner Self-directedness Scale (ALSDS)

The ALSDS was deemed appropriate for the current study, as Botha's (2014) model of adult learner self-directedness was developed for the adult learner within the multicultural South African context. The model underpinning the ALSDS attempts to consolidate the contextual, behavioural and psychological foundations of adult learners' self-directedness learning orientation so as to position adult learners in ODeL environments for self-directed learning (Coetzee & Botha, 2013).

5.4.3 The Graduateness Skills and Attributes Scale (GSAS)

The Graduateness Skills and Attributes Scale (GSAS) developed by Coetzee (2010) was used to measure graduateness skills and attributes in this study.

5.4.3.1 Development of the Graduateness Skills and Attributes Scale (GSAS)

Coetzee (2010) developed and validated the GSAS to describe and measure the qualities of personal growth and intellectual development of graduates produced by higher education institutions and to assess the relevance of the skills and attributes these graduates take to the workplace. The instrument was developed to measure eight subscales of graduateness, namely, interactive skills; problem-solving and decision-making skills; continuous learning orientation; enterprising skills; skills in presenting and applying information; goal-directed behaviour; ethical and responsible behaviour; and analytical thinking skills. It is a standardised questionnaire that was developed in South Africa and provides a multi-factorial perspective on individuals' sense of internal graduateness (Coetzee, 2010, 2014a, 2014b).

5.4.3.2 Description of the Graduateness Skills and Attributes Scale (GSAS)

Coetzee's (2010) scale is a self-rated, multi-factorial measure consisting of eight subscales and 64 items measured on a six-point Likert-type scale, ranging from 1 (never) to 6 (always). The subscales include interactive skills (16 items); problem-solving and decision-making skills (8 items); continuous learning orientation (7 items); enterprising skills (9 items); skills in presenting and applying information (5 items); goal-directed behaviour (10 items); ethical and responsible behaviour (5 items); and analytical thinking skills (4 items).

5.4.3.3 Administration and scoring of the Graduateness Skills and Attributes Scale (GSAS)

The GSAS is a self-rating questionnaire which is administered individually and takes about 30 minutes to complete. The instrument uses a six-point Likert-type scale to measure respondents' internal sense of graduateness as regards each of the items. A six-point Likert scale (1 = strongly disagree; 6 = strongly agree) was chosen because the scale forces choice and gives better data. The subscales include the following: (1) interactive skills with questions such as "*I can communicate my viewpoints with clarity and fluency in English"; "I take care to use appropriate vocabulary and grammar when communicating with others*"; (2) problem-solving and decision making skills with questions such as "*I make quick but clear decisions that spur others on toward action"; "I usually set priorities with a proper sense of urgency and importance*"; (3) continuous learning orientation with questions such as "*I follow up on goals, tasks and assignments to ensure successful completion"; "I am able to build wide and effective networks of contacts to achieve my goals*"; (4) enterprising skills with questions such as "*I prefer to work under my own direction"; "I have sound financial awareness*"; (5) skills in presenting and applying information with questions such as "*I can write my ideas and opinions clearly to convince my audience"; "I find it easy to commit information to memory quickly*; (6) goal-directed behaviour with questions such as "*I spend a lot of time surfing the internet to find new information on search engines"; "I develop plans for specific goals and tasks*"; (7) ethical and responsible behaviour with questions such as "*I personally take the credit or blame for the results of my work"; "I encourage responsible behaviour toward the community and the environment*"; and (8) analytical thinking skills with questions such as "*I can break information into component parts to see relationships and patterns"; I can make a rational judgement from analysing information and dat*a".

5.4.3.4 Interpretation of the Graduateness Skills and Attributes Scale (GSAS)

Each subscale, namely interactive skills, problem-solving, continuous learning orientation, enterprising skills, skills in presenting and applying information, goal-directed behaviour, ethical and responsible behaviour and analytical thinking skills, is measured separately. The six-point Likert-type scale requires respondents to rate each item and indicate their responses as (1) “never” (2) “rarely”, (3) “sometimes”, (4) “often”, (5) “almost agree”, and (6) “always”. The higher the number, the more the respondent agrees with the statement.

5.4.3.5 Psychometric properties of the Graduateness Skills and Attributes Scale (GSAS)

Coetzee (2010, 2014a, 2014b) explored the graduateness skills and attributes of a sample (n = 270) of final-year undergraduate, honours, master’s and doctoral distance-learning students who were predominantly employed in the service industry. The study sample provided evidence that the GSAS items meet the psychometric criteria of construct, convergent and discriminant validity, and the content is also appropriate for the theoretical constructs being considered (Ismail, 2017). Coetzee (2010) noted statistically acceptable reliability in terms of the Cronbach’s alpha coefficients for each subscale, which were between the range of .75 and .92. Coetzee (2014a, 2014b) further noted Cronbach’s alpha coefficients for each of the eight subscales ranging between .79 and .96. Ismail (2017) reported an overall GSAS reliability coefficient of .95, while the internal consistency reliability coefficients for the subscales ranged between .58 (ethical and responsible behaviour) and .85 (interactive skills).

5.4.3.6 Motivation for using the Graduateness Skills and Attributes Scale (GSAS)

The GSAS was deemed to be appropriate for the present study as it is easily and quickly administrable. The instrument is inexpensive to administer and has been proven to be both valid and reliable. Including the GSAS in the current study provided an understanding of the construct of graduateness skills and attributes in relation to adult learners’ psycho-technological learning capabilities and self-directed learning orientation and resultant employability.

5.5 ETHICAL CONSIDERATIONS AND ADMINISTRATION OF THE PSYCHOMETRIC BATTERY

Ethics are standards of conduct underpinned by moral principles (Rallis, 2009). Terre Blanche et al. (2006) provide the history of ethical conduct in social research dating back to the aftermath of the atrocities committed by the Nazi medical researchers. The authors further confirm that the purpose of research ethics is to protect the welfare of the research participants. The following procedures and the Unisa policy on research ethics were adhered to in the current research to ensure alignment and compliance with the necessary ethical requirements and ethical responsibilities:

Permission to undertake this research was sought and obtained from both the Department of Industrial and Organisational Psychology Ethics Committee (see Appendix A) and the Research Permission Subcommittee of the Unisa Senate Research and Innovation and Higher Degrees Committee (SRIHDC) (see Appendix B). The relevant data for the research was gathered using Lime Survey, a web-based survey. The link to the web-based survey was uploaded on the online teaching portal, myUnisa, where students were invited to complete the survey.

A covering letter, inviting students to voluntarily participate in the study, accompanied the questionnaire. This covering letter explained the reason for the study, confidentiality agreements as well as guidelines on how to complete the questionnaire. At the bottom of the covering letter, a tab was included to confirm consent to participate in the study, thereby providing informed consent to use the data for research purposes only. Participants had to click on the tab to consent to the study in order to proceed to the questionnaire.

The anonymity of the research participants was maintained in that they were not asked to provide information that might result in their identity being revealed. Confidentiality of the research participants was maintained as they received the invitation to participate in the study via an internet link and used the same link to submit their responses. To ensure the integrity of the data, the Lime Survey administrator managed the database, and all responses were registered on Lime Survey on the Unisa server. Before, during and after the study, the researcher ensured that the research participants were not exploited or subjected to direct or indirect coercion while participating in the research study. Ultimately, the researcher will ensure that the recommendations made will be beneficial to the student community and the HEI in question, and feedback will be provided on the research results on request.

5.6 CAPTURING OF CRITERION DATA

Responses from the participants on each of the items in the four questionnaires were captured in an electronic database which was converted to an SPSS data file.

The IBM Statistical Programme for Social Sciences (SPSS) software Version 26 for the Microsoft Windows platform (SPSS Inc., 2016) and SAS software version 9.4 (SAS, 2019) were used to analyse the data. Both descriptive and inferential statistics were used in the analysis of the data to establish the internal consistency or reliability and validity of the measuring instruments (SAS Institute Inc, 2013). Additionally, the CALIS procedure in SAS (2019) was used to ascertain the optimised maximum likelihood fit indices using the Levenberg-Marquardt Optimisation procedure (More, 1978). Rasch modelling was conducted using Winsteps (Version 3.70.0) (Linacre, 2010).

5.7 FORMULATION OF THE RESEARCH HYPOTHESES

Lavrakas (2008) defines a research hypothesis as a precise, clear and testable proposition or predictive statement about the possible outcome of a scientific research-based study on a particular population in relation to specified variables. Other possible outcomes include the postulated differences between groups on specified variables and the relationship between variables. Such postulations are usually informed by theory, previous research or logic. The research hypotheses underpinning the current study are summarised in Table 5.2 below.

Table 5.2

Research Hypotheses

Research aim	Research hypothesis	Statistical procedure
Research aim 1: To operationalise the constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) into a valid and reliable measure	H1: Students' psycho-technological learning capabilities (computer skills and technical self-efficacy) can be operationalised into a valid and reliable measure.	Exploratory factor analysis (EFA) Confirmatory factor analysis (CFA)
Sub-aim 1.1: To assess the psychometric properties (internal consistency reliability and construct validity) of the newly developed Psycho-Technological Learning Capabilities Scale (PTLCS).		Rasch modelling
Sub-aim 1.2: To establish the nature of the interrelationships between the subscale dimensions (computer skills and internet self-efficacy) of the PTLCS.		Scale intercorrelations
Sub-aim 1.3: To establish the factorial equivalence (i.e. measurement invariance) of the PTLCS for the various socio-biographical groups, namely age, gender and ethnicity.		Multi-group confirmatory factor analysis: CFA

Research aim	Research hypothesis	Statistical procedure
Research aim 2: To investigate the nature, magnitude and direction of the relationship between psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS), socio-biographical characteristics (age, gender and ethnicity) and graduateness skills and attributes (as measured by the GSAS).	H2: Students' psycho-technological learning capabilities, self-directed learning orientation and socio-biographical characteristics (age, gender and ethnicity) are significantly and positively related to their graduateness skills and attributes.	Correlation analysis
Research aim 3: To assess whether psycho-technological learning capabilities and self-directed learning orientation significantly predict graduateness skills and attributes	H3: Students' psycho-technological learning capabilities and self-directed learning orientation significantly predict their graduateness skills and attributes.	Multiple regression analysis
The socio-demographic characteristics of age, gender and ethnicity were treated as control variables in the study. The following research aims were posed:		
Research aim 4: To assess whether socio-biographical characteristics, namely age, gender and ethnicity, significantly moderate the relationship between (1) psycho-technological learning capabilities, (2) self-directed learning orientation, and graduateness skills and attributes.	H4: The relationship between students' (1) psycho-technological learning capabilities; (2) self-directed learning orientation and their graduateness skills and attributes is moderated by their socio-biographic characteristics (age, gender and ethnicity).	Hierarchical moderated regression analysis

Research aim	Research hypothesis	Statistical procedure
Research aim 5: To determine whether students from different socio-biographical groups, namely age, gender and ethnicity, differ significantly regarding their psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS) and graduateness skills and attributes (as measured by the GSAS).	H5: Students from different socio-biographical groups (age, gender and ethnicity) differ significantly regarding their psycho-technological learning capabilities, self-directedness learning orientation and their graduateness skills and attributes.	Tests for significant mean differences

Source: Author's own work

5.8 STATISTICAL PROCESSING OF DATA

The statistical procedure relevant to the current study included descriptive statistics, EFA, CFA, Cronbach's alpha coefficients, composite reliability coefficient, Rasch analysis for unidimensionality of the PTLCS, means, standard deviations, kurtosis and skewness and frequency data), correlational analysis (Pearson product-moment correlations), and inferential and multivariate statistics (multiple regression analysis, hierarchical moderated regression analysis, and tests for significant mean differences).

The statistical procedure started with the preliminary descriptive analysis, which included the screening of all cases and variables to ensure data accuracy prior to further statistical analysis. This led the to the next step where a detailed description of the study sample in terms of the respondents' socio-biographical variables, namely age, gender, and ethnicity. Thereafter, descriptive statistical analysis was conducted with an evaluation of the psychometric suitability of the measuring instruments, followed by the description and interpretation of the construct-level data using measures of central tendency (means) and dispersion (standard deviations, skewness and kurtosis).

The subsequent step entailed correlational analysis to test the strength of the relationships between the independent and dependent variables. This step led to the final step in which inferential and multivariate analyses were conducted to test the research hypotheses as outlined in Table 5.2 above.

The data investigation process comprised five phases, each consisting of various steps of statistical analysis, as summarised below:

Phase 1:	PTLCS - EFA and CFA, RASCH modelling, reliability, common method bias, and multigroup CFA.
Phase 2:	ALSDS and GSAS: CFA of measurement model, common method bias.
Phase 3:	PTLCS, ALSDS and GSAS: CFA of measurement model.
Phase 4:	PTLCS, ALSDS and GSAS: Descriptives, means and SD's, reliabilities and correlations.
Phase 5:	PTLCS, ALSDS and GSAS: Inferential statistics - Multiple regression, hierarchical moderated regression and tests for differences.

Phase 1 involved five studies:

Study 1:	Conducting EFA to confirm the factor structure of the newly developed PTLCS.
Study 2:	Conducting CFA to assess the construct validity of the factor structure of the newly developed PTLCS.
Study 3:	Assessing for common method bias in the PTLCS.
Study 4:	RASCH modelling: reliabilities and differential item functioning (DIF).
Study 5:	Conducting multigroup CFA to assess measurement invariance of the PTLCS for age, gender and ethnicity.

These five studies of Phase 1 were performed to achieve the following research aim:

Research aim 1: To operationalise the constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) into a valid and reliable measure.

Sub-aim 1.1: To assess the psychometric properties (internal consistency reliability and construct validity) of the newly developed PTLCS.

Sub-aim 1.2*:* To establish the nature of the interrelationships between the subscale dimensions (computer skills and internet self-efficacy) of the PTLCS.

Sub-aim 1.3**:** To establish the factorial equivalence (i.e. measurement invariance) of the PTLCS for the various socio-biographical groups, namely age, gender and ethnicity.

5.8.1 Preliminary statistical analysis

The preliminary statistical analysis was performed to ensure that the data was accurately recorded and useable, as well as to obtain a quantitative summary of the data to provide an overall understanding of the sample distribution. The preliminary statistics included measures of distribution (frequency and percentage), central tendency (mean) and dispersion (range, standard deviation, skewness and kurtosis).

The following steps comprised the preparation of the data:

(1) screening all recorded cases for accuracy, missing data, outliers and unengaged responses
(2) screening all variables in order to gain a general view of the variation in the data, and
(3) describing the sample distribution in terms of socio-biographical variables, namely age, gender and ethnicity.

During case screening, the preliminary data analysis included various steps undertaken to screen all the recorded cases for accuracy, missing data, outliers and incomplete responses.

In the data collection phase, questionnaires were distributed and accessed electronically by respondents where they recorded their responses in a pre-coded format. The respondents accessed the questionnaires via their personal university assigned email. This encouraged the accuracy of the data since respondents recorded their responses themselves. The research respondents were required to answer all the questions which resulted in no missing data. Frequency statistics for each of the scale items were calculated using SAS version 9.4 (SAS, 2019). Essentially, the frequencies highlighted the minimum and maximum values, the means and the standard deviations which were examined to ascertain and ensure the accuracy of the data. All of the items fell within the possible range of values, thereby indicating that the data was accurate. Missing data occurs when there are no values assigned to an observation or question, meaning that the respondents' responses are not available for further statistical analysis (Mirzaei et al., 2021). Hair et al. (2014) posit that missing data adversely affects the generalisability of the research results. Hair et al. (2014) and Mirzaei et al. (2021) further suggest that some missing data can be overlooked while others must be rectified by acknowledging and accommodating them in the statistical analysis. Mirzaei et al. (2021) and Howitt and Cramer (2017) further suggest that if responses are missing for a large number of research participants, there may be something wrong with the measure which needs to be examined and addressed.

To address possible ethical concerns, respondents were informed from the outset that participation in the survey was completely voluntary and that respondents would be allowed to exit the survey at any point before final submission. Essentially, this meant that if the respondents felt uncomfortable or dissatisfied in answering any of the questions, they could withdraw from the survey. Examining the cases for outliers also formed part of the case screening. Outliers occur as a result of measurement errors or mixing several non-homogenous observations (Khezrimotlagh et al., 2020). Khezrimotlagh et al. (2020) further assert that outliers can significantly affect the estimation of a data set, resulting in considerable under-estimations of the efficiency of the observations; as such, researchers must decide whether to omit or resolve and include the outlier in the sample to be analysed (Hair et al., 2014). In the current study, no outliers were found because of the use of pre-coded responses for categorical or demographical data, as well as the use of mainly Likert scales to measure the relevant constructs. This finding ensured that all of the completed questionnaires were used for further statistical analysis.

The final step was to determine whether the sample size was sufficient to have acceptable statistical power. Kyriazos (2018) asserts that an adequate statistical power contributes to observing the true relationship of a dataset and the sample size has an impact on the accuracy of all statistical calculations, especially in EFA. Scholars agree that the performance fit indices appear to increase as the sample size increases (Lei & Li, 2016; Sen & Cohen, 2021). As rule of thumb, Kyriazos (2018) suggests that a sample size of N = 200 with a measure having up to 40 items should offer adequate statistical power for data analysis. The sample size of N = 378 used in this study was considered adequate for achieving satisfactory statistical power.

5.8.1.1 Description of the construct-level data

In the current study, descriptive statistical analyses were applied in order to organise, analyse and interpret the data at construct level. Breslin (2020) explains that descriptive statistics are tabular and graphical ways of presenting a data set in an easily comprehensible manner. Breslin (2020) further suggests that tables and graphs can be used to summarise and organise data in order to facilitate an understanding of the underlying data and its overall usefulness, and highlight potential patterns or relationships within the data. Descriptive statistics were used to explain aspects of the data in relation to the research constructs, namely, psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS) and graduateness skills and attributes (as measured by the GSAS).

The means and standard deviations, which are measurements of central tendency, were applied in the current research to determine the dimensions of the research constructs (Breslin, 2020). The mean, also referred to as the “average”, is used in continuous data and is equivalent to the sum of all the values in the data divided by the number of values in the data (Breslin, 2020). Allen (2017) asserts that the standard deviation is an accepted measure of spread of a normal distribution, while Breslin (2020) mentions that by using the square root of the variance term, the unit of measure of the standard deviation is similar to the values in the data set, thus allowing for easier interpretation. If the histogram is bell-shaped (normal distribution), 68% of the scores lie within one standard deviation above or below the mean, 95% of the scores lie within two standard deviations above or below the mean, and 99% of scores lie within three standard deviations above or below the mean (Breslin, 2020).

The shape of the distribution of the data was also explained by calculating the kurtosis and skewness for the variables consisting of ordinal data (Breslin, 2020). Skewness indicates the lack of symmetry in the data while kurtosis ascertains whether the data are heavy or light tailed relative to a normal distribution (Allen, 2017; Breslin, 2020; Hair et al., 2014). Skewness and kurtosis values of zero occur in a normal distribution (Allen, 2017). According to Allen (2017) and Breslin (2020), distributions with a negative skewness have a longer left tail, and those with a positive skewness have a longer right tail. A curve that has a symmetric shape is considered to have zero skewness.

5.8.1.2 Testing the assumptions of multivariate analysis

The following section presents the assumptions considered during the multivariate procedures and tests for significant mean differences, namely *normality, linearity, homoscedasticity* and *multicollinearity.*

Hair et al. (2014) asserts that a fundamental assumption in multivariate analysis is normality, reflecting the shape of the data distribution for each metric variable and its correspondence to the normal distribution. If the variation from the normal distribution is huge, all resulting statistical tests are regarded as invalid. The Shapiro-Wilk test and the Kolmogorov-Smirnov test are commonly used to test normality (Frey, 2018; Mishra et al., 2019). If the test yields a significant p-value, the null hypothesis can be accepted and the data may be referred to as being normally distributed (Mishra et al., 2019). In the current study, skewness and kurtosis were applied to test for multivariate normality in conjunction with the Kolmogorov-Smirnov test. These tests were found to be the most suitable for examining multivariate normality.

The assumption of linearity is to ascertain whether a linear relationship exists between variables, as this is required to conduct a correlation analysis (Hair et al., 2014; Swank & Mullen, 2017). Swank and Mullen (2017) advise that linearity can be detected through scatterplots, histograms or graphs, where a researcher can determine whether the relationship is linear of curvilinear. Hair et al. (2014) emphasise the importance of determining all relationships to identify any deviations from linearity that may affect the magnitude of correlations. In the current study, there was no indication of curvilinear relationships, thereby confirming that the relationships between the variables were adequately linear to continue with inferential and multivariate statistical analysis.

Another assumption, homoscedasticity, suggests that the dependent variable(s) display the same levels of variance across the range of predictor variable(s) (Hair et al., 2014; Mortaza et al., 2014). In the current study, bivariate scatterplots were generated for all potential variable pairs and used to test for both linearity and homoscedasticity. These bivariate scatterplots showed no irregularities.

Multicollinearity occurs when two or more variables are highly correlated with one another ($r \geq .80$) (Bowring et al., 2021; Daoud, 2017). Multicollinearity indicates a condition of extreme redundancy among the respective variables while, conversely, singularity transpires when a perfect correlation among the variables exists ($r = 1.00$) (Bowring et al., 2021; Simons & Bahr, 2020). In the current study, multicollinearity and singularity assumptions were tested by applying the variance inflation factor (VIF), tolerance, eigenvalues and condition indices. These tests showed no irregularities.

All data was imported to an SPSS file and analysed using statistical methods, specifically utilising the statistical programs SPSS (Statistical Package for Social Sciences) Version 26 for the Microsoft Windows platform (SPSS Inc., 2016) and SAS version 9.4 (SAS, 2019). Rasch modelling was conducted by using Winsteps (Version 3.70.0) (Linacre, 2010).

5.8.2 Exploratory factor analysis (EFA)

Yong and Pearce (2013) define factor analysis as a method that operates on the notion that measurable and observable variables can be reduced to fewer latent variables that share a common variance and are unobservable, also known as reducing dimensionality. EFA is a methodological approach which tries to uncover complex patterns by exploring the dataset and testing predictions. It is usually the first step in building scales or a new metrices (Yong & Pearce, 2013). EFA may be used as an exploratory first step during the development of a measure, and then CFA can be used as a second step to examine and confirm the factor structure identified in the EFA (Bashir & Bala, 2019; Kumar, 2015).

The EFA procedure in the current study used PCA with a varimax rotation method to clarify the relationship among the factors. A Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity were computed as part of the EFA, as the PTLCS was in the process of being developed. The process followed several iterative cycles of factor analysis on the data set, and after each iteration the total variance explained and numbers of factors extracted were examined. Factors with low communalities and no correlation were deleted with the aim of improving the factor structure to obtain a matrix with much clearer loadings (Bashir & Bala, 2019). If the variables share common factor(s), then the partial correlations should be small and the KMO should be close to 1.0, for example the KMO measure should equal .6 when the correlation matrix equals the partial correlation matrix. The SPSS program code sets KMO to .6 when the correlation matrix is an identity matrix, avoiding the division-by-0 problem (Ashraf et al., 2014; Bashir & Bala, 2019; Sreejesh et al., 2014). The results of these tests are presented in Chapter 6 (Research results: exploratory factor analysis).

In the literature review the a priori theoretical factor structure of the PTLCS was hypothesised by operationalising two theoretical dimensions, namely, technological skills (initially named computer skills) and technical self-efficacy (previously named internet self-efficacy), and then generating items for each of the two theoretical subdimensions of the PTLCS. EFA was used as a pre-test to evaluate the questionnaire items in terms of item and factor loadings. The main objective for conducting the EFA was to modify the a priori theoretical factor structure by identifying the dimensional factors onto which the items loaded best and to identify redundant items. The EFA was also used to assess whether the PTLCS had unidimensionality, that is, whether the scale items assess a single underlying/overall factor or construct (psycho-technological learning capabilities). Dibble et al. (2011) assert that unidimensionality is a prerequisite for meaningful estimates of reliability, as such it is important to first establish the factor structure of the scale.

Pallant (2016) suggests that a good factor structure is evident from 40% of the cumulative variance explained. Evidence of unidimensionality (homogeneity) is represented by one factor accounting for at least 40% of the total variance. Once the dimensionality of the PTLCS was determined, the second-order (multidimensional) structural validity of the proposed model could be tested using a structural equation modelling technique, namely CFA. CFA and Rasch analysis were used to test the hypothesis that the newly developed PTLCS has valid and reliable measurement properties.

Exploratory factor analysis was conducted on a randomly selected sample (n = 150) of the full data set (N = 378). The principal component method of extraction (maximum likelihood) and quartimax rotation with Kaiser normalisation were used in order to simplify and clarify the data structure (Sreejesh et al., 2014). According to Sreejesh et al. (2014), rotation of the factors assists to improve the interpretation by reducing some of the ambiguities that often accompany the initial unrotated factor output. In the current study, quartimax rotation (orthogonal) was used as a method for data analysis. The KMO value should be at least at the recommended minimum value of .60 (Hair et al., 2014) or .70 at p = < .05 (Sreejesh et al., 2014), while the larger the value of the Bartlett's test the greater the likelihood that the correlation matrix is not an identity matrix and hence the null hypothesis can be rejected (Sreejesh et al., 2014).

The last decision was to decide on the number of factors to retain for further analysis. The size of eigenvalue units and the number of items that loaded adequately in each factor were considered for the retention of items. An eigenvalue cut-off of 1.00 units was used to establish the number of principal component factors, following recommendations in the literature on the minimum number of items required in each factor (Kumar, 2015). All items with an eigenvalue of 1.66 and higher were retained and each factor had to have a minimum of four items because the a priori theoretical factor structural model and item generation proposed four underlying factors for the newly developed PTLCS. The original PTLCS contained 16 items, of which two were removed, leaving 14 items to be used in further statistical analysis (see Chapter 6 section 6.1.2). Table 5.3 depicts a summary of the parameters applied during the EFA phase of this research.

Table 5.3

Summary of Parameters used during the Exploratory Factor Analysis

Measure/procedure	**Parameters**	**Source (s)**
Sample size	50 is very poor; 100 is poor; 200 is fair; 300 is good; 500 is very good; and 1000 or more is excellent.	(Lakens, 2021; Sreejesh et al., 2014)
Kaiser-Meyer-Olkin	Minimum acceptable value for EFA ≥ .60	(Hair et al., 2014; Sreejesh et al., 2014).
Bartlett's test of sphericity	Significance $p \leq .05$.	(Sreejesh et al., 2014).
Eigenvalue (Kumar, 2015)	Represents the amount of variance in the total sample accounted for by each factor.	Factors that obtain eigenvalues > 1 should be retained (Kyriazos, 2018).

Measure/procedure	Parameters	Source (s)
Factor loadings (Kumar, 2015)	Test items that are highly related to each other will load on one factor, and factor analysis should explain variance in the scores.	A factor loading of > .50 or higher is regarded as significant (Costello & Osborne, 2005; Kumar, 2015).

*Sources: Costello and Osborne (2005); Hair et al. (2014); Kumar (2015); Kyriazos (2018); Lakens (2021); Sreejesh et al. (2014).

5.8.3 Confirmatory factor analysis and construct validity

CFA is aimed at checking whether the theoretical specification of the factors is in accordance with the actual data (Hair et al., 2014). Essentially, CFA is conducted to test the hypothetical model and, where the data does not fit the hypothesised model, the model is modified based on modification indices (Kyriazos, 2018). In the current study, various CFA analyses were conducted to confirm the factor structures of the three scales, to examine their discriminant and convergent validity and to address issues of common method variance (Chang et al., 2010; Podsakoff et al., 2003).

The number of latent factors and patterns in which each item loaded into a particular factor were underpinned by the output obtained from the EFA as well as the theoretical conceptualisation of the constructs in the literature review (Chapters 3 and 4). Table 5.4 provides an overview of the maximum likelihood method and fit indices used to establish the best model fit for each measure.

The best model fit was assessed by evaluating the goodness-of fit (GOF) (Alavi et al., 2020). Alavi et al. (2020) assert that the chi-square fit index evaluates the fit between the hypothesised model and the data from the measurement items. Essentially, the model chi-square is the chi-square statistic obtained using the maximum likelihood method (Alavi et al., 2020). The model fit was evaluated by using the absolute-fit indices (χ^2 and χ^2/df). The chi-square (χ^2/df) value indicates the difference between the observed and estimated covariance matrices in structural equation modelling (SEM) (Hair et al., 2014). Hair et al. (2014) further advise that if the χ^2 test is small, it indicates that the two covariance matrices are statistically different and further highlights a problem with the fit. The degrees of freedom (*df*) represents an important parameter in the calculations and is equal to the number of categories minus 1 (Hair et al., 2014).

Hooper et al. (2008) highlight limitations associated with the use of the chi-quare in that the test assumes multivariate normality and thus models can be rejected in cases where there are substantial deviations from normality. Secondly, the chi-square is a statistical significance test and is therefore sensitive to the sample size, meaning that the chi-square tends to reject a model when a large sample size is used. Where a small sample size is used, the statistic may lack power and subsequently fail to discriminate between well-fitting and poorly fitting models (Hooper et al., 2008).

Based on these restrictions, alternative indices to assess model fit are recommended (Hair et al., 2014; Hooper et al., 2008; Kyriazos, 2018). Wheaton et al. (1977) suggest that researchers report the normed chi-square (χ2/df or CMIN/DF). Although there is no consensus regarding an acceptable ratio for this statistic, χ2/df values of less than 3.0 are generally deemed acceptable (Hair et al., 2014), although as high as 5.0 is also deemed an acceptable ratio for this statistic (Hooper et al., 2008; Wheaton et al., 1977).

However, this statistic also remains problematic as it tends to be sensitive to sample size only for incorrect models and a universally acceptable criterion for its interpretation has not been found (Goodboy & Kline, 2017). Consequently, the χ2 statistics (i.e. χ2 and χ2/df) were included as a preliminary assessment of model fit. Additional indices, including both absolute and incremental indices, were used to examine different aspects of the measurement models (Alavi et al., 2020; Hooper et al., 2008). These indices are specified in Table 5.4 and briefly discussed below.

Table 5.4

Summary of Measures/Indices and Criteria used in the Confirmatory Factor Analysis

Measure/Index	Description	Criteria applied
Absolute fit indices: determine how well an a priori model fits the sample data and demonstrate which proposed model has the most superior fit (Hooper et al., 2008; Kelloway, 2017).		
Chi-square (χ^2 or CMIN) (Barendse et al., 2015; Hair et al., 2014; Hooper et al., 2008)	A statistical measure for evaluating overall model fit and further assess the magnitude of discrepancy between the sample and fitted covariances matrices.	A good model fit would provide an insignificant result at $p \geq .05$.

Measure/Index	Description	Criteria applied
Normed chi-square (χ^2/df or CMIN/df) (Hair et al., 2014; Sahoo, 2019; Wheaton et al., **1977**)	A significant χ^2 value relative to the degrees of freedom indicates that the observed and implied variance-covariance matrices are different.	For an acceptable model fit the ratio of χ^2 to df (CMIN/DF) should be ≤ 3 (≤ 5 is sometimes permissible).
Goodness-of-fit index (GFI) (Hair et al., 2014; Hooper et al., 2008; Kelloway, 2017)	A measure of the proportion of variance that is accounted for by the estimated sample covariance.	Statistic ranges between 0 and 1. Higher values indicate a better fit. A value of ≥ .90 is traditionally deemed acceptable, with a value of ≥ .95 preferred.
Adjusted goodness- of-fit index (AGFI) (Kelloway, 2017)	Corrects the GFI, which is affected by the number of indicators of each latent variable.	Ranges between 0 and 1. Higher values indicate a better fit. A value of ≥ .90 indicates a good model fit.
Standardised root mean squared residual (SRMR) (Barendse et al., 2015; Hooper et al., 2008; Hu & Bentler, 1999)	Indicates the difference between observed and predicted covariances.	A lower SRMR value represents better fit, while a higher value represents a worse fit. A rule of thumb is that the SRMR should be < .05 for a good fit. Values smaller than .10 may be interpreted as acceptable.
Relative or incremental fit indices: represent the degree to which the tested model accounts for the variance in the data in relation to a baseline model (Hair et al., 2014; Hooper et al., 2008).		
Normed fit index (NFI) (Hair et al., 2014; Hooper et al., 2008; Hu & Bentler, 1999; Kelloway, 2017)	Assesses the model by comparing the chi-square value of the model to that of the null model.	Ranges between 0 and 1, and a model with perfect fit would produce an NFI of 1. The rule of thumb for this index is that .95 is indicative of good fit relative to the baseline model. Values > .90 are typically interpreted as indicating an acceptable fit.

Measure/Index	Description	Criteria applied
Comparative fit index (CFI) (Hair et al., 2014; Hooper et al., 2008; Hu & Bentler, 1999; Kelloway, 2017)	This statistic assumes that all latent variables are uncorrelated (null/independence model) and compares the sample covariance matrix with this null model.	Values range between 0 and 1, with higher values indicating better fit. CFI values of ≥ .90 are conventionally associated with good model fit, but a value of ≥ .95 is recommended.
Fit indices based on the noncentral chi-square distribution: these measures are based on the assumption that no model is "correct" but that it can only be "approximately correct".		
Root mean square error of approximations (RMSEA) (Barendse et al., 2015; Hair et al., 2014; Hooper et al., 2008).	A measure indicating how well the model, with unknown but optimally chosen parameter estimates, would fit the population's covariance matrix.	The lower RMSEA values indicate better fit. Values of ≤ .05 or ≤ .08 are generally recommended with ≤ .05 regarded as good fit, and between .08 and .10 regarded as a mediocre fit.
Information theoretical fit measures: these measures express the extent to which the present model will cross-validate in future samples of the same size from the same population (Kaplan, 2009).		
Akaike information criterion (AIC) (Kaplan, 2009; Kelloway, 2017)	A measure used to consider the fit of both the model and the number of estimated parameters and to assist in choosing between competing models.	The better the fit, the lower the AIC value.

Sources: Barendse et al., 2015; Hair et al. (2014); Hooper et al., (2008); Hu and Bentler (1999); Kaplan (2009); Kelloway (2017); Sahoo (2019).

In the current study, both the GFI and AGFI indices were used to compare the fit of alternative models (one-factor, original and modified models) (Alavi et al., 2020; Hair et al., 2014; Hooper et al., 2008). GFI indicates how well the model specified reproduces the observed covariance matrix among the indicator items (Alavi et al., 2020; Sahoo, 2019). The AGFI index differs from the GFI in that it adjusts the GFI for the degrees of freedom in the specified model (Kelloway, 2017). Both approaches have been criticised because, when there are a large number of degrees of freedom in the sample size, the GFI has a downward bias, and both approaches are influenced by the sample size (Hooper et al., 2008). As such, these two indices were not relied on, however they were given their theoretical importance as they are rooted in the covariance structure analyses

(Hooper et al., 2008). Both indices range from 0 to 1 with values close to 1 (≥ .90), thus being indicative of a good fit (Hair et al., 2014).

The SRMR is the square root of the mean of the squared discrepancies between the implied and observed covariance matrices and is used to establish a metric to measure of model fit (Kelloway, 2017). Hooper et al. (2008) suggest values for the SRMR ranging from 0 to 1, with a well-fitting model obtaining values less than .05. Hu and Bentler (1999) further advise that values as high as .08 are deemed acceptable and an SRMR value of 0 indicates a perfect fit (Hooper et al., 2008).

Incremental fit indices, also known as comparative or relative fit indices, are a group of indices that compare the chi-square value to a baseline model (Alavi et al., 2020; Hooper et al., 2008; Sahoo, 2019). Sahoo (2019) asserts that the usual baseline model is called the null model in which all observed variables are not correlated. In the current study, the following incremental fit indices were reported: the normed fit index (NFI) (Hu & Bentler, 1999) and the comparative fit index (CFI) (Hair et al., 2014).

Hooper et al. (2008) assert that the NFI assesses the model by comparing the chi-square value of the model to the chi-square value of the null model. The null/independence model is the worst-case scenario as it specifies that all measured variables are uncorrelated. Sahoo (2019) suggests that the value of the NFI should fall within the range 0 to 1, with a perfect-fit model producing an NFI value of 1. Hair et al. (2014) and Hooper et al. (2008) recommend an NFI value of more than .90 for a good fit.

The CFI is used to enhance the NFI as it seeks to determine the estimated model as an overall fit to the data compared to the null model (Sahoo, 2019). Kaplan (2009) explains that the basic idea behind the CFI is that the fit of the model is compared to the fit of some baseline model that usually specifies complete independence among the observed variables. Similar to the NFI value, the CFI value lies between 0 and 1, with 1 representing a perfect fit relative to the baseline model (Kaplan, 2009). Hair et al. (2014) and Hu and Bentler (1999) further advise that a value of CFI ≥ .95 indicates a good fit and a value of ≥ .90 is considered acceptable.

Additionally, the RMSEA was conducted to ascertain whether the SEM estimated model fits a population rather than the study sample (Hu & Bentler, 1999). Sahoo (2019) asserts that lower RMSEA is always considered as good for model fit. RMSEA values between .08 and .10 indicate mediocre fit, while values less than .08 reflect good fit (Sahoo, 2019). Hu and Bentler (1999) recommend that a threshold value closer to .06 can be deemed a fair fit. Hair et al. (2014) therefore suggest that an RMSEA value within the range of .03 and .08 with 95% confidence interval should be reported.

The Akaike information criterion (AIC) is a measure that uses both the fit of the model and the number of estimated parameters (Kelloway, 2017). Kaplan (2009) further adds that the AIC measures the deviation of the predictive distribution from the conceptual construct that underpins the estimation procedure. Kaplan (2009) highlights that a limitation with this method is that when selecting from a set of competing models, maximum likelihood will always prefer the saturated model. Kaplan (2009) asserts that the model with the lowest AIC values among the competing models is deemed to fit the data best from a predictive perspective.

CFA was performed to assess the construct validity of the three scales (PTLCS, ALSDS and GSAS) and the overall measurement model comprising of PTLCS, ALSDS and GSAS.

Ascertaining the construct validity of the measurement models was beneficial for confirming the psychometric suitability of the scale measures within the South African context and ODEL environments. Factor analysis also supported the internal consistency and internal validity of the scale measures, thereby establishing the psychometric suitability of the measurement scale for the South African context.

Construct validity refers to the extent to which a set of items reflect a content domain (Hair et al., 2014; Swank & Mullen, 2017). Construct validity can be attained through convergent and discriminant validity. Convergent validity relates to the extent to which indicators of a specific construct converge or have a high proportion of variance in common (Hair et al., 2014), while discriminant validity focuses on comparing the test scores from a test under development to a score from a test that is designed to measure an alternative construct (Swank & Mullen, 2017).

In the current study, convergent validity was confirmed by computing the factor loadings or path estimates and internal consistency reliability. Hair et al. (2014) define factor loadings as the correlation between the original variables and their factors, with a focus of understanding the nature of the factor. Essentially, factor loadings display the role each variable plays in defining each factor. Loadings indicate the degree of correspondence between the variable and the factor, with higher loadings indicating that the variable is representative of the factor (Hair et al., 2014). High loadings on a factor would indicate that they converge on a common latent construct (Hair et al., 2014).

Table 5.5

Construct Validity of the Measurement Models

Indicator	Description	Criteria applied
Convergent validity is a comparison of the items from the measure under development and another item from a measure that theoretically measures the same construct.		
Factor loadings	The correlation between the original variables and its factors with the aim of understanding the nature of the factor.	All standardised loadings estimates should be significant (ideally > .7 but > .5 acceptable).
Reliability coefficient (Cronbach's alpha, α)	Is a measure of internal consistency and uses inter-item correlations to determine whether items are measuring the same domain.	α ≥ .7 is considered acceptable for developing instruments to indicate adequate convergence.
Discriminant validity: The extent to which a construct is truly distinct from other constructs		
Confirmatory factor analysis (CFA)	Items that make up a construct load on a latent or unobserved factor representing the construct.	The best-fit models were determined by applying the criteria listed in Table 5.4.

Sources: Hair et al. (2014); Hu and Bentler (1999); Kumar (2015); Putnick & Bornstein (2017); Swank and Mullen (2017)

5.8.4 Reliability of the measurement scales

Kumar (2015) asserts that reliability is paramount in scale development and calculating coefficient alpha/Cronbach's alpha statistic is one way of assessing reliability. Hair et al. (2014) report that the statistic ranges from 0 to 1, with values of .60 to .70 deemed the lower limit of acceptability. Ideally, the Cronbach's alpha coefficient should exceed .70 for developing instruments or .80 for an established instrument (Kumar, 2015). Kumar (2015) further adds that items contributing to low reliability need to be removed and new items developed. In the current study, the Cronbach's alpha was used to measure the internal consistency reliability of the measuring instrument. Cronbach's alpha values larger than .70 (Kumar, 2015) suggest that the internal reliability of the scale used is sufficient although it may decrease to .60 in exploratory research (Hair et al., 2014).

However, Cronbach's alpha can either under- or over-estimate reliability (Raykov, 1998). Composite reliability was therefore also considered as it is viewed as a less biased estimate of reliability than the Cronbach's alpha coefficient. For both the Cronbach's alpha coefficient and the composite reliability coefficient, a value of ≥ .70 is regarded as satisfactory (Geldhof et al., 2014).

5.8.5 Multigroup confirmatory factor analysis (CFA)

In the multigroup CFA., measurement invariance was assessed. Mellenbergh (1989) postulated that the association between the items and the latent factors or latent traits of individuals should not depend on the group membership or when the data was collected (Mellenbergh, 1989; Van De Schoot et al., 2015). Based on the work by Mellenbergh (1989), Lurino and Saucier (2020) assert that measurement invariance is necessary as its assists the researcher to gauge the cross-cultural applicability of an instrument.

Putnick and Bornsetin (2017) assert that measurement invariance can be assessed in an item-response theory (IRT) framework or an SEM framework using the CFA, with the SEM framework being commonly used rather than the IRT framework. Putnick and Bornstein (2017) further explain that in a CFA, the items making up a construct load on a latent or unobserved factor representing the construct. Lurino and Saucier (2020) suggest the following reasons why researchers choose to test measurement invariance with a CFA framework rather than an IRT framework:

- The CFA framework allows testing of the equivalence of the factor structure, whereas the IRT framework only tests for equivalence between isolated scales of items.
- The CFA framework is more flexible for testing the equivalence between many groups, while the IRT framework requires pairwise comparisons.
- The CFA framework tends to be more consistent with scales that have been modelled (i.e. simple sums of individual items) and used in past research.

In the current study, CFA theory (see section 5.8.3 above) was applied to assess measurement invariance between the age, gender and ethnicity groups across three structural equivalence levels, namely (1) configural invariance (to ascertain whether the constructs have the same pattern of free and fixed loadings), (2) metric variance (testing whether each item contributes to the latent construct to a similar degree across groups) and (3) scalar invariance (tests whether the mean differences in the latent construct capture all mean differences in the shared variance of the items) (Putnick & Bornstein, 2017). In the current study, configural and metric invariance were noted for the age, gender and ethnicity subgroups, while scalar invariance was not reported (see Chapter 6).

5.8.6 Common method bias

Common method bias (CMB) or common method variance (CMV) is where a systematic variance is shared among the variables collected brought about by the measurement method rather than the constructs being measured (Bell, 2019). Bell (2019) further highlights that CMV can arise in research where there is an independent and dependent variable from a single source. Chang et al. (2010) support this and further explain that respondents who tend to provide similar answers to survey questions create false correlations.

Chang et al. (2010) propose remedies that can be used to address CMV. Remedies include (1) researchers using other source of information for some of the key measures; (2) adopting procedural remedies in designing and administering the measuring instrument, from mixing the order of the questions to using different scale types; (3) applying complex specifications for regression models, and (4) applying statistical remedies after data collection such as the post hoc Harman one-factor analysis, the unmeasured latent method construct test, the correlation marker technique, and the CFA marker technique (Bell, 2019; Chang et al., 2010), to check whether variance in the data can be mostly attributed to a single factor. In the current study, Harman's one-factor analysis was applied. Additionally, all the items were loaded from each of the constructs into an EFA to evaluate whether one single factor emerged or whether one general factor accounted for most of the covariance between the measure (Chang et al., 2010). The model fit statistics were assessed in terms of the criteria indicated in Table 5.4. The single-factor model was compared with the alternative multidimensional models to determine the best fit model. Accordingly, the outcome of Harman's single-factor test indicated that most of the variance in the data could be accounted for by a general factor. The CFA results determined the dimensionality of the measurement model for the current sample.

5.8.7 Rasch modelling

Rasch and reliability analysis for the PTLCS was conducted on the total sample of N = 378. The Rasch item fit statistics further assisted in assessing the unidimensionality (homogeneity) of each of the four PTLCS dimensions. Following the EFA factor extraction process, Rasch modelling was conducted using Winsteps (Version 3.70.0) (Linacre, 2010). Winsteps software first uses a normal approximation algorithm to obtain initial estimates of model parameters and then uses these initial estimates for iterative joint maximum likelihood estimation (Linacre, 2010). The iterative process stops once convergence criteria are reached. Rasch models have the algebraic form of logit-linear models. The Rasch model is a mathematical formulation linking the probability of the outcome when a single person attempts a single item. It is thus one of the families of latent trait models for the measurement of achievement and is arguably the least complex member of this family (Pallant & Tennant, 2007). This model was used in this research to examine the psychometric properties (unidimensionality or homogeneity and internal consistency reliability) of the newly developed PTLCS. Response rating category functioning and differential item functioning were also assessed by means of Rasch modelling.

Psychometric measurement models or instruments require unidimensionality; that is, valid and legitimate summing of rating scale items into an interpretable total score rests on the requirement that the items represent one common underlying (latent) variable (Hagell, 2014). The Rasch model is therefore probabilistic and not deterministic; as such, it is expected that the model may fail to predict the observed values. In this regard, two statistics are used to represent these deviations: infit mean square (information-weighted fit statistic) and outfit mean square (outlier-sensitive fit statistic). The ideal value for the infit and outfit statistics should be 1.0 (Barker et al., 2017) to indicate unidimensionality or homogeneity (i.e. that the items of the respective dimension adequately measure the intended underlying construct) (Linacre, 2010). Fit statistics, the infit and outfit, help detect discrepancies between the data and Rasch model expectation (Barker et al., 2017). Chi-square values, provided in infit and outfit mean statistics, divided by their degrees of freedom, are used to determine how well the data fits the prescribed model (Brand-Labuschagne et al., 2012). Acceptable values are +1 and range from 0 to positive infinity (Bond & Fox, 2007). Essentially, to evaluate the unidimensionality of a scale, item fit mean-square statistics (MNSQ) are utilised, as these statistics indicate how well the item measures the intended underlying construct, with the ideal value being 1 (Brand-Labuschagne et al., 2012). In the current study, infit statistics were used to assess the fit of items to the Rasch model and the unidimensionality of the measure.

Person fit to the Rasch model is an index of whether individuals are responding to items in a consistent manner or if responses are idiosyncratic or erratic (Barker et al., 2017; Brand-Labuschagne et al., 2012). Responses may fail to be consistent when people are bored and inattentive to the task, when they are confused, or when an item evokes an unusually salient response from an individual. Brand-Labuschagne et al. (2012) advise that the person separation index should be used as an alternative to person reliability and should be between 0 and 1.

Item reliability, on the other hand, indicates how well difficulty levels of the item are distributed along the measured latent variable (Barker et al., 2017; Brand-Labuschagne et al., 2012). An item may be a misfit because it is too complex or confusing, or because it actually measures a different construct. Item and person fit of at least 2.00 (Bond & Fox, 2007) implies that participants would probably have indicated similar responses in other contexts. The mean item infit and person infit also assessed whether the responses underfitted (≥ 1.30) or overfitted (≤ .70). Ideally, outfit statistics below 2.00 indicate that the scale provided useful information (Brand-Labuschagne et al., 2012).

Differential item function (DIF) was used to identity item bias. Misajon et al. (2016) and Pallant and Tennant (2007) further explain that item bias exists when different groups within the sample respond to item(s) differently despite having equal levels of the underlying characteristic being measured. Pallant and Tennant (2007) explain that there are two types of DIF, namely, uniform DIF (where the group shows consistent systematic differences in their responses to an item across the whole range of the attribute being measured) and non-uniform DIF (where the group's responses to an item vary across the whole range of the attribute being measured). In the current study the DIF results are presented in section 6.6.

5.8.8 Correlations

Correlations were performed to achieve research aim 2:

Research aim 2: To investigate the nature, magnitude and direction of the relationship between psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS), socio-biographical characteristics (age, gender and ethnicity) and graduateness skills and attributes (as measured by the GSAS).

Multivariate statistical analysis refers to the application of statistical and mathematical methods to plan research in an optimised manner to extract the maximum information from the data analysis (De Jesus Silva et al., 2020). Hair et al. (2014) assert that correlations represent the linear association between variables, while De Jesus Silva et al. (2020) add that correlations examine the relations between two groups of variables, assessing the existence and intensity of associations between the groups. Hauke and Kossowski (2011) assert with regard to the history and properties of Pearson's correlation coefficient, that it was discovered by Bravais in 1846 but described by Karl Pearson in 1896.

Chaun (2006) explains that Cohen's statistical power analysis is the most popular approach for calculating the adequate sample size to optimise, as opposed to maximising the sampling effort within time and money constraints. Chaun (2006) further explains that the statistical level of significance for most studies is often fixed at alpha (*p)* = .05, where the alpha is the probability of wrongly rejecting the null hypothesis, thus committing a Type I error. Effect size generally means the degree to which the phenomenon is present in the population or the degree to which the null hypothesis is false (Cohen, 1992).

Cohen (1992) suggested standardising effect sizes into small, medium and large values depending on the type of statistical analyses employed. The effect sizes to test the significance of the product moment correlation coefficient (*r*) are as follows: .10 (small practical size effect), .30 (medium practical size effect), and .50 (large practical size effect) respectively (Chaun, 2006; Cohen, 1992). These guidelines, as proposed by Chen (1992), were used in the current study.

5.8.9 Multiple regression analysis

Multiple regression was performed to achieve research aim 3:

Research aim 3: To assess whether psycho-technological learning capabilities and self-directed learning orientation significantly predict graduateness skills and attributes.

Standard multiple regression was performed by entering all independent variables into the model simultaneously. Each independent variable was subsequently evaluated in terms of its predictive power, over and above that offered by all the other independent variables (Pallant, 2016). Multiple regression helped to establish how much variance in each of the dependent variables was explained by the independent variables (R^2), and how much unique variance in the dependent variable each of the independent variables explained (β).

Standard multiple regression was performed by entering all the independent variables into the model simultaneously. Each independent variable was subsequently evaluated in terms of its predictive power, over and above that offered by all the other independent variables (Pallant, 2016). Multiple regression helped to establish how much variance in each of the dependent variables was explained by the independent variables (R^2), and how much unique variance in the dependent variable each of the independent variables explained (β).The CALIS Procedure (SAS, 2019) was used to perform the regression analysis to ascertain and explain whether the independent variables, psycho-technological learning capabilities and self-directed learning orientation significantly predict the dependent variable, graduateness skills and attributes.

5.8.10 Hierarchical moderated regression

Hierarchical moderated regression was performed to achieve research aim 4:

Research aim 4: To assess whether socio-biographical characteristics, namely age, gender and ethnicity, significantly moderate the relationship between (1) psycho-technological learning capabilities, (2) self-directed learning orientation, and graduateness skills and attributes.

Hierarchical moderated regression is a technique for identifying moderator variables and also to clarify the relationships between the variables (Anderson, 1986). Hierarchical moderation analysis is aimed at empirically quantifying and testing hypotheses about the contingent nature of the mechanisms by which independent variables exert influence on dependent variables (Hayes, 2018). The aim was thus to establish whether the strength of the effects of the independent variables on the dependent variables was conditional on the interaction effect of age, gender and ethnicity. Guidelines as proposed by Cohen (1992) and Chaun (2006) were applied in the current study, where the effect size index (f^2) for small, medium and large effect sizes was f^2 = .02, .15, and .35 respectively. Cohen (1992) suggests that a medium effect size is desirable as it would be able to approximate the average size of the observed effects in the various variables. In the current study, the effect size index as suggested by Chen (1992) was applied to ascertain whether the socio-biographical characteristics, namely age, gender and ethnicity, significantly moderated the relationship between (1) psycho-technological learning capabilities, (2) self-directed learning orientation, and graduateness skills and attributes respectively.

5.8.11 Tests for significant mean differences

Tests for significant mean differences was performed to achieve research aim 4:

Research aim 5: To determine whether students from different socio-biographical groups, namely age, gender and ethnicity, differ significantly regarding their psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS) and graduateness skills and attributes (as measured by the GSAS).

Normality is a useful assumption in many modelling frameworks where it is assumed that the common starting point in statistical tests is to assume normally distributed residuals in SEM (Ho & Yu, 2015). In the current study, a test for normality was first performed to establish whether the data had a normal distribution. The Shapiro-Wilk and Kolmogorov-Smirnov tests were used to test for normality. The null-hypothesis of these tests proposes that the population is normally distributed. Ho and Yu (2015) and Yazici and Yolacan (2006) suggest that when the *p*-value is greater than the chosen alpha level ($\leq .05$), then the null hypothesis cannot be rejected (Ho & Yu, 2015). In the current study, independent samples T-test procedures were used to test for significant mean differences between the gender, age and ethnicity groups. Cohen's d test was used to assess practical effect size in terms of the differences between the respective groups for each of the variables.

5.9 CHAPTER SUMMARY

This chapter addressed the first eight steps of the empirical research as reflected in Figure 5.1. These steps included the discussion of the research approach; determination and description of the research population and sample; a description of the development of the measurement scale; a motivation and justification for the psychometric battery; a discussion on the ethical considerations applied in the current study and a description of the administration and scoring of the psychometric battery; the capturing of criterion data; the formulation of the research hypothesis; and the statistical analysis of the data; as well as the measuring instruments, ethical considerations, capturing of data and the formulation of the research hypotheses.

The chapter also outlined the five phases of the empirical investigation with the aim of addressing the empirical research aims as stated in Chapter 1 (see section 1.3.2.2). The chapter concluded with a description of the statistical and practical significance levels that were applied in the interpretation of the data analyses.

Chapter 6 further contributes to the achievement of the empirical research aims, as stated in Chapter 1 (see section 1.3.2.2), by reporting the statistical results of the study.

CHAPTER 6: RESEARCH RESULTS

The current study is an exploratory study focused on the development of a new scale (i.e. the Psycho-Technological Learning Capabilities Scale (PTLCS)), for the measurement of psychological and technological learning capabilities of students. Chapters 3 and 5 operationalised and provided justification for the theoretical framework and the subdimensions of the PTLCS, including the items generated for each subdimension. The current chapter reports the results of the statistical procedures performed to test the research hypotheses in order to achieve the empirical research aims (see Chapter 5).

Empirical research aim 1 was to operationalise constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) into a valid and reliable measure, namely, the PTLCS. The following empirical research sub-aims were formulated for research aim 1:

Sub-aim 1.1: To assess the psychometric properties (internal consistency reliability and construct validity) of the newly developed PTLCS. ***Sub-aim 1.2****:* To establish the nature of the interrelationships between the subscale dimensions (computer skills and internet self-efficacy) of the PTLCS. ***Sub-aim 1.3*****:** To establish the factorial equivalence (i.e. measurement invariance) of the PTLCS for the various socio-biographical groups, namely age, gender and ethnicity.

To achieve research aim 1, three studies were conducted. Study 1 was a **pilot study** to identify the underlying factor structure of the PTLCS by means of EFA. Study 2 was a **validation study** to assess the construct validity (by means of CFA). Study 3 was a study to test the **predictive validity** of the PTLCS (by means of multiple regression analysis).

As also stated in Chapter 5, the initial final sample for the study was (N = 399). However, after further cleaning of the data in order to exclude missing case values, the final sample was (N = 378). Therefore, the statistical analysis for the current study focused on a final sample (N = 378) in a specific research setting.

- **Pilot study and confirmatory construct validity study**: The data set was randomly split into a pilot study (n = 150) and a second, confirmatory construct validation study (n = 228). Scientific rigour was applied in ensuring that no participant in the pilot study (n = 150) was included in the random sample of study 2 (validation study: n = 228).
- **Construct and predictive validity study:** In study 3, the best CFA model derived from the confirmatory sample in study 2, was applied to the full sample (N = 378) for testing the predictive validity of the PTLCS.

Table 6.1

Summary: Studies Assessing the Factorial Structure of the PTLCS

Study	Description
Study 1: Pilot study	Involved a randomly selected sample (n = 150) of the full data set (N = 378) to test the dimensionality and factorial validity of the newly developed PTLCS.
Study 2: Construct validity	CFAs were conducted on the initial factor structure obtained from study 1 (EFA) in order to confirm the factor structure and construct validity (measurement model) of the newly developed scale. The CFA involved the remaining (n = 228) sample of participants as a validation sample. Care was taken that none of the EFA sample of participants (n = 150) was included in the CFA sample. Rasch and reliability analysis of the best fit CFA measurement model was also conducted on the n = 228 sample.
Study 3: Construct and predictive validity	In this study, the best fit CFA measurement model obtained from the validation sample (n = 228) was then tested by means of a CFA onto the full sample (N = 378). The best fit model was then utilised in further statistical analysis in order to test the research hypotheses relevant to the empirical research aims. Study 3 further involved correlation analysis and multi-group structural equivalence testing (metric invariance, configural invariance and scalar invariance) for age, gender and ethnicity groups on the full sample (N = 378).

Source: Author’s own work

As a starting point, the following section outlines the EFA (pilot study) results of the KMO and Bartlett’s test, and principal component analysis (including scree plot) which were conducted using a varimax rotation technique. The chapter also presents the results of the Rasch analysis which was conducted to examine the psychometric properties of the new PTLCS, and to provide statistical evidence of the achievement of the empirical aims of the research and research hypothesis as set out below:

H1: Students' psycho-technological learning capabilities (computer and internet self-efficacy) can be operationalised into a valid and reliable measure.

6.1 PILOT STUDY: PRELIMINARY STATISTICAL ANALYSIS – ASSESSING THE FACTORIAL STRUCTURE OF THE PTLCS

In the literature review (Chapter 3), the theoretical factor structure of the PTLCS was hypothesised by operationalising psycho-technological learning capabilities (computer skills and internet self-efficacy) and then generating items for each of the theoretical subdimensions of the PTLCS. The reader is here referred to Table 3.1 in Chapter 3.

EFA (pilot study: n = 150) was not used to verify, but rather to modify the a priori theoretical factor structure (see Chapter 3, Table 3.1) of the items by identifying the dimensional factors onto which the items loaded best and to identify redundant items. The EFA was also used to determine whether the PTLCS items assess a single underlying/overall factor or construct (computer skills and internet self-efficacy).

6.1.1 Exploratory factor analysis: sample adequacy

Exploratory factor analysis was conducted, using the CALIS procedure supported by the SAS system (SAS, 2019), on a randomly selected subsample (n = 150) of the full data set (N = 378). The principal component method of extraction (maximum likelihood) and quartimax rotation with Kaiser normalisation were used. Bartlett's test of sphericity tests the null hypothesis that there is no relationship between items (matrix identity) and follows the chi square distribution (Bartlett, 1950; Sreejesh et al., 2014). Ideally, the larger the value of the Bartlett's test the greater the likelihood that the correlation matrix is not an identity and hence the null hypothesis can be rejected (Sreejesh et al., 2014). The Kaiser-Meyer-Olkin (KMO) is a test to measure sampling adequacy and should be greater than .60 (minimum) or .70 at p = < .05 (Sreejesh et al., 2014).

As shown in Table 6.2, the KMO value for the PTLCS was .89; *p* = .000. The value exceeded the recommended minimum value of .60 (Hair et al., 2014; Sreejesh et al., 2014), while the Bartlett's test of sphericity (Bartlett, 1950; Sreejesh et al., 2014) attained a statistical significance of *p* = .000 for the scale, thus supporting the factorability of the correlation matrix for the scale. These results indicate that the sample used in the study was adequate and that significant correlations existed between the variables of the correlation matrices of the PTLCS.

Table 6.2

KMO and Bartlett's Test: PTLCS

Kaiser-Meyer-Olkin measure of sampling adequacy: PTLCS		**.89**
Bartlett's test of sphericity	Approximate chi-square	2262.442
	Df	91
	Sig.	.000

Notes: n = 150

6.1.2 Exploratory factor analysis: item loadings of the PTLCS

Two factors with an eigenvalue greater than 1 are visible in Table 6.3. The criteria (Hair et al., 2014; Owen, 1995) mentioned below guided the number of factors to be extracted from the EFA analysis for further statistical purposes of the PTLCS. These factors were subjected to further rotation.

- Statistical criteria used conventionally, such as Kaiser's eigenvalue-larger-than-one-criterion, were considered. Because the a priori theoretical factor structural model and item generation proposed two core underlying factors for the newly developed PTLCS (i.e. computer skills and internet self-efficacy – see Chapter 3), it was decided to retain factors with an eigenvalue of 1.66 and higher. As explained in Chapter 3, it is important to note that the dimension of access was not regarded as a factor, but only as control variable to monitor whether access to a computer and the internet influenced the responses on the factors computer skills and internet self-efficacy. In summary, a two-factor structure for the PTLCS was hypothesised.
- The theoretical expectation regarding both the number of factors and the interpretability of the factors obtained was considered.

Table 6.3 provided evidence of the multidimensionality of the PTLCS. Table 6.3 further shows that the multidimensionality of the PTLCS could be ascribed to the presence of a general factor. Overall, when considering the two factors in Table 6.3, 71% of the variance was explained, which is over the 60% variance explained threshold for evidence of essential unidimensionality (an underlying general factor).

Table 6.3

Factor Extraction using Principal Component Analysis

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative%	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative%
1	8.303	59.306	59.306	8.303	59.306	59.306	7.238	51.697	51.697
2	1.666	11.898	71.204	1.666	11.898	71.204	2.731	19.507	71.204

Figure 6.1

Scree Plot for Factor Retention of the PTLCS

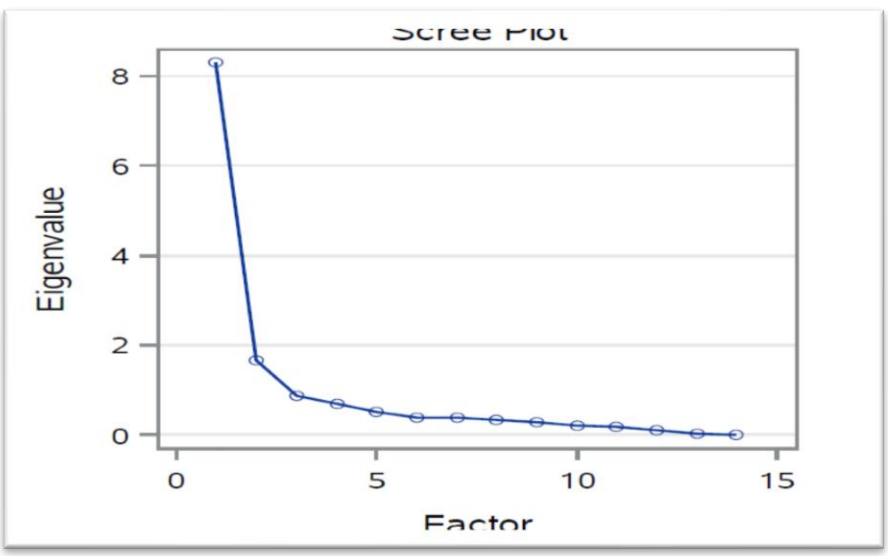


Table 6.4 below summarises the original 16 items of the PTLCS that were evaluated using the EFA in an attempt to ascertain item and factor loading and to identify and remove redundant items.

Table 6.4

Original Items of the PTLCS Factors

Question number	Factor number	Factor name	EFA Code	Item
1	F1	Access	F1_SQ001	I have access to a computer for my studies
2	F1		F1_SQ002	I have access to the internet for my studies
3	F2	Computer Skills	F2_SQ001	I can download software for my computer without assistance
4	F2		F2_SQ002	I can create folders to save my documents
5	F2		F2_SQ003	I can use search engines to find additional resources on the internet
6	F2		F2_SQ004	I back up my files every week to safeguard my work
7	F2		F2_SQ005	I back-up my files on devices such as an external hard drive to safeguard my work
8	F2		F2_SQ006	I can update the security software on my computer without assistance from the ICT department
9	F2		F2_SQ007	I can transfer files from other devices, for example, camera, smartphone, external hard drive, to the hard drive on my computer
10	F3	Internet Self-efficacy	F3_SQ001	I am confident in sending emails generally
11	F3		F3_SQ002	I feel confident in typing all my written assignments
12	F3		F3_SQ003	I feel confident in downloading official study material from the module site on myUnisa
13	F3		F3_SQ004	I feel confident in downloading additional resources from the module site on myUnisa
14	F3		F3_SQ005	I feel confident in downloading information from the internet for my studies
15	F3		F3_SQ006	I feel confident in downloading information from the internet for my assignments
16	F3		F3_SQ007	I feel confident in uploading my assignments on the online submission platform (myUnisa)

Source: Author’s own work

Table 6.5 summarises the resultant 14 items for the two factors that were retained after the EFA was conducted. Three items for internet self-efficacy obtained lower than .30 loadings. However, it was decided to retain them for the CFA analysis because the items were important for the theoretical content of the scale.

Table 6.5

Revised Item Loadings of the PTLCS Factor Loadings

PTLCS item number	Description of item	Factor 1 Technological skills	Factor 2 Technical Self-efficacy
Factor 1 Technological Skills			
Computer skills Q1	I can download software for my computer without assistance	.88	
Computer skills Q2	I can create folders to save my documents	.88	
Computer skills Q3	I can use search engines to find additional resources on the internet	.97	
Computer skills Q4	I back up my files every week to safe guard my work	.96	
Computer skills Q5	I back up my files on devices such as an external hard drive to safe guard my work	.84	
Computer skills Q6	I can update the security software on my computer without assistance from the ICT department	.82	
Computer skills Q7	I can transfer files from other devices, for example, camera, smartphone, external hard drive, to the hard drive on my computer.	.75	
Factor 2 Technical self-efficacy			
Internet Self-efficacy Q1	I am confident in sending emails generally.		.34
Internet Self-efficacy Q2	I feel confident in typing all my written assignments		.12
Internet Self-efficacy Q3	I feel confident in downloading official study material from the module site on myUnisa		.10
Internet Self-efficacy Q4	I feel confident in downloading additional resources from the module site on myUnisa		.79
Internet Self-efficacy Q5	I feel confident in downloading information from the internet for my studies		.89
Internet Self-efficacy Q6	I feel confident in downloading information from the internet for my assignments		.80
Internet Self-efficacy Q7	I feel confident in uploading my assignment on the online submission platform (myUnisa)		.23

Notes: n = 150

Based on the loading of the items on factor 1 (computer skills) and factor 2 (internet self-efficacy), the theoretically proposed factors of computer skills and internet self-efficacy were re-labelled as technological skills (factor 1) and technical self-efficacy (factor 2).

- The revised factor 1**, technological skills** (7 items), described the student's ability to save and transfer files on electronic platforms; to use electronic search engines to find information and to unilaterally download software for a computer.
- The revised factor 2, **technical self-efficacy** (7 items), described the student's confidence in searching, downloading and sharing information using electronic platforms, typing and uploading documents on electronic submission portals.
- The construct of access (i.e. items: I have access to a computer for my studies; I have access to the internet for my studies) was treated as a control variable and not as a sub-factor.

In summary, the EFA confirmed the multidimensionality (i.e. two-factor structure) of the PTLCS as proposed by the theoretical model. The original 14 items (7 from technological skills, and 7 items from technical self-efficacy) loaded onto the two dimensions. The two items under the dimension of access did not load onto the two core dimensions and accordingly were removed from further statistical analysis.

Table 6.6

Summary of the EFA Factorial Structure of the PTLCS

Factor	Definition of construct	Number of items
Technological skills (F1)	The ability to save and transfer files on electronic platforms; to use electronic search engines to find information and to unilaterally download software for a computer.	7
Technical self-efficacy (F2)	Technical self-efficacy describes the student's confidence in uploading assignments, and in searching for and downloading information and official study materials for assignments using electronic platforms such as the internet and module website.	7
Overall PTLCS		14

Source: Author's own work

6.2 STUDY 2: CONFIRMATORY FACTOR ANALYSIS – TESTING THE CONSTRUCT VALIDITY OF THE MEASUREMENT MODEL OF THE PTLCS

The next step was to test the construct (factorial) validity of the EFA two-factor structure that was obtained from the subsample of 150 on the separate randomly selected sample of (n = 228).

CFA was conducted, using the SAS system version 9.4 (SAS, 2019), on a randomly selected subsample (n = 288: excluding the EFA, n = 150, participants) of the full data set (N = 378). The CALIS procedure in SAS was applied in order to determine the optimised maximum likelihood fit indices using the Levenberg-Marquardt optimisation procedure (More, 1978). CFA is mainly undertaken to assess the validity of the measurement model of each scale. It thus allows researchers to draw valid conclusions in their research (Bollen & Pearl, 2013).

The guidelines suggested by Hair et al. (2014), Hooper et al. (2008) and Sahoo (2019) on the various indices were used to ascertain an acceptable fit, as listed below.

- Chi-square statistics: *p* ≥. 05
- CMIN/DF: adequate model fit is ≤ 3 (≤ 5 is occasionally acceptable);
- RMSEA and SRMR: Value ≤ .05 indicates a good fit; >.05 and ≤ .08 as a satisfactory fit; >.08 and ≤. 10 as a moderate fit, and > .10 deemed unacceptable
- CFI and NFI: ≥ .90 and ≤ .94 = adequate fit; ≥ .94 = ideal fit
- Standardised path loadings > .50 and ideally > .70.

Table 6.7

CFA Results of Subsample

CFA model	Chi-square	df	Chi-square/df	*p*	RMSEA	SRMR	CFI	NFI	AIC
Model 1	569.39	52	10.95	<.0001	.23	.06	.83	.82	621.39
Optimised model 2	79.67	39	2.04	<.0001	.09	.03	.98	.97	157.67

Note: n = 288

Two CFA models were tested and compared. CFA model 1 (all items loading onto the respective sub-factor, and the two factors loading onto the overall PTLS factor) did not obtain a good fit: chi-square/df = 10.95 (*p* = < 0.0001); RMSEA = .23; SRMR = .06; CFA = .83 and NFI = .82.

The CFA model 2 (all items loading onto the respective sub-factor, and the two factors loading onto the overall PTLS factor) used the Levenberg-Marquardt optimisation procedure for the covariance structure that included error variances. Two items (Q4 and Q5) of the subdimension technical self-efficacy were removed in the model optimisation procedure, resulting in only five items for Factor 2 instead of the seven items of the EFA.

The results showed that the two-factor PTLCS derived from the EFA (n = 150) fit the data for the sample (n = 228): chi-square/df = 2.04 (p = < 0.0001); RMSEA = .09; SRMR = .03; CFA = .98 and NFI = .97. The AIC values also decreased from CFA model 1 (AIC = 621.39) to CFA model 2 (AIC = 157.67). The standardised path loadings for CFA model 2 were then inspected.

Table 6.8 (pages 171- 172) summarises the standardised path loadings. The path loading of each item onto the respective sub-factor was significant in all cases and above .50, confirming the convergent validity of the two factors. The path loading of Q6 for technical self-efficacy was below .50 (= .43). However, it was decided to retain the item to ensure the internal consistency reliability of the subscale. The two factors had significant path loadings to the overall psycho-technological learning capabilities factor (> .90). The CFA results provided evidence of the construct (convergent and discriminant) validity of the PTLCS.

Table 6.8

Standardised Path Loadings for the PTLCS

Item	Item description	Estimate (β)	t
Technological skills			
Q1	I can download software for my computer without assistance	.83	36.90
Q2	I can create folders to save my documents	.75	23.96
Q3	I can use search engines to find additional resources on the internet	.94	90.47
Q4	I back up my files every week to safe guard my work	.92	67.58
Q5	I back up my files on devices such as an external hard drive to safe guard my work	.89	55.91
Q6	I can update the security software on my computer without assistance from the ICT department	.84	36.62
Q7	I can transfer files from other devices, for example, camera, smartphone, external hard drive, to the hard drive on my computer.	.80	32.09

Item	Item description	Estimate (β)	t
Technical self-efficacy			
Q1	I am confident in sending emails generally.	.62	14.94
Q2	I feel confident in typing all my written assignments	.94	91.90
Q3	I feel confident in downloading official study material from the module site on myUnisa	.91	63.45
Q6	I feel confident in downloading information from the internet for my assignments	.43	7.77
Q7	I feel confident in uploading my assignment on the online submission platform (myUnisa)	.85	40.22
Psycho-technological learning capabilities	Technological skills	.98	24.46
Psycho-technological learning capabilities	Technical self-efficacy	.91	22.27

Note: n = 228. t-values > 4.00 (****p* ≤ .0001); t-values > 2.56 (***p* ≤ .01); t-values > 1.96 (**p* ≤ .05)

6.3 STUDY 2: CONFIRMATORY FACTOR ANALYSIS – TESTING THE CONSTRUCT VALIDITY OF THE MEASUREMENT MODEL OF THE PTLCS ON TOTAL SAMPLE

Using the best fit measurement model generated from study 2, a CFA was conducted on the total sample of N = 378. As shown in Table 6.9, two CFA models were tested and compared.

Table 6.9

CFA Results of Total Sample

CFA model	Chi-square	df	Chi-square/df	*p*	RMSEA	SRMR	CFI	NFI	AIC
Model 1	812.32	52	15.62	<.0001	.21	.06	.83	.82	864.32
Optimised model 2	135.35	39	2.04	<.0001	.09	.03	.98	.97	213.35

Note: N = 378

CFA model 1 (all items loading onto the respective sub-factor, and the two factors loading onto the overall PTLS factor) did not obtain a good fit: chi-square/df = 15.62 (p = < 0.0001); RMSEA = .21; SRMR = .06; CFA = .83 and NFI = .82.

The CFA model 2 (all items loading onto the respective sub-factor, and the two factors loading onto the overall PTLS factor) used the Levenberg-Marquardt optimisation procedure for the covariance structure that included error variances. CFA model 2 shows that the two-factor PTLCS derived from the EFA (n = 150) fit the data for the total sample (N = 378): chi-square/df = 2.04 (p = < 0.0001); RMSEA = .09; SRMR = .03; CFA = .98 and NFI = .97. The AIC values also decreased from CFA model 1 (AIC = 864.32) to CFA model 2 (AIC = 213.35). The standardised path loadings for CFA model 2 in Table 6.10 were then inspected.

Table 6.10 summarises the standardised path loadings. The path loading of each item onto the respective sub-factor was significant in all cases and above .50, confirming the convergent validity of the two factors. The path loading of Q6 for technical self-efficacy was below .50 (= .43). However, it was decided to retain the item to ensure the internal consistency reliability of the subscale. The two factors had significant path loadings to the overall psycho-technological learning capabilities factor (> .90). The CFA results provided further evidence of the construct (convergent and discriminant) validity of the PTLCS for the full sample.

Table 6.10

Standardised Path Loadings for the PTLCS on Total Sample

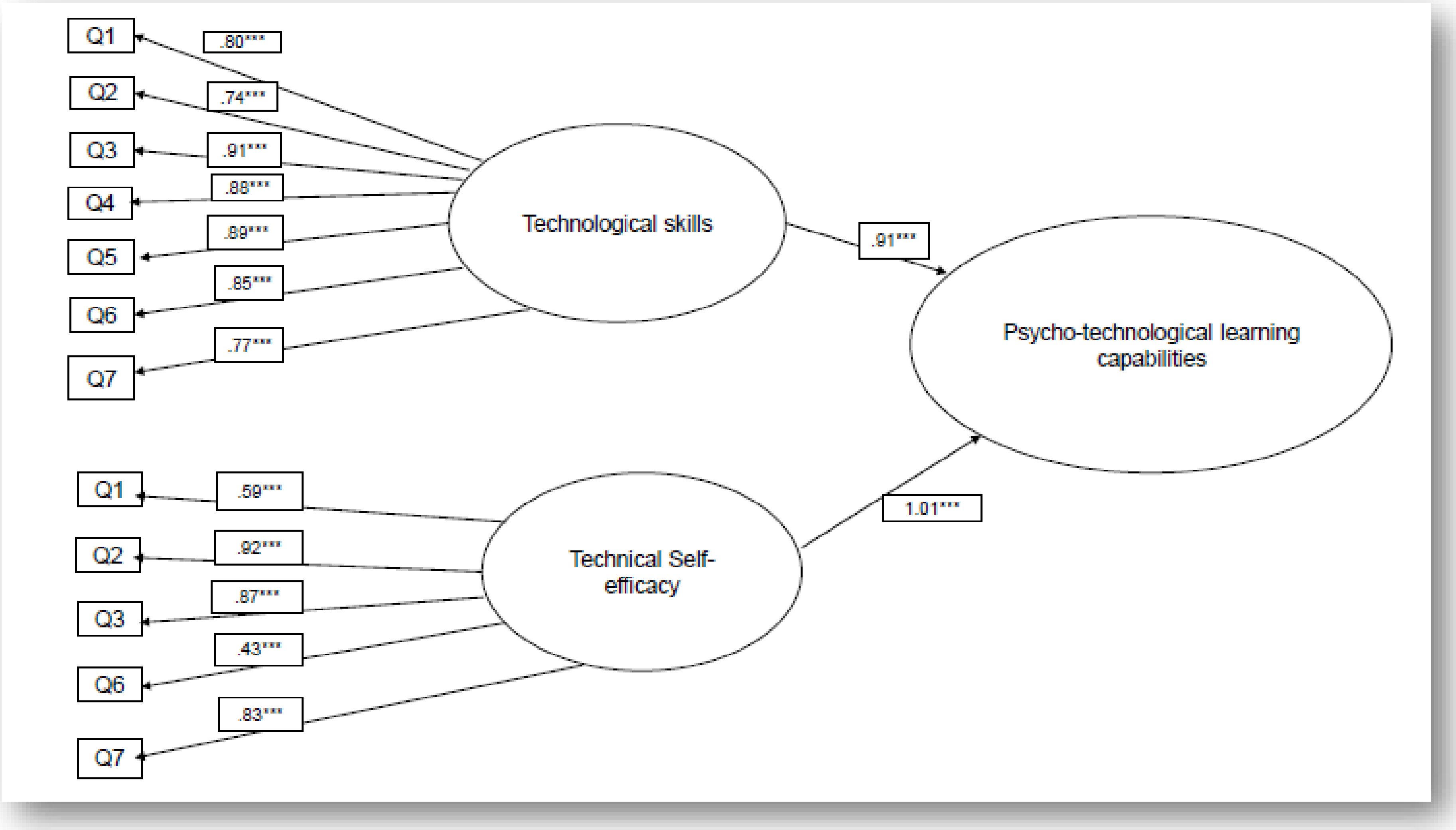
Item	Item description	Estimate (β)	t
Technological skills			
Q1	I can download software for my computer without assistance	.80	39.16
Q2	I can create folders to save my documents	.74	29.23
Q3	I can use search engines to find additional resources on the internet	.91	79.87
Q4	I back up my files every week to safe guard my work	.88	62.61
Q5	I back up my files on devices such as an external hard drive to safe guard my work	.89	64.67
Q6	I can update the security software on my computer without assistance from the ICT department	.85	50.36

Item	Item description	Estimate (β)	t
Q7	I can transfer files from other devices, for example, camera, smartphone, external hard drive, to the hard drive on my computer.	.77	33.60
Technical self-efficacy			
Q1	I am confident in sending emails generally.	.59	17.05
Q2	I feel confident in typing all my written assignments	.92	81.11
Q3	I feel confident in downloading official study material from the module site on myUnisa	.87	54.50
Q6	I feel confident in downloading information from the internet for my assignments	.43	9.75
Q7	I feel confident in uploading my assignment on the online submission platform (myUnisa)	.83	42.33
Psycho-technological learning capabilities	Technological skills	.91	25.41
Psycho-technological learning capabilities	Technical self-efficacy	1.011	27.23

Note: N = 378. t-values > 4.00 (****p* ≤ .0001); t-values > 2.56 (***p* ≤ .01); t-values > 1.96 (**p* ≤ .05)

Figure 6.2

Path Loadings obtained for the Psycho-Technological Learning Capabilities Scale (PTLCS)



**Note: N = 378; *******p < .0001*

Overall, the results provided evidence of the construct validity of the two-factor PTLCS, consisting of technological skills and technical self-efficacy. Based on the CFA final best fit model, the items of the final version of the PTLCS were reduced to 12 (see Table 6.11).

Table 6.11

Summary of the CFA Final Factorial Structure of the PTLCS

Factor	Definition of construct	Number of items
Technological skills	The ability to unilaterally download and update software for a computer; save and transfer files on electronic platforms or devices; back up files and to use electronic search engines to find information.	7
Technical self-efficacy	I am confident in sending emails; downloading official study material on myUnisa; typing all written assignments; downloading information from the internet to assignments and uploading typed assignments on myUnisa.	5
Overall PTLCS		12

Source: Author's own work

The best fit model (N = 378) was utilised in further statistical analysis in order to test the research hypotheses relevant to the empirical research aims.

6.4 STUDY 2: TESTING FOR COMMON METHOD VARIANCE

Owing to the self-report nature of the research design, the next step was to test for common variance (N = 378) . Common method variance presents a potential threat of bias in behavioural research (Chang et al., 2010; Podsakoff et al., 2003), especially when collecting data at the same time from the same group of participants (Chang et al., 2010). Accordingly, Harman's one-factor test and CFA (one-factor solution) were conducted to assess the model fit data of the revised PTLCS. Table 6.12 below summarises the results of Harman's one-factor test and the CFA conducted on the revised PTLCS factorial structure. Acceptable thresholds for model acceptance for values less than .07 for RMSEA and values less than .08 for SRMR and a CFI value close to and above .90 are considered an acceptable fit (Hooper et al., 2008; Hu & Bentler, 1999).

Table 6.12

Testing for Common Method Variance: Factor Solutions

Measurement instrument	Harman's one-factor test: percentage variance explained by a single factor	One factor solution (CFA)
Psycho Technological Learning Capabilities Scale (PTLCS)	7.80%	CMIN/df = 45*** RMSEA = .08 SRMR = .03 NNI = .97 CFI = .98 AIC = 216.8103

Note: N = 378; ****p* ≤ .0001

The one-factor solution for the PTLCS showed that loading the 12 PTLCS items onto one overall construct accounted for only 7.80% of the covariance among the scale variables. This result suggests a multi-factorial structure may be present. However, when loading the two PTLCS factors onto a single construct in the CFA one-factor model, the fit indices showed that the single factor fit the model well, with a CFI value above .90 (chi-square/df ratio = 45; $p < .0001$; RMSEA = .08; SRMR = .03; CFI = .98). The one-factor CFA result suggests a measure of common method bias that could potentially be present. The findings were taken into consideration in the testing of the research hypotheses and the interpretation of the findings.

The next step was to evaluate the internal consistency, reliability and construct validity of the PTLCS, as presented in section 6.4 below.

6.5 STUDY 3: ASSESSING INTERNAL CONSISTENCY RELIABILITY – RASCH ANALYSIS OF THE PTLCS

The Rasch measurement model has become a more popular approach for testing the psychometric properties of existing and newly developed instruments of data collection (Pallant & Tennant, 2007). The model was developed by a Danish mathematician, Georg Rasch in 1960 with the aim of supporting true measurement (Boone & Noltemeyer, 2017). In the Rasch modelling approach, data collected from questionnaires are tested against the expectations of this model. According to Van Zile-Tamsen (2017), the Rasch analysis is based on item response theory (IRT) which provides a more effective approach to exploring the psychometric properties of measuring instruments and for explaining response bias (Bradley et al., 2015), as opposed to the classical test theory where the standard error of measurement is assumed to vary across individuals and is not dependent on a particular sample of respondents.

Brand-Labuschagne et al. (2012) further explain that Rasch analysis is performed on all items to evaluate (1) the validity and reliability of each dimension and (2) the rating scale categories of each dimension. The reliability is evaluated and determined at two levels, namely, the item (item separation index and item reliability index) and the person (person separation index and person reliability index).

Person separation reliability reports on how truthfully the participants answered the item and is comparable to the Cronbach's alpha coefficients, while the item reliability indicates how well the difficulty levels of the item are distributed along the measured latent variable (Brand-Labuschagne et al., 2012). For an instrument to be regarded as useful both the person and the item separation indexes should be at least 2.00 (Brand-Labuschagne et al., 2012).

Table 6.13 shows that the item separation indices were well above 2.00. The person separation indices were relatively close to 2.00 although lower than 2.00 which could be attributed to measurement error. Measurement error is defined as the difference between the true or actual value and the measured value (Viswanathan, 2011). The true value is the average of the infinite number of measurements, and the measured value is the precise value. Measurement error compromises random and systematic error. Random error is caused by factors that randomly influence the measurement of the variable, for example the participants' mood, complex language or unclear wording, and double-barrelled questions. Systematic error is where the same error is present with regard to the measuring instrument and affects the accuracy of the results (Viswanathan, 2011).

Table 6.13

Person and Item Summary Statistics (PTLCS)

Scale dimension	**Average measure (SD)**	**Infit (SD)**	**Outfit (SD)**	**Separation**	**Reliability**	**Alpha**
Technological Skills						
Person	1.87 (1.16)	.96 (.85)	.95 (1.04)	1.36	.65	
Item	.00 (1.02)	1.00 (.37)	1.05 (.41)	10.63	.99	.81
Technical self-efficacy						
Person	2.06 (1.34)	1.09 (1.02)	1.05 (.98)	1.70	.74	
Item	.00 (.32)	1.00 (.37)	1.05 (.41)	2.18	.83	.94
PTLSC (overall scale)						
Person	2.44 (1.28)	1.10 (.78)	.95 (1.00)	1.87	.78	
Item	.00 (.80)	1.05 (.36)	1.04 (.76)	7.47	.98	.93

Notes: N = 378

Table 6.13 summarises the Rasch fit and reliability coefficients for the subscales and overall scale. Overall, the Rasch analysis provided evidence of the reliability and unidimensionality of the PTLCS. According to Smith et al. (2008) the ideal value for the infit and outfit statistics should be 1.0. Table 6.13 above shows that the infit and outfit statistics were either close to 1.0 or greater than 1.0, indicating the homogeneity of the PTLCS.

Table 6.13 indicates acceptable Rasch item reliability (≥ .98) for the overall PTLCS, while the two scales reported an item reliability of .99 for *Technological skills* and .83 for *Technical self-efficacy* respectively. The acceptable item reliability indicates that the difficulty levels of the items were well distributed among the measured latent variables and confirms that the items measured differentiated well among the measured variables.

The person reliability coefficient is comparable to the traditional internal consistency reliability coefficient. Overall, the person and item reliability coefficients were acceptable for the purposes of the study. The Cronbach's alpha coefficient for the overall PTLCS was α = .93, which is very high, while the two subscales also reported Cronbach's alpha coefficients (α = .81 for technological skills and α = .94 for technical self-efficacy).

The item separation (≥ 7.47) and person separation (≥ 1.87) for the overall PTLCS were adequate compared to the guideline of at least 2.00 (Bond & Fox, 2007), which means that participants would probably have indicated similar responses in other contexts. The mean item infit and person infit for the overall PTLCS were acceptable, as all the outfit statistics were below 2.00, indicating that the scale provided useful information.

6.6 STUDY 3: RASCH: DIFFERENTIAL ITEM FUNCTIONING

Flowing from the test for unidimensionality and reliability, differential item analysis was conducted. Differential item functioning (DIF) occurs when participants from two different groups with equal levels of ability are not equally able to answer an item correctly on the measuring instrument (Karami, 2012). With the multicultural South African context, there is a glaring need for item bias analysis, especially during test development and evaluation of possible test bias when determining the validity of measuring instruments (De Beer, 2004). DIF was conducted on the newly developed PTLCS to assess the presence of bias among the sample participants on the two subscales of the PTLCS and the overall PTLCS. The subgroups assessed are age (< 30 years; > 30 years), gender (male and female) and ethnicity groups (black and white), and are considered to have equal levels of ability and would have the same probability of selecting a particular response to an item.

In the current study, the Mantel-Haenszel (MH) method was used. The MH procedure matches participants according to their observed correct score and contingency tables are prepared for each item (Bastug, 2016). Guidelines for parameters of magnitude, as suggested by Karami (2012), were considered and applied in this study in that insignificant DIF: < .50 logits; mild (probably inconsequential): between .50 and 1.00 logits and notable: > 1.00 logits. A negative DIF index shows that the item is easily agreed upon by a certain group while a positive DIF index means that an item is more unlikely to be agreed upon by a group that has similar abilities but different levels of probability of responding to the item correctly. The criteria used for the DIF analysis were as follows: DIF contrast ≥ .50 < 1 ($p \leq .05$) and DIF contrast ≥ 1 ($p \leq .01$).

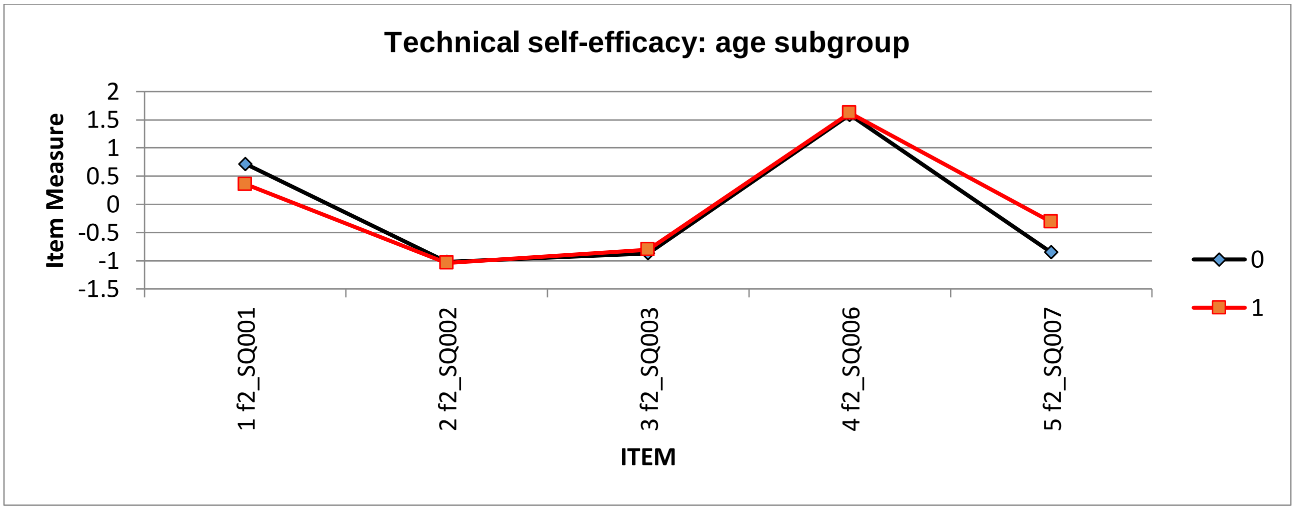
6.6.1 Differential item functioning: technical self-efficacy subscale

The age contrast DIF results are presented in Figure 6.3. A significant level of difficulty was observed for the two age groups in terms of one of the items measuring technical self-efficacy.

Both age groups, < 30 years and > 30 years, found item F2_SQ006 *I feel confident in downloading information from the internet for my assignments)* relatively difficult to endorse. A mild level of difficulty was noted by both age groups on item F2_SQ001 (*I am confident in sending emails generally*), while the two age groups found it relatively easy to endorse the remaining items.

Figure 6.3

Age Subgroup Contract Plot for the Technical Self-efficacy Subscale

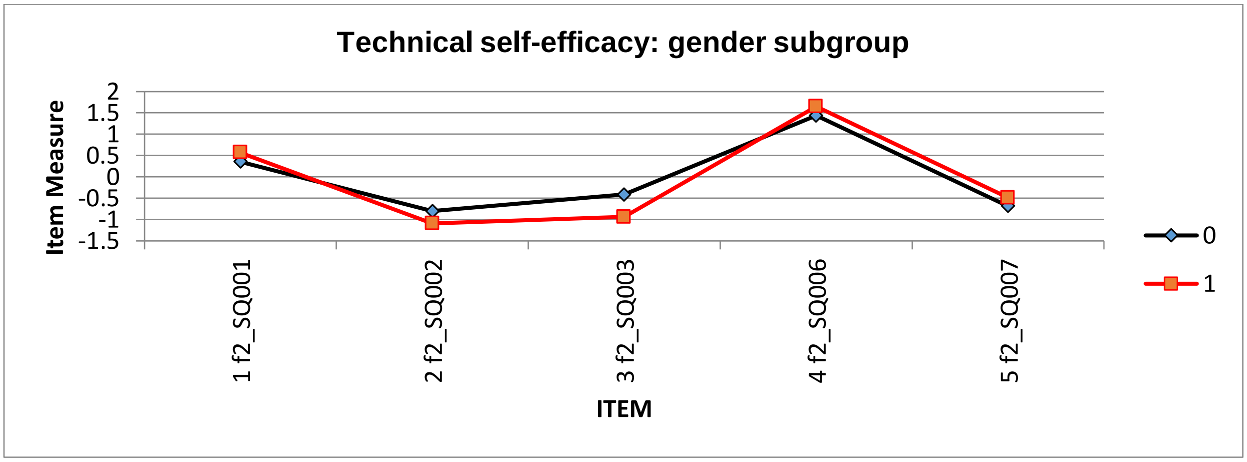


Notes: DIF parameters: < .50 logits = insignificant; .50–1.00 logits = mild/probably inconsequential; > 1.00 logits = notable and significant.
Coding: 0 = < 30 years; 1 = > 30 years

The gender contrast DIF results are presented in Figure 6.4 below. A significant level of difficulty was observed for the two gender groups in terms of one of the items measuring technical self-efficacy. Both gender groups found item F2_SQ006 *(I feel confident in downloading information from the internet for my assignments)* relatively difficult to endorse. A mild level of difficulty was noted by both gender groups on item F2_SQ001 *(I am confident in sending emails generally*), while the two gender groups found it relatively easy to endorse the remaining items.

Figure 6.4

Gender Subgroup Contract Plot for the Technical Self-efficacy Subscale



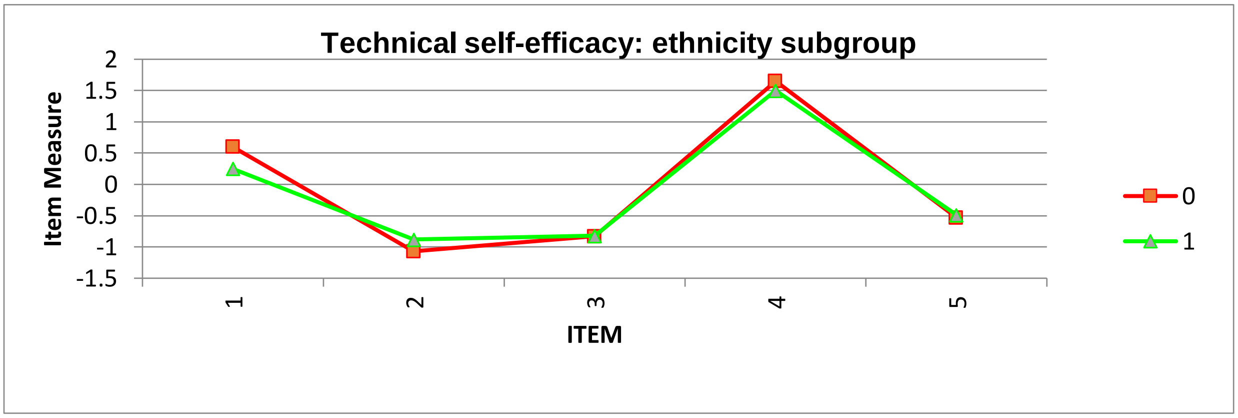
Notes: DIF parameters: < .50 logits = insignificant; .50–1.00 logits = mild/probably inconsequential; > 1.00 logits = notable and significant.

Coding: 0 = Male; 1 = Female

The ethnicity group contrast DIF results are presented in Figure 6.5 below. A significant level of difficulty was observed for the ethnic groups in terms of one of the items measuring technological skills. Participants from the two main ethnic groups found item F2_SQ006 *(I feel confident in downloading information from the internet for my assignments)* relatively difficult to endorse. A mild level of difficulty was noted by two of the three race groups on item F2_SQ001 (*I am confident in sending emails generally*), while the three race groups found it relatively easy to endorse the remaining items.

Figure 6.5

Ethnicity Subgroup Contract Plot for the Technical Self-efficacy Subscale



Notes: DIF parameters: < .50 logits = insignificant; .50–1.00 logits = mild/probably inconsequential; > 1.00 logits = notable and significant.
Coding:= ; 0 = Black ; 1 = White

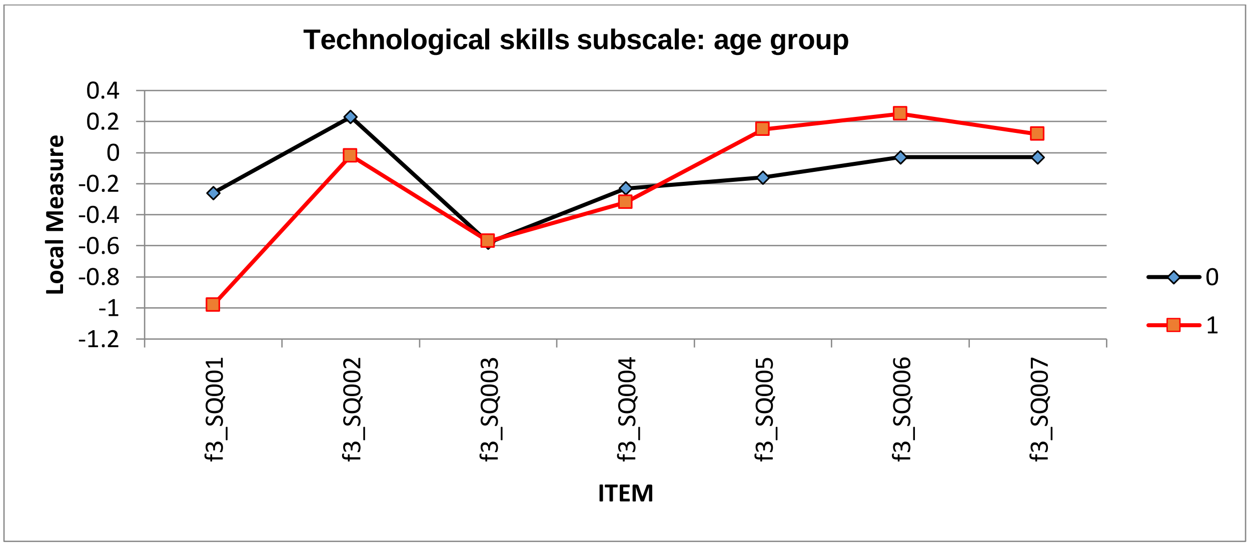
Section 6.5.2 provides an overview of the DIF results for the technological skills subscale based on the age, gender and race subgroups in the current study.

6.6.2 Differential item functioning: technological skills subscale

The age contrast DIF results are presented in Figure 6.6 below. Insignificant levels of difficulty were observed between both age groups on all seven items of the technological skills subscale. Essentially, the two age groups found it relatively easy to endorse all the items of the subscale.

Figure 6.6

Age Subgroup Contract Plot for the Technological Skills Subscale

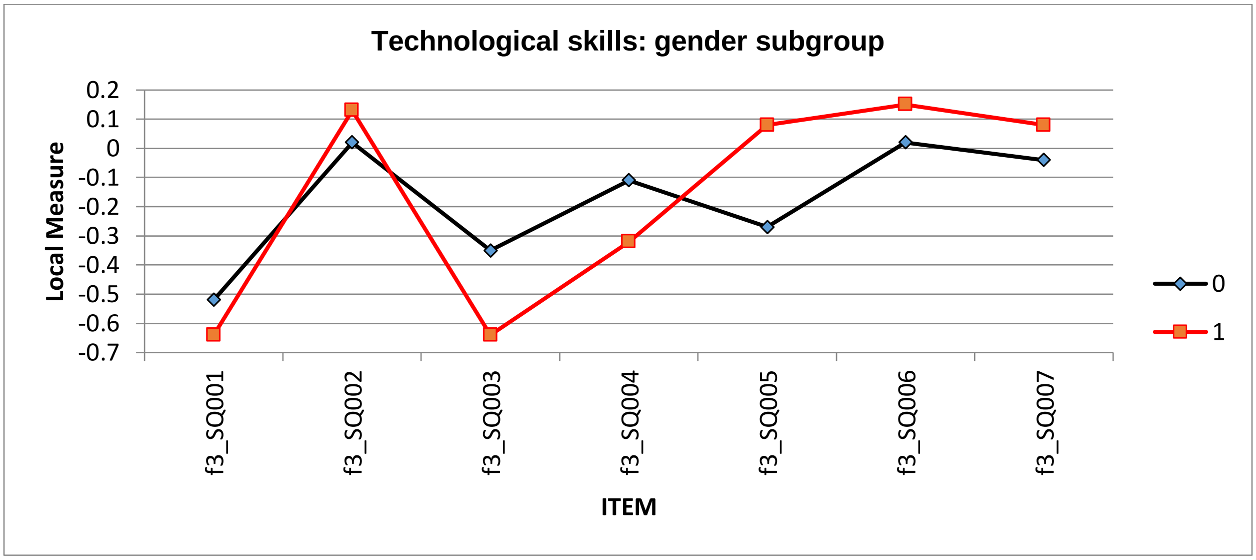


Notes: DIF parameters: < .50 logits = insignificant; .50–1.00 logits = mild/probably inconsequential; >1.00 logits = notable and significant. Coding: 0 = < 30 years; 1 = > 30 years

The gender contrast DIF results are presented in Figure 6.7 below. No significant levels of difficulty were observed for the two age groups in terms of all seven items measuring technological skills. Both gender groups found it relatively easy to endorse all the items of the subscale.

Figure 6.7

Gender Subgroup Contract Plot for the Technological Skills Subscale

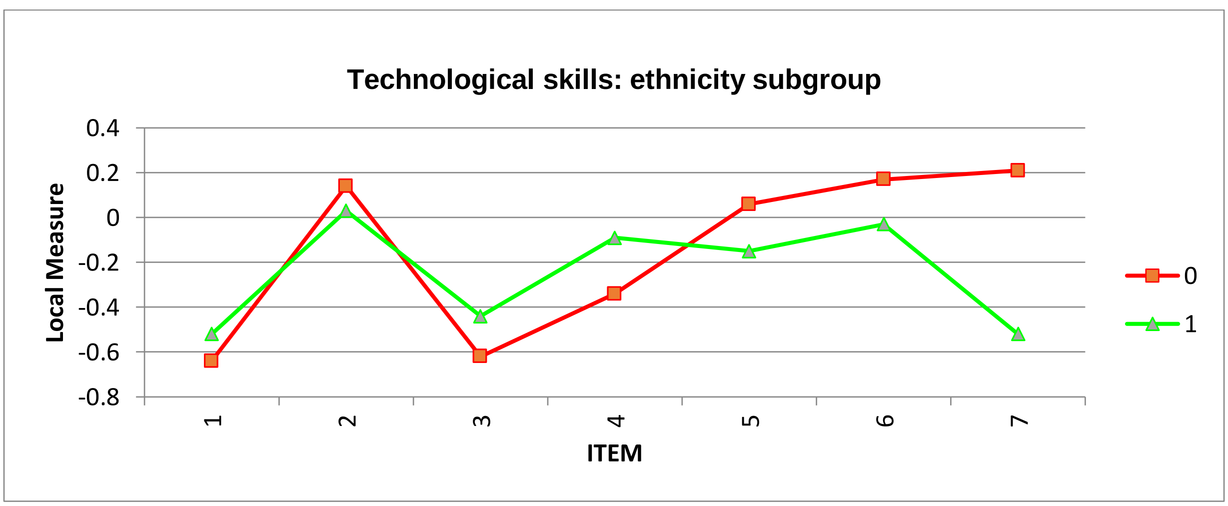


Notes: DIF parameters: < .50 logits = insignificant; .50–1.00 logits = mild/probably inconsequential; > 1.00 logits = notable and significant.
Coding: 0 = Male; 1 = Female

The ethnicity group contrast DIF results are presented in Figure 6.8 below. No significant levels of difficulty were observed for the three race groups in terms of all seven items measuring technological skills. Essentially, all three race groups found it relatively easy to endorse all the items of the subscale.

Figure 6.8

Ethnicity Subgroup Contract Plot for the Technological Skills Subscale



Notes: DIF parameters: < .50 logits = insignificant; .50–1.00 logits = mild/probably inconsequential; > 1.00 logits = notable and significant.
Coding:= ; 0 = Blacks ; 1 = White

In summary, the EFA provided evidence of the multidimensionality of the PTLCS while the Rasch analysis provided evidence of the internal consistency reliability, usefulness and unidimensionality (homogeneity) of the two dimensions of the revised PTLCS. The DIF results indicated minimal (inconsequential) bias concerns among the age, gender and ethnicity group respondents on the PTLCS items.

6.7 STUDY 3: MULTI-GROUP STRUCTURAL EQUIVALENCE

Following the statistical analyses to confirm the measurement model fit and structural validity of the PTLCS, the following stage involved multi-group structural equivalence testing (configural invariance, metric invariance, and scalar invariance) for the age, gender and ethnic groups on the full sample (N = 378) through multi-group CFA. This stage (Stage 2) addressed research sub-aim 1.3: To establish the factorial structure of the PTLCS' equivalent for the various socio-demographical groups, namely age, gender and ethnicity.

According to Xu and Tracey (2017), measurement invariance assists researchers to ascertain whether the measurement of latent constructs varies across multiple groups, focusing on configural, metric and scalar invariance.

- Configural invariance tests whether the same items measure the technological skills and technical self-efficacy constructs across multiple groups (i.e. age, gender and ethnicity); that is, whether the same factor structure holds true for the groups.
- Metric invariance builds on configural invariance by requiring that in addition to the PTLCS constructs being measured by the same items across the groups, the factor loadings of those items should be equivalent across the various groups. Invariance of factor loadings suggests that the constructs have the same meaning to the various groups.
- Scalar invariance builds on metric invariance by requiring that intercepts also be equivalent across the groups. Scalar invariance enables the ability to justify significant mean comparisons across the groups.

The best fit structural (CFA) model (N = 378) was used as a framework for the multi-group CFA. The CALIS procedure (SAS, 2019) was used for the statistical analysis. Table 6.14 reports the model fit statistics of the best fit model for each of the respective subgroups.

Table 6.14

Model Fit Statistics for the Various Sub-groups

Biographical sub-group	Chi-square/df	RMSEA	SRMR	CFI	NNFI	AIC
Age						
<30 years	.71***	.11	.06	.96	.93	199.8194
>30 years	.54***	.09	.04	.98	.96	184.0775
Gender						
Males	1.55***	.17	.09	.88	.81	218.5457
Females	.45***	.09	.03	.98	.96	202.9944
Ethnicity						
African participants	.46***	.09	.04	.97	.96	191.3652
White participants	1.14***	.14	.05	.93	.89	217.1497

Note: N = 378; ****p* ≤ .0001. African participants denote people of African, coloured and Indian origin.

Overall, the SRMR, CFI and NNFI values in Table 6.14 indicate acceptable model fit. The CFI for males was close to .90, indicating that the measurement model was acceptable for research purposes (i.e. conducting structural equivalence tests). The RMSEA for age group < 30 years (= .11), males (= .17) and white participants (= .14) was above the threshold parameter for good model fit. This finding was taken into consideration in the interpretation of the findings.

Hooper et al. (2008) posit that scholars recommend cut-off limits for the RMSEA as follows: between .08 and .10 (mediocre fit), while an index of below .08 shows a good fit. The authors further suggest that with recent arguments the cut-off value has been adjusted to .06 or an upper limit of .07 as being a generally acceptable cut-off index. Hooper et al. (2008) confirm that in a well-fitting model the lower limit of the RMSEA must be close to 0 while the upper limit should be less than .08. Hair et al. (2014) assert that there are debates by scholars on a “good” RMSEA value. The authors posit that though research has suggested a cut-off value of .05 or .08 they postulate that drawing an absolute cut-off for RMSEA is not advisable. Based on the assumptions proposed by Hair et al. (2014) advising against the absolute reliance on the RMSEA value, the current study places reliance on the CFI and NNFI values to determine model fit.

The multi-group CFA, using the CALIS procedure (SAS, 2019), was conducted to examine the measurement invariance between the age, gender and ethnicity groups in terms of three levels of structural equivalence, namely (1) configural invariance, (2) metric variance and (3) scalar invariance.

- *Configural invariance* is a test that examines whether the overall factor structure stipulated by the measure, in this instance the PTLCS, fits well for all groups in the study sample (Lee, 2018). In this study configural invariance was done to determine whether the factor structure of the PTLCS was the same for each of the respective biographical subgroups, namely age, gender and ethnicity. The model fit statistics reported in Table 6.15 show good model fit, indicating that the factor structure of the PTLCS is equivalent for the gender and ethnicity subgroups respectively. However, the factor structure did not hold true for the age groups.
- *Metric invariance* means that each item contributes to the latent construct to a similar degree across groups (Putnick & Bornstein, 2017). In the current study, metric invariance was conducted to assess whether the factor loadings of each item on each factor were the same for all the respective subgroups (age, gender and ethnicity). Table 6.15 shows good model fit for the age, gender and ethnicity groups. The results suggest that the constructs had the same meaning for the various groups.
- *Scalar invariance* means that the mean differences in the latent construct capture all mean differences in the shared variance of the items. To ascertain this, scalar invariance is assessed by constraining the item intercepts to be equivalent in the two groups (Putnick & Bornstein, 2017). Scalar invariance, in this study, was examined by constraining both loadings and intercepts in order to allow for meaningful mean comparisons to be done across the subgroups. Table 6.15 shows lack of scalar invariance (RMSEA and SRMR too high), meaning that caution should be taken when exploring the mean differences among age, gender and ethnicity groups for the particular sample. This result was taken into consideration in the interpretation of the findings.

Table 6.15

Fit Statistics for the Multi-group Equivalence Models

Equivalence testing	Biographical group	Chi-square/df	RMSEA	SRMR	CFI	NNFI	AIC
Configural invariance	Age	.85***	.11	.46	.95	.93	459.0283
	Gender	.72***	.11	.05	.96	.93	421.5401
	Ethnicity	.69***	.11	.04	.96	.94	408.515
Metric invariance	Age	.73***	.10	.06	.96	.95	390.0406
	Gender	.85***	.11	.07	.95	.93	434.2364
	Ethnicity	.83***	.11	.08	.95	.94	424.848
Scalar invariance	Age	.82***	.11	.42	.95	.93	490.1999
	Gender	1.21***	.14	.95	.93	.89	476.1884
	Ethnicity	.90***	.12	.40	.94	.92	541.7152

Note: N = 378; ****p* ≤ .0001.

In summary, the multi-group equivalence models indicated configural and metric invariance in the newly developed PTLCS for the age, gender and ethnicity subgroups. Configural invariance was not evident for the age groups and scalar invariance was not evident for the age, gender and ethnicity subgroups. These results were considered in the interpretation of the findings.

The empirical results obtained from the statistical analysis (EFA, CFA, Rasch, and structural equivalence) provided supportive evidence for accepting research hypothesis H1:

Research hypothesis 1: The elements of the theoretical framework for students' psycho-technological learning capabilities (computer and internet self-efficacy) can be operationalised into a valid and reliable Psycho-Technological Learning Capabilities Scale (PTLCS).

6.8 STUDY 3: PRELIMINARY ANALYSIS: CONSTRUCT VALIDITY OF THE ALSDS AND GSAS

The following section presents the test for common variance (N = 378) of the ALSD and GSAS. Harman's one-factor test and CFA (one-factor solution) were conducted to assess the model fit data of the revised PTLCS. Table 6.16 below summarises the results of the Harman's one-factor test and the CFA conducted on the ALSD and GSAS factorial structure. Acceptable thresholds for model acceptance for values less than .07 for RMSEA and values less than .08 for SRMR and a CFI value close to and above .90 are considered an acceptable fit (Hooper et al., 2008).

Table 6.16

Statistics: Common Method Variance and Construct Validity: ALSD and GSAS

Measurement instrument	Harman's one-factor test: percentage variance explained by a single factor	One factor solution (CFA)	Multi-factor solution (CFA)
Adult learner self-directedness scale (ALSDS)	5.47%	CMIN/df = 1.29*** RMSEA = .03 SRMR = .05 NNI = .93 CFI = .93 AIC = 701.33	CMIN/df = 1.76*** RMSEA = .04 SRMR = .06 NNI = .83 CFI = .68 AIC = 889.86
Graduateness Skills and Attributes Scale (GSAS)	23.22%	CMIN/df = 377*** RMSEA = .06 SRMR = .05 NNI = .97 CFI = .93 AIC = 1005.9099	CMIN/df = 1924*** RMSEA = .07 SRMR = .07 NNI = .73 CFI = .74 AIC = 5848.2669

Note: N = 378; ****p* ≤ .0001

6.8.1 Common method bias: ALSDS and GSAS

Table 6.16 reports that the ALSDS one-factor Harman's solution explained only 5.47% of the covariance among the ALSDS variables. However, the one-factor CFA indicated good fit of the data: CMIN/df = 1.29; RMSEA = .03; SRMR = .05; NNI = .93 and CFI = .93; AIC = 701.33. The finding suggests the presence of common method variance in the ALSDS which was considered in the interpretation of the findings.

Table 6.16 also reports that the GSAS one-factor Harman's solution explained only 23.22% of the covariance among the GSAS variables. However, the one-factor CFA indicated good fit of the data: CMIN/df = 377; RMSEA = .06; SRMR = .05; NNI = .97 and CFI = .93; AIC = 1005.9099. The finding suggests the presence of common method variance in the GSAS which was considered in the interpretation of the findings.

6.8.2 Construct validity of the ALSDS and GSAS

The multi-factor ALSDS CFA, as reported in Table 6.16 above, indicated a less optimal fit with the data which suggested some concerns about the construct validity of the ALSDS: CMIN/df = 1.76; RMSEA = .04; SRMR = .06; NNI = .68 and CFI = .83; AIC = 889.86. It appears that the one-factor CFA model for the ALSDS had a better fit with the data than the multi-factor model. The concern about construct validity of the ALSDS was considered as a potential limitation of the ALSDS which could influence the interpretation of findings.

Table 6.16 reported the multi-factor GSAS CFA to be a less optimal fit with the data, which suggested some concerns about the construct validity of the GSAS: CMIN/df = 1924; RMSEA = .07; SRMR = .07; NNI = .73 and CFI = .74; AIC = 5848.2669. It is noted that the one-factor CFA model for the GSAS had a better fit with the data than the multi-factor model. The concern about the construct validity of the GSAS was considered as a potential limitation of the GSAS which could influence the interpretation of findings.

6.9 STUDY 3: DISCRIMINANT VALIDITY OF OVERALL MEASUREMENT MODEL

The next step was to test the discriminant validity of the overall measurement model in order to establish whether multicollinearity would pose any threat to the interpretation of the study findings, as reported on Table 6.17 below.

- First: a one-factor CFA was performed which included the three scales (PTLCS, ALSDS, and GSAS) with their respective subconstructs loading onto one factor.
- Second: a multi-factor CFA was performed with the three scales (PTLCS, ALSDS, and GSAS), with their respective items loading onto the respective sub-factors of the scales.

Table 6.17

Results: Confirmatory Factor Analysis of the Measurement Model

	Chi-square	df	CMIN/df	*p*	RMSEA	SRMR	CFI	NNI	AIC
One-factor model	677.49	77	8.80	< .0001	.15	.09	.83	.79	733.49
Multi-factor model	318.02	74	4.30	< .0001	.08	.05	.92	.91	380.02

Note: N = 378

Table 6.17 shows that the multifactor CFA measurement model had a good fit, and was a better fit with the data than the one-factor CFA, which indicated the discriminant validity of the measurement model: CMIN/df = 4.30; RMSEA = .08; SRMR = .05; NNI = .91 and CFI = .92; AIC = 380.02. The discriminant validity indicated that multicollinearity among the constructs of the three scales was absent and therefore would not pose a threat to the interpretation of the findings.

This section related to research sub-aim 1.1: To assess the psychometric properties (internal consistency, reliability and construct validity) of the newly developed PTLCS. In summary, linear relationships existed between the latent construct and its indicators of interest. Subsequently, the measurement model (model 2) was retained because the model supported the theoretically hypothesised structural model. Model 2 showed that the two-factor PTLCS derived from the CFA (study 2: n = 228) fit the data for the total study sample (N = 378). In this regard, construct validity has been established.

The next section relates to sub-aim 1.2: To establish the nature of the interrelationships between the subscale dimensions (computer and internet self-efficacy) of the PTLCS. Please note, after the CFA of study 2, computer skills was relabelled as technological skills and internet self-efficacy was relabelled as technical self-efficacy.

6.10 STUDY 3: DESCRIPTIVE STATISTICS

Descriptive and correlational statistics pertain to the best fit CFA model of the PLTCS. The statistical analysis involved the total sample (N = 378)

6.10.1 Descriptive statistics: means, internal consistency reliability and standard deviations

This section provides the descriptive information on each of the subscale dimensions of the PTLCS, ALSDS and GSAS. Table 6.18 provides a summary of the results.

Table 6.18

Descriptive Statistics: PTLCS, ALSDS and GSAS

Construct	Cronbach alpha	Composite reliability	Mean	SD	Skewness	Kurtosis
Overall psycho-technical learning capability	.93	n/a	5.57	.70	-3.29	14.50
Technical self-efficacy	.94	.86	5.37	.84	-2.12	6.26
Technological skills	.81	.94	5.71	.68	-3.86	19.00
Overall adult learner self-directedness	.79	n/a	3.78	.39	-.97	1.71
Resource utilisation	.53	.54	3.90	.76	-.76	.24
Academic activity	.20	.17	2.86	.58	-.26	-.45
Success orientation	.76	.76	3.94	.56	-.84	.82
Academic motivation	.53	.51	3.98	.41	-.84	1.31

Construct	Cronbach alpha	Composite reliability	Mean	SD	Skewness	Kurtosis
Overall graduateness skills and attributes	.97	n/a	4.02	.49	-.49	1.04
Problem-solving skills	.84	.83	3.92	.57	-.26	.10
Analytical thinking skills	.75	.84	4.06	.61	-.24	-.53
Enterprising skills	.84	.82	3.81	.61	-.32	.07
Interactive skills	.93	.92	4.09	.54	-.67	1.88
Ethical behaviour	.77	.71	4.46	.51	-1.37	2.24
Presenting skills	.73	.74	3.95	.57	-.27	-.28
Continuous learning	.86	.84	4.04	.60	-.66	1.25
Goal-directed behaviour	.85	.83	4.04	.54	-.40	.27

Note: N = 378

Table 6.18 provides the internal consistency reliability coefficients of the PTLCS, ALSDS and GSAS.

<u>PTLCS</u>

The overall PTLCS and its subscales had good internal consistency reliability (.81 to .94). The standard deviations for the PTLCS ranged from .68 to .84. The skewness values for the PTLCS ranged from -2.12 to -3.86, thus falling outside the -1 and +1 normality range suggested for these coefficients. The kurtosis values of the PTLCS ranged from 6.25 to 19.00, thus falling outside the -1 and above 1 normality range suggested for these coefficients (Von Eye & Wiedermann, 2014). The kurtosis values indicated that the probability for extreme values was higher than for a normal distribution, indicating that the values were more dispersed and not spread around the mean. The highest mean scores obtained on the subdimensions on the PTLCS subscales were technological skills (*M = 5. 71; SD = .68*), while the lowest mean score was obtained on technical self-efficacy (*M = 5.37; SD = .84*), implying that these dimensions obtained the most positive self-evaluations.

ALSDS

The overall scale reliability coefficient of the ALSDS (α = .79) indicated acceptable internal consistency reliability, including for success orientation (.76). The remaining three subscales reported low internal consistency reliability coefficients, namely, academic activity (α = .20) and resource utilisation and academic motivation (α = .53). The standard deviations for the ALSDS ranged from .39 to .76, while the skewness values for the ALSDS ranged from -.49 to -.84, thus falling within the -1 and +1 normality range suggested for these coefficients. The highest mean scores obtained on the subdimensions on the adult learner self-directedness subscales were academic motivation (*M = 3.98; SD = .51*), success orientation (*M = 3.94; SD = .56*) and resource utilisation (*M = 3.90; SD = .76*). The lowest mean score was obtained on academic activity (*M = 2.86; SD = .58*).

GSAS

The overall scale reliability coefficient of the GSAS (α = .97), with acceptable internal consistency reliability on interactive skills (α = .93); continuous learning (α = .86); goal-directed behaviour (α = .85); problem-solving skills and enterprising skills (α = .84); ethical behaviour (α = .77); and analytical thinking skills (α = .75). Overall, the GSAS reported high internal consistency reliability coefficients, implying strong overall internal consistency for the scale. The standard deviations for the GSAS ranged from -.54 to .61. The skewness values for the GSAS ranged from -.24 to -1.37, thus falling outside the -1 and +1 normality range suggested for these coefficients (Pallant, 2013).

The rating scale categories for the GSAS measured responses as follows; 1: Never; 6: Always. As shown in Table 6.18, the participants obtained high mean scores on ethical behaviour (*M = 4.46; SD =.51*), analytical thinking skills (*M = 4.06; SD = .61*), continuous learning (*M = 4.04; SD = .60*) and goal-directed behaviour (*M = 4.04; SD =.54*). The lowest mean score was obtained on enterprising skills (*M = 3.81; SD = .61*). The low mean scores imply that this subscale obtained the least positive self-evaluation. The overall GSAS mean score (*M = 4.02; SD = .49*) indicates an average positive evaluation of graduateness skills and attributes.

Overall, Table 6.18 indicates that the respondents had positive self-evaluations regarding their technological skills, technical self-efficacy, self-directed learning orientation and graduateness.

The following section presents the correlational statistics between the PTLCS, ALSDS and the GSAS.

6.10.2 Correlation statistics

In this section, the correlational analysis is presented in order to achieve **research aim 2**:

Research aim 2: To investigate the nature, magnitude and direction of the relationship between psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS), socio-biographical characteristics (age, gender and ethnicity) and graduateness skills and attributes (as measured by the GSAS).

6.10.2.1 Correlations between socio-biographical groups, PTLCS and ALSDS

Pearson product-moment correlations in SAS version 9.4 (2019) software were used to determine the relationship between the socio-biographical groups and the research variables.

Table 6.19 below presents the results of correlations obtained among the socio-biographical groups (age, gender and ethnicity), the four subscales and overall PTLCS, and the four subscales and overall ALSDS.

The following dummy coding was used for the socio-demographic variables:

Age: Exploration stage < 30 = 0; Establishment stage > 30 = 1.
Gender: Male = 0; Female = 1
Ethnicity/race: Blacks (African, coloured, Indian) = 0; Whites = 1

Table 6.19

Bivariate Correlations of the Socio-biographical Groups, PTLCS and ALSDS

Variable		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Age	-												
2	Gender	-	-	-										
3	Ethnicity	-	-	-										
4	Access-Computer	.06	-.04	.21**	-									
5	Access-Internet	.07	-.02	.16***	.84****	-								
6	Technological skills	-.01	-.01	-.20***	.55****	.49****	-							
7	Technical self-efficacy	-.05	-.17***	-.36***	.49****	.42****	.76****	-						
8	Overall PTLCS	-.02	-.11**	-.35****	.55****	.49****	.95****	.93****	-					
9	Resource utilisation	.05	.03	-.07	.11	.07	.18***	.17***	.19****	-				
10	Academic activity	-.08	.03	.02	.07	-.01	.09	.11*	.11*	.36****	-			
11	Success orientation	.02	-.10*	.14	.23****	.17***	.35****	.38****	.39****	.40****	.23****	-		
12	Academic motivation	.01	-.05	-.02	.15	.15	.28****	.20****	.26****	.39****	.20****	.48****	-	
13	Overall Adult Self directedness.	.01	-.02	-.28****	.21****	.15	.34****	.32****	.36****	.72****	.53****	.81****	.76****	-

Notes: N = 378. **** $p \leq .0001$; *** $p \leq .001$; ** $p \leq .01$; * $p \leq .05$

6.10.2.1.1 Age

In terms of age, Table 6.19 above shows no significant bivariate correlations between age and any of the subscales of the PTLCS or ALSDS.

6.10.2.1.2 Gender

As indicated in Table 6.19, the results showed a significant negative bivariate correlation between gender and the technical self-efficacy subscale (r =-.17; small practical effect; $p \leq .001$); overall PTLCS (r = -.11; small practical size effect; $p \leq .05$) and the success orientation subscale (r = -.10; small practical size effect; $p \leq .05$).

6.10.2.1.3 Ethnicity

Table 6.19 indicates significant positive bivariate correlations between ethnicity and access to a computer (r = .21; small practical size effect; $p \leq .01$) and access to the internet (r = .16; small practical size effect; $p \leq .001$). A significant negative bivariate correlation was also obtained between ethnicity and the technological skills subscale (r =-.20; small practical size effect; $p \leq .001$) and technical self-efficacy (r = -.36; moderate practical size effect; $p \leq .0001$). Significant negative bivariate correlations were observed between ethnicity and overall ALSDS (r = -.28; small practical size effect; $p \leq .0001$).

6.10.2.2 Correlations between socio-biographical groups, PTLCS and GSAS

Table 6.20 presents the results of the bivariate correlations obtained among the socio-biographical groups (age, gender and ethnicity), the four subscales and overall PTLCS, and the eight subscales and overall GSAS.

Table 6.20

Bivariate Correlations of the Socio-biographical Groups, PTLCS and GSAS

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Age	-																
2	Gender	-	-	-														
3	Ethnicity	-	-	-														
4	Access-Computer	.06	-.04	.21**	-													
5	Access-Internet	.07	-.02	.16***	.84***	-												
6	Technological skills	-.01	-.01	-.20***	.55***	.49***	-											
7	Technical self-efficacy	-.05	-.17***	-.36***	.49***	.42***	.76***	-										
8	Overall PTLCS	-.02	-.11**	-.35****	.55***	.49***	.95***	.93***	-									
9	Problem solving	.04	-.13**	.07	.13**	.09	.29***	.33***	.33***	-								
10	Analytical thinking	-.001	-.15	-.12*	.14***	.13**	.28***	.34***	.33***	.71***	-							
11	Enterprising skills	.03	-.19***	-.06	.08	.05	.28***	.31***	.32***	.77***	.63***	-						
12	Interactive skills	.03	-.09	-.02	.17***	.14***	.34***	.35***	.37***	.77***	.57***	.73***	-					
13	Presenting skills	.04	-.06	-.12*	.07	.08	.25***	.22***	.25***	.76***	.60***	.73***	.74***	-				
14	Ethical behaviour	.06	-.06	.16***	.19***	.20***	.37***	.35***	.38***	.61***	.60***	.55***	.63***	.54***	-			
15	Continuous learning	.05	-.12**	-.02	.16***	.12**	.29***	.28***	.31***	.74***	.55***	.71***	.80***	.70***	.50***	-		
16	Goal directed	-.04	-.08	-.02	.11*	.12**	.27***	.24***	.27***	.76***	.54***	.67***	.71***	.74***	.49****	.80***	-	
17	Overall Graduateness	.03	-.14	.03	.16***	.13**	.35***	.36***	.38***	.91***	.73***	.87***	.91***	.85***	.69***	.87***	86****	-

Notes: N = 378. **** $p \leq .0001$; *** $p \leq .001$; ** $p \leq .01$; * $p \leq .05$

6.10.2.2.1 Age

In terms of age, Table 6.20 above shows no significant bivariate correlations between age and any of the subscales of the PTLCS or GSAS.

6.10.2.2.2 Gender

Table 6.20 above shows significant negative bivariate correlation between gender and the technical self-efficacy subscale (r =-.17; small practical effect; $p \leq .001$); overall PTLCS (r = -.11; small practical size effect; $p \leq .05$). Table 6.20 further shows a negative bivariate correlation between gender and the problem-solving skills subscale (r = -.13; small practical size effect; $p \leq .01$); the enterprising skills subscale (r = -.19; small practical size effect; $p \leq .0001$) and continuous learning skills (r = -.12; small practical size effect; $p \leq .01$).

6.10.2.2.3 Ethnicity

Table 6.20 indicates significant positive bivariate correlations between ethnicity and access to a computer (r = .21; small practical size effect; $p \leq .01$) and access to the internet (r = .16; small practical size effect; $p \leq .001$). A significant negative bivariate correlation was also obtained between ethnicity and the technological skills subscale (r =-.20; small practical size effect; $p \leq .001$) and technical self-efficacy (r = -.36; moderate practical size effect; $p \leq .0001$) and overall PTLCS (r = -.35; moderate practical size effect; $p \leq .0001$). Significant negative bivariate correlations were observed between ethnicity and the analytical skills subscale (r = -.12; small practical size effect; $p \leq .05$); as well as the presenting skills subscale (r = -.12; small practical size effect; $p \leq .05$). A positive bivariate correlation was observed between ethnicity and ethical behaviour (r = .16; small practical size effect; $p \leq .001$).

6.10.2.3 Correlations between socio-biographical groups, ALSDS and GSAS

Table 6.21 presents the results of the bivariate correlations obtained between the socio-biographical groups (age, gender and ethnicity), the four subscales and overall ALSDS, and the eight subscales and overall GSAS.

Table 6.21

Bivariate Correlations of the Socio-biographical Groups, ALSDS and GSAS

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	Age	-																
2	Gender	-	-	-														
3	Ethnicity	-	-	-														
4	Resource utilisation	.05	.03	-.07	-													
5	Academic activity	-.08	.03*	.02	.36****	-												
6	Success orientation	-.08	-.09	.014	.40****	.23****	-											
7	Academic motivation	.02*	-.05	-.02	.39****	.20****	.48****	-										
8	Overall adult self-directedness.	.001***	-.02	.03	.73****	.53****	.81****	.76***	-									
9	Problem solving	.04	-.13**	.07	.33****	.26****	.51****	.43****	.71****	-								
10	Analytical thinking	-.001	-.15	-.12*	.21****	.17***	.49****	.32****	.71****	.71****	-							
11	Enterprising skills	.03	-.19***	-.06	.26****	.21****	.44****	.35****	.77****	.77****	.63***	-						
12	Interactive skills	.03	-.09	-.02	.34****	.22****	.51****	.42****	.77****	.77****	.57****	.73****	-					
13	Presenting skills	.04	-.06	-.12*	.38****	.22****	.46****	.43****	.76****	.76****	.60****	.73****	.74****	-				
14	Ethical behaviour	.06	-.06	.16***	.20****	.13**	.47****	.31****	.61****	.61****	.60****	.56****	.63****	.54****	-			
15	Continuous learning	.05	-.12**	-.02	.36****	.28****	.47****	.44****	.56****	.74****	.55****	.71****	.80****	.70****	.50****	-		
16	Goal directed	-.04	-.08	-.02	.37***	.32****	.49****	.46****	.59****	.76****	.54****	.67****	.71****	.74****	.49****	.79****	-	
17	Overall graduateness	.03	-.14	.03	.37****	.27****	.56****	.47****	.61****	.91****	.72****	.87****	.91****	.85****	.69****	.88****	.86****	-

Notes: N = 378. **** $p \leq .0001$; *** $p \leq .001$; ** $p \leq .01$; * $p \leq .05$

6.10.2.3.1 Age

In terms of age, Table 6.21 above shows significant positive bivariate correlations between age and academic motivation subscale (r = .02; small practical size effect; $p \leq .05$) and overall ALSDS (r = -.001; small practical size effect; $p \leq .001$).

6.10.2.3.2 Gender

Table 6.21 above shows significant positive bivariate correlation between gender and the academic activity subscale (r =.03; small practical effect; $p \leq .05$). Table 6.21 further shows a negative bivariate correlation between gender and the problem-solving skills subscale (r = -.13; small practical size effect; $p \leq .01$); the enterprising skills subscale (r = -.19; small practical size effect; $p \leq .0001$) and continuous learning skill (r = -.12; small practical size effect; $p \leq .01$).

6.10.2.3.3 Ethnicity

Table 6.21 indicates that significant negative bivariate correlations were observed between ethnicity and the analytical skills subscale (r = -.12; small practical size effect; $p \leq .05$); as well as the presenting skills subscale (r = -.12; small practical size effect; $p \leq .05$). A positive bivariate correlation was observed between ethnicity and ethical behaviour (r = .16; small practical size effect; $p \leq .001$).

The correlation results provided supportive evidence for research hypothesis H2. Overall, these results showed significant bivariate correlations between the subscales of the PTLCS, the ALDS and the GSAS, which were small, moderate and large in practical effect size. Additionally, the results showed significant bivariate correlations between the socio-biographical groups (age, gender and ethnicity) with psycho-technological learning capabilities (technological skills and technical self-efficacy), self-directed learning orientation and their graduateness skills and attributes.

In summary, the following core conclusions were drawn:

Socio-biographical and PTLCS, ALSDS and GSAS

- In terms of age, significant positive correlations were only observed with the academic activity subscale and overall ALSDS.
- Gender was negatively correlated with technical self-efficacy and overall PTLCS. In addition, significant positive correlations were observed with the academic activity subscale of the ALSDS, while negative significant correlations were obtained with the problem-solving and enterprising subscales of the GSAS.
- When considering ethnicity, significant positive correlations were observed with the access to a computer and access to the internet subscales of the PTLCS. Additionally, significant negative correlations were obtained for the technological skills and technical self-efficacy subscales of the PTLCS. In terms of the GSAS, significant negative correlations were noted for the analytical skills and presenting skills subscales, while positive significant correlations were observed for the ethical behaviour subscale.
- The bivariate correlations were small to moderate in practical size effect.

Independent and dependent variables

- Significant positive bivariate correlations were observed between the subscales of the PTLCS, namely access to a computer, access to the internet, technological skills and technical self-efficacy. Additionally, significant positive bivariate correlations were found, with the overall PTLCS ranging from moderate to large practical size effect.
- With regard to the ALSDS, significantly positive bivariate correlations were found between all four subscales, ranging from a small to large practical size effect.
- A positive significant bivariate correlation was found between all eight subscales and overall GSAS, ranging from moderate to large practical size effect.
- Overall, the bivariate correlations were from small to large in practical size effect.

The results provided supportive evidence for research hypothesis H2:

Research hypothesis H2: Students' psycho-technological learning capabilities, self-directed learning orientation and socio-biographical characteristics (age, gender and ethnicity) are significantly and positively related to their graduateness skills and attributes.

The following section presents the results of the inferential statistics performed.

6.11 STUDY 3: INFERENTIAL STATISTICS

Inferential statistics were used to draw conclusions from the population and were reported and interpreted in the following three steps:

Step 1: Multiple regression analysis (testing predictive validity of the PTLCS)
Step 2: Hierarchical moderated regression analysis
Step 3: Tests for significant mean differences

The following subsection represents the methods and parameters applied during the multiple regression analysis in the current study.

6.11.1 Multiple regressions

Step 1 of the inferential statistical analysis involved multiple regression analysis to address **research aim 3**:

Research aim 3: To assess whether psycho-technological learning capabilities and self-directed learning orientation significantly predict graduateness skills and attributes.

The CALIS Procedure (SAS, 2019) was used to perform the regression analysis to ascertain and explain whether the independent variables, psycho-technological learning capabilities and self-directed learning orientation significantly predict the dependent variable, graduateness skills and attributes. The most significant results yielded from the analysis are reported in Table 6.22 below. The ANOVA (*Fp*) and R^2 values were used to indicate the variance that was explained by the model as provided in Table 6.22.

Table 6.22

Regression Analysis: Psycho-technological Learning Capabilities and Self-directed Learning Orientation as Predictors of Graduateness Skills and Attributes.

	Unstandardised		**Standardised**	**t**	***p***	**95% Confidence level**	
	β	SE	**β**			Lower Interval	Upper Interval
Constant	.92	.24		3.92	.000	.46	1.39
Age	.000	.04	.000	.003	.99	-.08	.08
Gender	-.100	.05	-.09*	-2.16	.03	-.19	-.01
Ethnicity	-.09	.04	-.09*	-2.06	.04	-.18	-.004
Access to computer	-.51	.04	-.11	-1.35	.18	-.13	.02
Access to internet	.02	.04	.15*	2.22	.03	.01	.16
Technical self-efficacy	.08	.04	.15*	2.22	.03	.01	.16
Technological skills	.60	.04	.15	1.27	.21	-.03	.15
Resource utilisation	.05	.03	.08	1.75	.08	-.01	.11
Academic activity	.09	.04	.11**	2.47	.01	.02	.016
Success orientation	.30	.04	.34***	6.78	.000	.21	.38
Academic motivation	.24	.06	.21***	4.37	.000	.13	.35
F(p)	25.06***						
R^2	.43+++						
Adjusted R^2	.41+++						

*Notes: N = 378. ***p ≤ .001 **p ≤ .01 *p ≤ .05. Standardised beta coefficients (ß) reported.*
+R^2 ≤ .12 (small practical effect size) ++R^2 ≥ .13 ≤ .25 (moderate practical effect size)
+++ R^2 ≥ .26 (large practical effect size)

Table 6.22 shows that the regression model was significant (*Fp ≤ .000).* The ANOVA model was also significant: *F* = 25.06; *p* = .000; R^2 = .41 (large practical effect). Accordingly, the predictor variables explained 41% of the variance in graduateness skills and attributes.

Table 6.22 Shows that the gender (β = -.09; *p* = .03) and ethnicity (β = -.09; *p* = .04) socio-biographical factors as control variables significantly predicted graduateness skills and attributes. The negative sign suggests differences among the gender and ethnicity groups respectively. Access to the internet (β = .15; *p* = .03), technical self-efficacy (β = .15; *p* = .03), academic activity (β = .11; *p* = .01), success orientation (β = .34; *p* = .000) and academic motivation (β = .21; *p* = .000) significantly predicted graduateness skills and attributes. The positive sign suggests that high levels of these five predictor variables are likely to explain high levels in graduateness skills and attributes. The results also provide evidence of the predictive validity of the PTLCS subscale, technical self-efficacy.

The multiple regression analysis results presented above provided supportive evidence for research hypothesis H3.

H3: Students' psycho-technological learning capabilities and self-directed learning orientation significantly predict their graduateness skills and attributes.

6.11.2 Hierarchical moderated regression

Step 2 of the statistical analysis involved the hierarchical moderated regression analysis to address **research aim 4:**

Research aim 4: To assess whether socio-biographical characteristics, namely age, gender and ethnicity significantly moderate the relationship between (1) psycho-technological learning capabilities, (2) self-directed learning orientation, and graduateness skills and attributes.

The Hayes PROCESS procedure for SPSS Release 2.15 (Hayes, 2013) was used to perform the moderated regression analysis. A 95% level of confidence interval was used. Significance levels were determined by using the more stringent lower and upper level confidence interval range (LLCI and ULCI) not containing zero.

Furthermore, hierarchical moderated regression was performed to test research hypothesis H4:

H4: The relationship between students' (1) psycho-technological learning capabilities; (2) self-directed learning orientation and their graduateness skills and attributes is moderated by their socio-biographic characteristics (age, gender and ethnicity).

The following dummy coding was used for the socio-demographic variables:

Age: Exploration stage < 30 = 0; Establishment stage > 30 = 1.
Gender: Male = 0; Female = 1
Ethnicity/race: Blacks (African, coloured, Indian) = 0; Whites = 1

6.11.2.1 *Psycho-technical Learning Capability Interaction with Age, Gender, Ethnicity*

This section reports the moderated regression results performed to assess whether socio-biographical characteristics, namely age, gender and ethnicity, significantly moderate the relationship between psycho-technological learning capabilities (as measured by the PTLCS) and the GSAS.

Table 6.23

Moderated Regression Results: Psycho-technical Learning Capability Interaction with Age, Gender, Ethnicity in Predicting Graduateness Skills and Attributes.

Variable	β	SE	t	*p*	LLCI	ULCI	*F*	*p*	*R²*
Age									
Constant	3.99	.03	116.60	.000	3.93	1.07	21.60	.000	.15***
Psycho-technical learning capability(A)	.33	.06	5.82	.000	.22	.44			
Age (B)	.04	.05	.79	.43	-.06	.13			
A X B	.10	.07	-1.42	.16	-.24	.04			
Conditional effect	**β**	**SE**	**t**	***p***	**LLCI**	**ULCI**			
Exploration stage < 30	.33	.06	5.82	.000	.22	.44			
Establishment stage > 30	.23	.04	5.55	.000	.15	.31			
Gender	**β**	**SE**	**t**	***p***	**LLCI**	**ULCI**	***F***	***p***	***R²***
Constant	4.11	.05	84.27	*.000*	4.01	4.20	22.43	.000	.15***
Psycho-technical learning capability(A)	.26	.10	2.53	.01	.06	.45			
Gender (B)	-.12	.06	-2.12	.04	-.23	-.01			
A X B	-.001	.11	-.01	.99	-.21	.21			
Conditional effect	**β**	**SE**	**t**	***p***	**LLCI**	**ULCI**			
Male	.26	.10	2.53	.01	.56	.45			
Female	.25	04	7.19	.000	.19	.32			
Ethnicity									
constant	4.05	.03	142.81	.000	3.99	4.10	26.92	.000	.18***
Psycho-technical learning capability(A)	.23	.04	6.28	.000	.16	.30			
Ethnicity (B)	-.16	.05	-3.11	.002	-.26	-.06			
A X B	.34	.10	3.54	.000	.15	.52			
Conditional effect	**β**	**SE**	**t**	***p***	**LLCI**	**ULCI**			
Black	.23	.04	6.28	.000	.16	.30			
White	.56	.09	6.41	.000	.39	.74			

Note: N = 378. LLCI: lower level confidence interval. ULCI: upper level confidence interval
****p ≤ .001 **p ≤ .01 *p ≤ .05. Standardised beta coefficients (ß) reported.*

In terms of age, Table 6.23 shows that the ANOVA model was significant: $F = 21.60$, $p = .000$; $R^2 = .15$. The model explained 15% (moderate practical effect) of the variance in graduateness skills and attributes. The main effect of psycho-technical learning capability (β = .33; $p = .000$; LLCI =

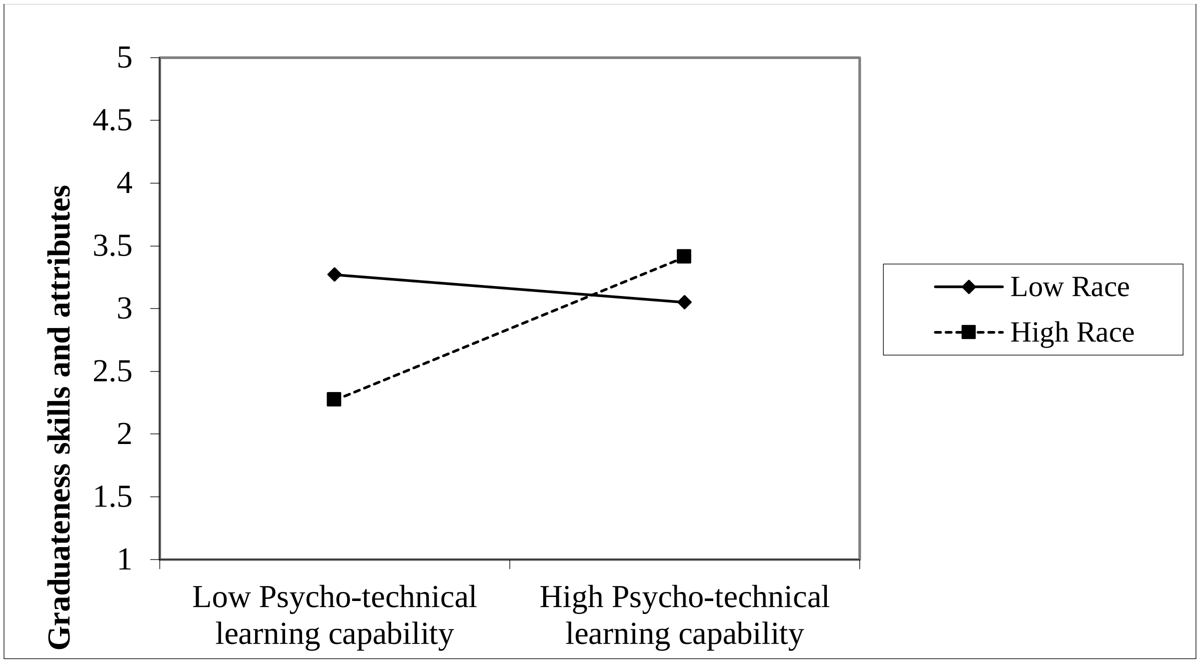
.22; ULCI = .44) was significant and the construct positively predicted graduateness skills and attributes. Age had a non-significant main effect (β = .04; p = .43; LLCI = -.06; ULCI = .13) on graduateness skills and attributes. In addition, no significant interaction (moderating) effect between psycho-technical learning capability and age was found in predicting graduateness skills and attributes (β = .10; p = .16; LLCI = -.24; ULCI = .04). However, the results showed that the prediction effect of psycho-technical learning capability was to an extent conditional on the mean scores of the age groups.

With regard to gender, Table 6.23 shows that the ANOVA model was significant: F = 22.43, p = .000; R^2 = .15. The model explained 15% (moderate practical effect) of the variance in graduateness skills and attributes. The main effect of psycho-technical learning capability (β = .26; p = .01; LLCI = .06; ULCI = .45) was significant and the construct positively predicted graduateness skills and attributes. Gender had a negative and significant main effect (β = -.12; p = .04; LLCI = -.23; ULCI = -.01) on graduateness skills and attributes. There was no significant interaction (moderating) effect between psycho-technical learning capability and gender in predicting graduateness skills and attributes (β = -.001; p = .99; LLCI = -.21; ULCI = .21). However, the results showed that the prediction effect of psycho-technical learning capability was to an extent conditional on the mean scores of the male and female groups.

In terms of ethnicity, Table 6.23 shows that the ANOVA model was significant: F = 26.92, p = .000; R^2 = .18, explaining 18% (moderate practical effect) of the variance in graduateness skills and attributes. The main effect of psycho-technical learning capability (β = .23; p = .000; LLCI = .16; ULCI = .30) was significant and the construct positively predicted graduateness skills and attributes. Ethnicity had a negative and significant effect (β = -.16; p = .000; LLCI = -.26; ULCI = -.06) on graduateness skills and attributes, with the negative sign implying differences between the ethnicity groups. There was also a significant interaction (moderating) effect between psycho-technical learning capability and ethnicity in predicting graduateness skills and attributes (β = .34; p = .000; LLCI = .15; ULCI = .52). The results showed that the prediction effect of psycho-technical learning capability was conditional on the mean scores of the black and white ethnicity groups. Figure 6.9 illustrates the conditional effect of the ethnicity groups with a significant interaction effect.

Figure 6.9

Interaction Effect Between Psycho-technical Learning Capability and Race in Predicting Graduateness Skills and Attributes



Note: Low scores: race (0) = Black (African, Coloured, Indian) participants; High scores: race (1) = White participants

Figure 6.9 shows that for white participants, high scores on psycho-technical learning capabilities (i.e. technological skills and technical self-efficacy) were associated with relatively high scores on graduateness skills and attributes. For black participants, high scores on psycho-technical learning capabilities were associated with relatively low moderate scores on graduateness skills and attributes.

For white participants, low scores on psycho-technical learning capabilities (i.e. technological skills and technical self-efficacy) were associated with relatively low scores on graduateness skills and attributes. However, for black participants, low scores on psycho-technical learning capabilities were associated with relatively high scores on graduateness skills and attributes. This result suggests that for white participants psycho-technical learning capabilities predict their graduateness skills and attributes. This may be associated with their perceived employability, while the black participants seemingly do not align their graduateness skills and attributes and employability with their levels of psycho-technical learning capabilities.

6.11.2.2 Self-directed Learning Orientation Interaction with Age, Gender and Ethnicity

Table 6.24 shows that the three ANOVA models were significant, explaining a large practical effect of the variance in the GSAS (R^2 range: .37 to .39). In all three models self-directed learning orientation had significant and positive main effects on the graduateness skills and attributes. Gender also had a significant main effect on the graduateness skills and attributes (β = -.14; *p* = .003; LLCI = -.23; ULCI = -.05).

Table 6.24

Moderated Regression Results: Self-directed Learning Orientation Interaction with Age, Gender, Ethnicity in Predicting Graduateness Skills and Attributes

Variable	**β**	**SE**	**t**	***p***	**LLCI**	**ULCI**	***F***	***p***	***R²***
Age									
Constant	4.02	.03	136.96	.000	3.97	4.08	74.47	.000	.37
Self-directed Learning Orientation (A)	.70	.07	10.32	.000	.57	.83			
Age (B)	-.01	.04	-.20	.84	-.09	.07			
A X B	.13	.10	1.26	.21	-.07	.33			
Age	**β**	**SE**	**t**	***p***	**LLCI**	**ULCI**	***F***	***p***	***R²***
Constant	4.13	.04	103.50	*.000*	4.05	4.20	79.60	.000	.39
Self-directed Learning Orientation (A)	.59	.11	5.24	.000	.37	.81			
Gender (B)	-.14	.05	-3.04	.003	-.23	-.05			
A X B	.20	.13	1.59	.11	-.05	.44			
Ethnicity									
constant	4.03	.03	164.30	.000	3.98	4.08	74.12	.000	.38
Self-directed Learning Orientation (A)	.79	.06	12.73	.000	.67	.91			
Race (B)	-.04	.04	-.92	.36	-.12	.05			
A X B	-.03	.002	11.71	.00	-.08	.05			

Note: N = 378. LLCI: lower level confidence interval. ULCI: upper level confidence interval

Table 6.24 shows the ANOVA model for age, gender and ethnicity as moderators of the relationship between self-directed learning orientation (as measured by the ALSDS) and graduateness skills and attributes (as measured by the GSAS). As reported in Table 6.24, no significant interaction (moderating) effects between the socio-biographical variables, namely, age, gender and ethnicity, and self-directed learning orientation (as measured by the ALSDS) in predicting graduateness skills and attributes (as measured by the GSAS) were observed.

In summary, the empirical results attained from the multiple regression analysis provided partial supportive evidence for research hypothesis H4:

Research hypothesis H4: The relationship between students' (1) psycho-technological learning capabilities; (2) self-directed learning orientation and their graduateness skills and attributes is moderated by their socio-biographic characteristics (age, gender and ethnicity).

The only interaction effect observed was between psycho-technological learning capability and ethnicity in predicting graduateness skills and attributes (β = .34; *p* = .000; LLCI = .15; ULCI = .52). The results indicated that the prediction effect of psycho-technological learning capability was conditional on the mean scores of the black and white ethnicity groups.

Generally, the results obtained from the multiple regression analysis and hierarchical moderated regression provided evidence of the predictive validity of the newly developed PTLCS.

6.11.3 Tests for significant mean differences

Step 3 of the inferential statistical analysis, namely, the test for significant mean differences, addressed research aim 5:

Research aim 5: To determine whether students from different socio-biographical groups, namely age, gender and ethnicity, differ significantly regarding their psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS) and graduateness skills and attributes (as measured by the GSAS).

When considering the tests of normality, the Shapiro-Wilk and Kolmogorov-Smirnov tests were significant based on the non-normality of the data distribution (the *p*-value was greater than the chosen alpha level). This section will only report on the variances between variables that were significant for the following socio-biographic variables:

- Age: Exploration stage < 30 years; Establishment stage > 30 years.
- Gender: Male; Female
- Ethnicity/race: blacks (African, coloured, Indian); whites

After the results had revealed a normal distribution of the data, SAS version 9.4 (SAS, 2019) was utilised to perform parametric statistical analysis. Independent samples *t*-test procedures were used to test for significant mean differences between the gender, age and ethnicity groups. Cohen's *d* test was used to assess practical effect size in terms of the differences between the respective groups for each of the variables.

6.11.3.1 Reporting differences in mean scores for age groups (PTLCS, ALSDS, GSAS)

The results of the *t*-test procedure and mean scores between the socio-biographical variable of age with regard to psycho-technological learning capabilities (PTLCS: technological skills and technical self-efficacy), self-directedness learning orientation-related variables (ALSDS) and the graduateness skills and attributes-related variables (GSAS) did not report any significant differences. For the sake of parsimony, the results are therefore not reported here.

6.11.3.2 Reporting differences in mean scores for gender groups (PTLCS, ALSDS, GSAS)

The next step was to perform the independent samples *t*-test procedure to assess for significant differences among the mean scores of male and female participants regarding their psycho-technological learning capabilities (technological skills and technical self-efficacy); self-directedness learning orientation (ALSDS) and graduateness skills and attributes (GSAS). Table 6.25 below presents the results of the significant mean differences.

Table 6.25

Tests for Significant Mean Differences: Gender

Variable	t	df	*p*	Source of difference	Mean	SD	Cohen d
Success orientation	2.05*	376	.04	Gender	Male: 4.01 Female: 3.97	.44 .40	.10
Enterprising skills	3.78****	376	.000	Gender	Male: 4.01 Female: 3.97	.48 .63	.07
Interactive skills	2.07*	376	.04	Gender	Male: 4.03 Female: 3.92	.55 .03	.28
Continuous learning	2.29*	376	.02	Gender	Male: 4.12 Female: 4.01	.05 .54	.29
Psycho-technological learning capabilities	2.13*	376	.03		Male: 5.57 Female: 5.30	.66 .88	.35

Note: N = 376. Male n = 93; Female n = 285

***** $p \leq .0001$ ***$p \leq .001$ **$p \leq .01$ *$p \leq .05$.*

As shown in Table 6.25, significant mean differences were only noted for the gender groups on success orientation (males M = 4.01; SD = .44; females M = 3.97; SD = .40; *t* = 2.05; *p* ≤ .04; *d* = .10; no practical effect size); enterprising skills (males M =4.01; SD = .48; females M = 3.97; SD = .63; *t* = 3.78; *d* = .07 no practical effect size); interactive skills (males M = 4.03; SD = .55; females M = 3.92; SD = .03; *t* = 2.07; *d* = .28 small practical effect size); continuous learning (males M = 4.12; SD= .05; females M = 4.01; SD = .54; *t* = 2.29; *d* = .29 small practical effect size); and the overall psycho-technological learning capabilities (males M = 5.57; SD= .66; females M = 5.30; SD = .88; *t* = 2.13; *d* = .35 small practical effect size). Overall, the results showed that the male participants scored significantly higher than the female participants on these variables.

6.11.3.3 Reporting differences in mean scores for ethnicity groups (PTLCS, ALSDS, GSAS)

The next step was to perform the independent samples *t*-test procedure to assess for significant differences among the mean scores of black and white participants regarding their psycho-technological learning capabilities (technological skills and technical self-efficacy); self-directedness learning orientation (ALSDS) and graduateness skills and attributes (GSAS). Table 6.26 below presents the results of the significant mean differences.

Table 6.26

Tests for significant Mean Differences: Ethnicity

Variable	**t**	**df**	***p***	**Source of difference**	**Mean**	**SD**	**Cohen d**
Success orientation	-2.62	373	.01	Ethnicity	Black: 3.99 White: 3.96	.43 .38	.07
Ethical behaviour	-2.08	373	.04	Ethnicity	Black: 4.42 White: 4.54	.53 .48	.24
Continuous learning	2.23	373	.03	Ethnicity	Black: 4.09 White: 3.95	.59 .63	.23
Psycho-technological learning capabilities	-4.01	373	.000	Ethnicity	Black: 5.46 White: 5.77	.78 .46	.48
Technical Self-efficacy	-5.23	373	.000	Ethnicity	Black: 5.20 White: 5.67	.91 .57	.62
Technological skills	-2.50	373	.01	Ethnicity	Black: 5.65 White: 5.83	.77 .44	.29
Access to Internet	-2.28	373	.02		Black: 5.54 White: 5.78	1.08 .66	.27

Note: N = 375. Black (African, Coloured, Indian) n = 250; White n = 125
***** p ≤ .0001 ***p ≤ .001 **p ≤ .01 *p ≤ .05.*

As reported in Table 6.26, significant mean differences were noted for the ethnicity groups on:

- success orientation (black participants; M = 3.99; SD = .43; white participants; M = 3.96; SD = .38; *t* = -2.62; *p* = .01; *d* = .07 (no practical effect size);
- ethical behaviour (black participants M= 4.42; SD = .53; white participants; M = 4.54; SD = .48; *t* = -2.08; *p* = .04; *d* = .24 (small practical effect size)
- continuous learning (black participants; M = 4.09; SD = .59; white participants; M = 3.95; SD = .63; *t* = 2.23; *p* = .03; *d* = .23 (small practical effect size)
- overall psycho-technological learning capabilities (black participants; M = 5.46; SD = .78; white participants; M = 5.77; SD = .46; *t* = -4.01; *p* = .000; *d* = .48 (small practical effect size)
- technical self-efficacy (black participants; M = 5.20; SD = .91; white participants; M = 5.67; SD = .57; *t* = -5.23; *p* = .000; *d* = .62 (moderate practical effect size)
- technological skills (black participants; M = 5.65; SD = .77; white participants, M = 5.83; SD = .44; *t* = -2.50; *p* = .01; *d* = .29 (small practical effect size), and
- access to the internet (black participants; M = 5.54; SD = 1.08; white participants; M = 5.78; SD = .66; *t* = -2.28; *p* = .02; *d* = .27 (small practical effect size).

Overall, the results showed that the black ethnicity participants scored significantly higher than the white ethnicity participants on the ALSDS success orientation and continuous learning, while the white ethnicity participants scored significantly higher than the black ethnicity participants on the ALSDS ethical behaviour, and the PTLCS overall psycho-technological learning capabilities, technical self-efficacy, technological skill, and access to the internet. The results noted in the current study could be indicative of the existing disparities in opportunities and access to and confidence in using technology for online learning.

In summary, the empirical results obtained from the t-test analysis provided supportive evidence for accepting research hypothesis H5 in terms of gender and ethnicity groups:

Research hypothesis H5: Students from different socio-biographic groups (age, gender and ethnicity) differ significantly regarding their psycho-technological learning capabilities, self-directedness learning orientation and their graduateness skills and attributes.

6.12 DECISIONS REGARDING THE RESEARCH HYPOTHESES

Based on the results and using the *p* ≤ .05 (5% level) as a criterion for accepting or rejecting the null hypotheses, the decisions regarding the research hypotheses are indicated in Table 6.27 below.

Table 6.27

Overview of the Decisions regarding the Research Hypotheses

Research hypotheses	Supportive evidence provided
H1: Students' psycho-technological learning capabilities (computer skills and technical self-efficacy) can be operationalised into a valid and reliable measure	Yes
H2: Students' psycho-technological learning capabilities, self-directed learning orientation and socio-biographical characteristics (age, gender and ethnicity) are significantly and positively related to their graduateness skills and attributes.	Yes
H3: Students' psycho-technological learning capabilities and self-directed learning orientation significantly predict their graduateness skills and attributes.	Yes
H4: The relationship between students' (1) psycho-technological learning capabilities; (2) self-directed learning orientation and their graduateness skills and attributes is moderated by their socio-biographic characteristics (age, gender and ethnicity).	Partially accepted (interaction effect between psycho-technical learning capability and ethnicity in predicting graduateness skills and attributes)
H5: Students from different socio-biographical groups (age, gender and ethnicity) differ significantly regarding their psycho-technological learning capabilities, self-directedness learning orientation and their graduateness skills and attributes.	Partially accepted for (gender and ethnicity)

Source: Author's own work

6.13 CHAPTER SUMMARY

This chapter provided the findings relating to the development of the new scale, namely the PTLCS. The statistical procedures to explore the factorial validity, unidimensionality and construct validity of the PTLCS were presented. The results of the empirical study were also reported in this chapter.

Chapter 7 will present the findings of the literature review and an interpretation with the findings from the empirical research. Additionally, the chapter will highlight research aim 6, to formulate conclusions and recommendations for online learning and development practices to enable adult learners' graduateness and employability and future research.

CHAPTER 7: DISCUSSION, CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

This chapter discusses the research results and addresses research aim 6 by drawing conclusions. The chapter further evaluates the limitations of the literature review and empirical study. Recommendations for future research and for online learning and development practices for the enhancement of adult learners' graduateness are also highlighted.

Research aim 6: To formulate conclusions and recommendations for future research and online learning and development practices for enabling adult learners' graduateness.

7.1 DISCUSSION OF RESULTS

The following section provides a discussion of the biographical profile of the sample. The empirical research aims that underpinned the study are also discussed, highlighting the key findings of the empirical study.

7.1.1 The biographical profile of the sample

The sample comprised a total of N = 378 students studying either one of the first-year Industrial and Organisational Psychology modules IOP1501 or IOP1601. The study sample consisted of predominantly black students (Africans, coloured and Indian) and females in the early adulthood life stage. The age range was balanced between participants in the 17 to 30 year (pre-early adulthood life stage or emerging adulthood phase) and those in the 31 to 45 year (early adulthood establishment phase) range. The emerging adulthood phase is a phase of exploring life and work possibilities with little knowledge of graduateness and employability requirements, while the adulthood establishment phase is characterised by more concrete and enduring decisions regarding the occupation, values and lifestyle with a need for graduateness development (Coetzee et al., 2016). The early adulthood phase, which is characteristic of the sample, alludes to a need for constructing and implementing a career identity, as well as developing the competencies needed for sustainable employability (Coetzee et al., 2016). In this regard, the current research is valuable in deepening an understanding of the participants' level of psycho-technological learning capabilities, self-directed learning orientation and self-perceived graduateness. The sample of participants represented a group of adult learners that may be in need of specific learning and development support in an ODeL learning setting to ensure their future employability. Research findings suggest that participants from different age, gender and ethnicity groups may be more in need of development support regarding the constructs relevant to the current study (Coetzee, 2012; Gokcearslan, 2017; Holt & Brocket, 2012; Jackson, 2012, 2016).

Although the study sample focused on students attempting the first-year online modules in Industrial and Organisational Psychology and the majority of participants were female, this was not deemed a limitation to the generalisability of the findings since it is a typical reflection of the wider population of the participating ODeL institution (Yamagata-Lynch et al., 2015).

The descriptive statistics revealed that the group of participants were highly confident about their psycho-technical learning capabilities and specifically technological skills (i.e. the ability to save and transfer files on electronic platforms; to use electronic search engines to find information and to download software for a computer). The participants also seemed confident about their capability of uploading assignments, in searching for information and downloading the official study material for assignments by using electronic platforms such as the internet and module sites (technical self-efficacy). These findings confirm the assumptions proposed by the Technology Acceptance Model (TAM) where a person's intention to use technology is based on its perceived usefulness and ease of use (Sagnier et al., 2020). Lazmin (2021) conducted a study among 1100 undergraduate Accounting students at a private university in Malaysia. The study findings indicate that students' acceptance behaviour towards online learning is influenced and mediated by their attitude regarding perceived ease of use and perceived usefulness. Zabadi and Al-Alawi (2016) explored students' attitudes towards e-learning and found statistically significant findings between gender groups, technology usage and skill. Essentially, their study found that students had a positive attitude towards e-learning (Zabadi & Al-Alawi, 2016). Torun (2020) confirms the assertions by Zabadi and Al-Alawi (2016) and further highlights the importance and application of Bandura's social cognitive theory on self-efficacy and asserts that the higher the confidence levels a learner has when using the internet and computer, the better their achievement levels in online learning. Essentially, the study findings confirm that students are likely to have high levels of readiness and confidence to pursue learning in an ODeL environment if they have a positive evaluation or perception of their skills to use a computer (Kuo et al., 2020; Torun, 2020) and the ease of use of technology (Kuo et al., 2020; Romero Martinez et al., 2020; Torun, 2020).

The participants from the current study also seemingly had a strong sense of self-directed learning orientation, specifically in terms of resource utilisation (i.e. when and how adult learners utilise the official resources provided by the university as they progress with their studies), success orientation (the self-reported cognitive processes of adult learners that display their level of self-confidence in their ability to be successful in their studies) and academic motivation (which refers to the source of adult learners' motivation concerning their academic activities as well as their resilience and problem-solving behaviours). These findings suggest that the participants were ready for and comfortable in the ODeL environment. Knowles (1975) asserts that self-directed learning assists learners to find meaning and purpose in their learning and to take responsibility for planning, implementing and evaluating their learning. In educational settings, scholars agree that self-directed learning is more effective in knowledge enhancement than in traditional teaching and is more effective in improving skills and attitudes (Lee et al., 2020; Murad et al., 2010). In support of these assertions and the current study findings, it has been noted that motivation plays a role in influencing the adult learner to enrol for a programme and continues to inform decisions by the adult learner to engage with the learning material to succeed in their learning (Botha, 2014; Botha & Coetzee, 2016; Bergamin et al., 2012; Garrison, 1997).

The participants seemed less confident about their academic activity (which relates to the intentional, purposeful learning actions in which adult learners engage and that are directly related either to furthering their studies or to improving their knowledge and skills). Botha and Coetzee (2016) further define engaged academic activity as the way students make use of the resources provided by the university, as well as the students' observed behaviour in the learning environment. Being in an ODeL environment, the adult learners in the study sample are expected to make use of the resources provided in this virtual and "loosely defined" learning materials (Botha & Coetzee, 2016). The findings of the current study may allude to the need for added student support in online learning environments in the form of e-learning support, tutorials, peer-led engagements and the involvement of students in the design of interventions (Cele, 2021).

The participants seemed to feel less confident about their graduateness which could be attributed by them being in the early phase of their careers. The present research may therefore be valuable in understanding the extent to which the development of psycho-technical learning capabilities and a self-directed learning orientation may help to enhance participants' graduateness skills and attributes. HEIs have a mandate to groom students by means of quality education and coordinated support to enhance the development of globally transferable competencies (Cele, 2021). A positive trend was the moderately high scores on continuous learning and goal-directed behaviour. These findings imply that the participants may be highly motivated to achieve success through their studies. Torun (2020) and Deci and Ryan (1985) postulate that motivation towards e-learning plays an important role in e-learning readiness when assessing academic achievement and satisfaction. Essentially, motivated students are more likely to yield better results in online learning environments (Baeten et al., 2016).

7.1.2 Discussion: research aim 1

This section discusses the results obtained for research aim 1.

Research aim 1: To operationalise the constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) into a valid and reliable measure.

Sub-aim 1.1: To assess the psychometric properties (internal consistency reliability and construct validity) of the newly developed Psycho-Technological Learning Capabilities Scale (PTLCS).

Sub-aim 1.2*:* To establish the nature of the interrelationships between the subscale dimensions (computer skills and internet self-efficacy) of the PTLCS.

Sub-aim 1.3**:** To establish the factorial equivalence (that is, measurement invariance) of the PTLCS for the various socio-biographical groups, namely age, gender and ethnicity.

The theoretical framework of the PTLCS was discussed in Chapter 3. The PTLCS was developed as a bi-factor scale comprising two second order factors (computer skills and internet self-efficacy). The development of the PTLCS involved the scale development process suggested by DeVellis (2003), namely (1) conceptualising the content domains of the scale and its subfactors (see Chapter 3); (2) generating and evaluating items (see Chapter 3); and (4) refining items (see Chapters 3 and 6). This process ensured that scientific rigour was applied in the development of the PTLCS. The EFA supported the presence of a general higher order and two secondary order factors. As shown in Figure 7.1, analysis of the EFA item factor loadings resulted in a bi-factor scale with two subfactors labelled as technological skills and technical self-efficacy. The original 16 items were reduced to 14 items after the EFA and further reduced to 12 items after the CFA that confirmed the bi-factor structure of the PTLCS.

Table 7.1

Revised Labels and Definitions of the 12-item PTLCS

PTLCS scale	**Definition**	**Number of items**	**Item number**
Higher order factor: Psycho-technological learning capability **Definition:** The psychological and technical learning capabilities of adult learners in ODeL environments			
Second order factor: technological skills	The student's ability to save and transfer files on electronic platforms; to use electronic search engines to find information and to unilaterally download software for a computer.	n = 7	1–7
Second order factor: technical self-efficacy	The student's confidence in searching, downloading and sharing information using electronic platforms, typing and uploading documents on electronic submission portals.	n = 5	8–12

Source: Author's own work

7.1.2.1 Evidence of the reliability and construct validity of the PTLCS

The results confirmed the construct validity and internal consistency reliability of the PTLCS. Rasch analysis indicated that the PTLCS is a valid and reliable scale that is useful for application in the ODeL setting. Rasch analysis also provided evidence of the unidimensionality (homogeneity) of the PTLCS. It was further important to assess for threats of bias, considering that data was collected at the same time from the same group of participants. The test for common method bias provided evidence of a lack of multicollinearity among the two subfactors of the PTLCS. The CFA further confirmed the convergent and discriminant validity of the PTLCS.

The uniqueness of the PTLCS in comparison with other similar scales such as the Internet Self-Efficacy Scale (Eastin & LaRose, 2000) and the 25-item instrument developed by Prinsloo and Van Rooyen (2007) seems evident in the sense that the PTLCS captures an evaluation of adult learners' self-perceived technological skills and technical self-efficacy in one instrument, holding general access to a computer and the internet as control variables. Additionally, the PTLCS encapsulates aspects of graduateness in that adult learners assess their information-searching skills and confidence in using technology-based resources. In line with the arguments of Aslan (2021), the PTLCS is a starting point for assessing adult learners' digital literacy, as they are required to have the ability to access, produce and share accurate information and use technology in the learning and teaching process in online learning environments.

The PTLCS appears to be useful in ODeL environments, as the instrument has been developed and validated within the multicultural South African context and Africa generally. The PTLCS may be pivotal in assisting prospective adult learners at ODeL institutions in assessing their readiness and confidence levels in their self-perceived technological skills and technical self-efficacy to successfully complete their online studies. Determining readiness levels with regard to e-learning is an important factor that institutions should explore as part of their strategies for successful practices in e-learning (Torun, 2020). Additionally, the PTLCS may assist in evaluating students' levels of self-perceived technological skills and technical self-efficacy to successfully complete their online studies (Lazim et al., 2021; Sagnier et al., 2020). Such self-evaluation will help to ensure that learners enter online learning environments with the knowledge of what will be required of them to successfully complete their studies. The HEI used in the current study is a mega university and is the only dedicated distance education institution on the African content (Letseka, 2021).

Research provides evidence of the importance of technological skills such as computer skills for optimal learning in ODeL contexts (İşman & Çelikli, 2009). Research further explains that students' internet or technical self-efficacy and beliefs about online learning are critical determinants of students' attitudes towards online learning (Madu et al., 2011; Nyoni, 2014; Porter & Donthu, 2006). The higher the confidence levels the learner has in using both a computer and the internet in their studies and the more self-directed they are, the more likely they are to develop their self-directed sense of graduateness. In this regard, the PTLCS would appear to be a useful and valuable measure to assess these learning capabilities of ODeL students. Isman and Celikli (2009) assert that many students are entering higher education and the workforce without basic computer literacy. In an online learning context, Isman and Celikli (2009) highlight that a lack of experience with technology affects students' level of technology self-efficacy, resulting in students experiencing high levels of anxiety related to technology use both in their studies and work context (Shu et al., 2011).

7.1.2.2 Evidence of lack of differential item functioning

The Rasch differential item functioning (DIF) results provided evidence of a lack of bias among the age groups (< 30 years and > 30 years), male and female participants and black and white participants in answering the items in the PTLCS. All groups found the items of the technological skills subscale relatively easy to endorse which suggests a lack of item bias.

Overall, the Rasch analysis provided support for an argument for generalisability validity by providing evidence of the absence of differential item functioning for age, gender and ethnic groups, and adequate item and person reliability estimates.

The different age, gender and ethnic groups appeared to have similar experiences of difficulty in answering two items on the technical self-efficacy subscale (i.e. *"I feel confident in downloading information from the internet for my assignments"*; and "*I am confident in sending emails generally"*). These findings point to the necessity for learning and development support by academics for their students. There is a plethora of studies investigating differences in gender with regard to internet and computer self-efficacy in online learning environments. Scherer and Siddiq (2015) explored the computer self-efficacy of teachers in performing basic and advanced tasks and found no significant differences among the gender groups. Sun et al. (2016) reported that there were no significant differences in internet self-efficacy among the gender groups within a sample of college students in Taiwan. Contrary to these findings, Cai et al. (2017) found that male students had a more positive attitude and higher levels of confidence towards using technology compared to their female counterparts. He and Freeman (2019) conducted a study amongst undergraduate college students and found that females were less confident with using computers and felt more anxious about using computers compared to their male counterparts. With online learning gaining momentum in the 4IR and becoming an essential part of acquiring academic and professional qualifications (Heckel & Ringeisen, 2019; Mian et al., 2020; Sato et al., 2017), students need to be confident with the technical features of online learning, namely in using a computer and the internet, in order to be successful within online learning environments (Heckel & Ringeisen, 2019; Vimalkumar et al., 2021; Wolverton et al., 2020).

The findings point to a possible lack of experience and less confidence in navigating one's way on the internet among the participants. This finding could be attributed to the fact that the majority of the participants were in the early adulthood phase and still need to learn to adjust to the use of technology in the ODeL environment. Kuo et al. (2014) and Eastin and LaRose (2000) highlight that internet or technical self-efficacy is positively related to internet experience and frequency of use. Essentially, the more an individual uses the internet and gains experience at navigating their way on the internet, the more likely their confidence levels will rise with regard to using the internet. Adult learners with a positive attitude towards technologies are more likely to have a higher internet self-efficacy compared to those who have a negative attitude in this regard (Kuo et al., 2014). Adult learners' confidence levels in performing internet-related tasks seem to influence their interaction with, amongst other things, the course content of an online programme (Eastin & LaRose, 2000). Sato et al. (2017) assert that although there are guidelines on online course development, these guidelines do not consider the unique needs of adult learners enrolled for online learning. As such, Shikulo and Lekhetho (2020) suggest that ODL institutions should provide effective support services to meet the academic needs of underprepared students to promote student persistence, and ultimately result in academic success.

The findings further indicate that participants' evaluations of their confidence to execute the tasks as measured by the two items *I feel confident in downloading information from the internet for my assignments,* and *I am confident in sending emails generally,* were mostly similar. Eastin and LaRose (2000) and Keshavarz (2020) highlight that internet self-efficacy (technical self-efficacy) is affected by age, gender education level, internet access and availability of computers. Essentially, African females (< 30 years), considered to be Generation Z, would find it relatively easier to download information for their assignments and to send emails. The difference may be attributed to the notion posed by Aslan (2021) that Generation Z uses technology products much more effectively that other generations, as they make portable technology products such as tablets, smart phones and computers a significant part of their lives. Essentially, the more an individual engages in activities involving the use of the internet, the more they become confident in executing internet-related activities (Keshavarz, 2020).

7.1.2.3 Evidence of factorial equivalence/measurement invariance

Assessing factorial equivalence or measurement invariance is essential in the diverse multicultural ODeL setting. Equivalence of measures points to a lack of bias and is a prerequisite for valid comparisons across age, gender and ethnic populations (Xu & Tracey, 2017). The results provided evidence that the factor structure of the PTLCS is the same for both the gender (men and women) and the ethnic (black and white participants) subgroups. The factor structure was not equivalent for the age groups (< 30; > 30 years), however. This finding signals that the same construct (psycho-technological learning capabilities) is measured across the gender and ethnic groups studied and points to the universal (i.e., gender and ethnic independent) validity of the underlying PTLCS construct.

The results further provided evidence of the metric invariance or measurement unit equivalence of the PTLCS for the age (<30; >30 years), gender (men and women), and ethnicity (black and white) groups. The findings suggest that the PTLCS construct and subfactors had the same meaning for the various groups and that the PTLCS may be confidently applied in multiculturally diverse ODeL environments.

However, the results showed absence of full-scale (or scalar) equivalence. Absence of scalar equivalence implies that caution should be taken when exploring the mean differences among the age, gender and ethnicity groups (Putnik & Bornstein, 2017). Further replication studies with a larger representation of age, gender and ethnic groups are recommended to further explore the full-scale equivalence of the PTLCS.

7.1.2.4 Main findings: synthesis

Overall, the results of the exploratory and confirmatory factor analysis revealed the psychometric properties of the PTLCS, the nature of the interrelationships between the subscale and the factorial structure of the PTLCS. The following key insights about the value of the PTLCS as a valid and reliable measure of technological skills and technical efficacy in the ODeL setting are highlighted:

- The PTLCS factorial structure fits the theoretical model and its two conceptual subdomains of technological skills and technical self-efficacy well.
- The notion of technical self-efficacy relates well to online and digital learning. Aslan (2021) asserts that self-efficacy is the learner’s belief in their ability to successfully manage situations that may contain new and unpredictable elements.

- Self-perceived technological skills denote confidence about the use of a computer and in mastering technological behaviours and outcomes within the ODeL technology environment (Hayashi et al., 2004; Hsia et al., 2014; Vimalkumar et al., 2021). Research shows that a lack of experience with technology results in students experiencing higher levels of anxiety related to technology use both in their studies and their work context (Isman & Celikli, 2009; Shu et al., 2011; Vimalkumar et al., 2021).
- The PTLCS has empirical support for an argument for generalisability validity because of the absence of differential item functioning for age, gender and ethnicity groups, and adequate item and person reliability estimates.
- The PTLCS shows evidence for the universal (i.e. gender and ethnicity independent) validity of the underlying PTLCS construct. The PTLCS construct and subfactors had the same meaning for the various groups. However, the absence of scalar equivalence implies that caution should be taken when exploring the mean differences among the age, gender and ethnicity groups for the sample of participants.
- Further replication studies with a larger representation of age, gender and ethnicity groups are recommended to further explore the full-scale equivalence of the PTLCS.

7.1.3 Discussion: research aim 2

This section discusses the results obtained for research aim 2.

Research aim 2: To investigate the nature, magnitude and direction of the relationship between psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS), socio-biographical characteristics (age, gender and ethnicity) and graduateness skills and attributes (as measured by the GSAS).

Generally, the results showed positive and significant associations between the participants' psycho-technological learning capabilities. Their self-directed learning orientation and graduateness skills and attributes. The overall measurement model indicated discriminant validity among these constructs and tests for common method bias on the three scales (PTLCS, ALSDS and GSAS) indicated lack of multicollinearity threats. The significant and positive associations between the variables warranted further statistical analyses.

The significant associations between psycho-technological learning capabilities, self -directed learning orientation and graduateness skills and attributes suggest that learning and mastering these attributes and capabilities are supportive of the graduateness and potential employability of the ODeL student. Hughes et al. (2021) emphasise digital connectivity and competence as critical in ensuring that people have access to decent work in the 4IR (Briede & Popova, 2020). Pertinent to the current study is the importance of adult learners' self-perceived technological skills and technical self-efficacy and a self-directed learning orientation to achieve academic success and graduateness in order to promote their employability in the 4IR. Burke et al. (2020) highlight the difference between naïve students (those who believe that they only need their degree to navigate the graduate labour market) and knowing students (students who believe that in addition to their degree they require resources and credentials to support the reduced buying power of their degrees in the graduate labour market). Burke et al. (2020) conclude that students need to understand and prepare for the graduate labour market in order to enjoy a smooth transition into this market. Briede and Popova (2020) concur with Burke et al. (2020) and assert that there is an increased demand for top skills as a result of the 4IR and new jobs and professional skills. Topical skills in every profession after 2022 will include analytical thinking and innovation; active learning and learning strategies; creativity, originality and initiative; technology design and programming; critical thinking and analysis; complex problem-solving; leadership and social influence; emotional intelligence; reasoning, problem-solving and ideation; systems analysis and evaluation (Briede & Popova, 2020).

With regard to age, no significant bivariate correlations were observed for any of the subscales of the PTLCS and the ALSDS, or the PTLCS with the GSAS. However, the study findings showed a **small** significant positive bivariate correlation between age and academic motivation subscale (the observable behaviour of adult learners that confirms the presence of at least some of the personal dispositions described by success orientation for ODeL) and overall ALSDS. Generally, age has not been found to influence academic motivation (Heo & Han, 2018). Studies have explored academic motivation as a separate construct in relation to adult learners' self-directed learning (Ghorbani et al., 2020), However, Kara et al. (2019) report generally that the academic motivation of adult learners is negatively affected by a lack of support from institutions and family; as well as the demands of the multiple roles that they play which may result in their online studies being viewed as an extra load. Kara et al. (2019) further emphasise that middle-aged adults in the 36 to 55 year age group tend to show less academic motivation due to their failure to balance their education and work, with married females with children experiencing more imbalance as they tend to focus on the family (Kara et al., 2019; Selwyn, 2011). Based on this backdrop, it is recommended that further studies be conducted to explore the relationship between age and the academic motivation subscale to either refute or confirm the findings of the current study.

With regard to gender, the study findings showed a small but significant negative correlation with the technical self-efficacy subscale (measure of the student's confidence in searching, downloading and sharing information using electronic platforms, typing and uploading documents on electronic submission portals) and overall PTLCS, as well as the success orientation subscale (which refers to the internal dispositions of adult learners that facilitate success) of the ALSDS. Additionally, the study findings showed that there was a small but significant negative correlation between gender and some of the GSAS, namely, the problem-solving skills subscale (the ability of the graduate employee to consider the complexities of the larger cultural, business and economic reality when attempting to deal with a problem or situation and to initiate the required changes in both their personal and work life), the enterprising skills subscale (which involves being adventurous and applying critical thinking, initiative and proactivity when engaging in economic activities) and the continuous learning skill subscale (refers to the graduates' cognitive meta-awareness and openness towards their own learning, willingness to proactively engage in acquiring new knowledge, skills and abilities throughout their lives and career in reaction to, and in anticipation of, changing technology and performance criteria). In their study, Botha and Coetzee (2017) reported that the male participants scored higher on entrepreneurial orientation, while Ismail (2017) reported that all the graduate skills and attribute subscales had the greatest influence on graduate employability combined with self-esteem capacities. Based on the review of the literature there is a dearth of studies exploring the influence of socio-biographical variables on PTLCS, ALSDS and GSAS.

7.1.4 Discussion: Research aim 3

This section discusses the results obtained for research aim 3.

Research aim 3: To assess whether psycho-technological learning capabilities and a self-directed learning orientation significantly predict graduateness skills and attributes.

The results indicated gender and ethnicity as important control variables to consider in enhancing participants' graduateness skills and attributes. Botha and Coetzee (2017) highlighted that there is a dearth of research especially in South Africa on socio-biographical elements such as age, gender and race. However, Botha and Coetzee (2017) reported that there were significant differences between various gender, race and age groups in the subscales of the employability attributes framework of entrepreneurial orientation, proactivity, career resilience, cultural competence, sociability and self-efficacy. These findings warranted exploring the moderating effect of the variables (see research aim 4).

As expected, access to the internet was an important predictor of ODeL students' graduateness skills and attributes. A positive attitude towards the use of email and internet-based activities has been found to have an impact on academic performance in online learning environments (Nketiah-Amponsah et al., 2017). Romero Martinez et al. (2020) assert that positive attitudes towards ICT reflect a valuable field of study for education, considering how technology has cascaded to the education environments, with adult learners having to accept technology in such environments (Sagnier et al., 2020). Adult learners therefore need to be confident in their technical self-efficacy in order to succeed in their online studies (Landrum, 2020; Nyoni, 2014; Sagnier et al., 2020; Taat & Francis, 2020) so as to subsequently develop the graduateness skills and attributes required in the 4IR (Coetzee, 2014; Green at el., 2014; Kreber, 2014; Metcalfe et al., 2020; Mian et al., 2020; Osborne et al., 2014)

Technical self-efficacy (the student's confidence in searching, downloading and sharing information using electronic platforms, typing and uploading documents on electronic submission portals) appeared to be a more significant and positive predictor of participants' graduateness skills and attributes than their technological skills (the student's ability to save and transfer files on electronic platforms; to use electronic search engines to find information and to unilaterally download software for a computer). These findings could be attributed to the rise in internet-based activities (Chu & Tsai, 2009) propelled by the 4IR (Mian et al., 2020; Sagnier et al., 2020).

Academic activity (the intentional activity of an adult learner to engage in academic activity that is directly related either to them furthering their studies or improving their knowledge and skills), success orientation (refers to the internal dispositions of adult learners that facilitate success) and academic motivation (the observable behaviour of adult learners that confirms the presence of at least some of the personal dispositions described by success orientation for ODeL) also positively explained the participants' levels of self-perceived graduateness skills and attributes. Overall, self-directed success orientation and academic motivation were the strongest predictors of heightening levels of self-perceived graduateness skills and attributes. The findings could be attributed to the determination that adult learners possess to remain motivated in order to successfully complete their studies (Botha & Coetzee, 2017). ODeL HEIs will have to ensure that adult learners are provided with sufficient support and resources to remain motivated in their studies until completion.

In summary, the adult learners in this study reported that technical self-efficacy, academic activity, success orientation and academic motivation were important for developing their graduateness and employability. Wolverton et al. (2020) assert that instructors in online learning environments will have to devote time during orientation programmes to sensitise adult learners to the importance of using technology to facilitate greater computer self-efficacy, and to provide feedback to adult learners while also providing meaningful course material to enhance a positive course experience and a sustained throughput (Sato et al., 2017).

7.1.5 Discussion: research aim 4

This section discusses the results obtained for research aim 4.

Research aim 4: To assess whether socio-biographical characteristics, namely age, gender and ethnicity, significantly moderate the relationship between (1) psycho-technological learning capabilities, (2) self-directed learning orientation, and graduateness skills and attributes.

The results suggested that only ethnicity moderates the prediction effect of participants' psycho-technological learning capabilities on their self-perceived graduateness skills and attributes. Ethnicity had a negative interaction effect, suggesting that the interaction effect was conditional on the differing mean scores of black and white participants. Research aim 5 explored the significant mean differences between black and white participants.

The results indicated that for the white participants, **high scores** on psycho-technical learning capabilities (i.e. technological skills and technical self-efficacy) were associated with relatively high scores on graduateness skills and attributes. For black participants, **high scores** on psycho-technical learning capabilities were associated with relatively low moderate scores on graduateness skills and attributes.

For white participants, **low scores** on psycho-technical learning capabilities (i.e. technological skills and technical self-efficacy) were associated with relatively low scores on graduateness skills and attributes. However, for black participants, **low scores** on psycho-technical learning capabilities were associated with relatively high scores on graduateness skills and attributes. The result suggests that for white participants psycho-technical learning capabilities predict their graduateness skills and attributes. This may be associated with their perceived employability, while the black participants seemingly do not align their graduateness skills and attributes and employability with their levels of psycho-technical learning capability.

This finding indicates the possible disparity in economic status in that the white participants may seemingly be more economically favoured to develop skills in using a computer and the internet and are exposed to resources that can promote their graduateness compared to the black participants. Although the black participants scored high on psycho-technical learning capabilities, it is likely that these participants have access to these resources in the work environment. Cai et al. (2017) found that males generally showed a more favourable attitude towards technology use than females. Boeren (2011) found that men participate in online learning because of work, while females engage in online learning for personal reasons. With this in mind, it will be helpful for ODeL institutions to focus their strategies on providing more support for learners, as the majority of students are female. Strategies may include basic computer literacy skills to build their confidence in using technology for their online studies.

Counterintuitively, neither age nor gender had any interaction effect with either psycho-technological learning capability or self-directed learning orientation in predicting graduateness skills and attributes. Scholars have noted that women do not tend to pursue work-related opportunities as they perceive themselves to be less employable (Boeren, 2011) and are more negative about their career prospects (Coetzee, 2012b). This finding warrants further exploration in future research to either validate or add to the findings of the current study.

Overall, the results suggested that only ethnicity moderates the prediction effect of participants' psycho-technological learning capabilities on their self-perceived graduateness skills and attributes. Cai et al. (2017) suggest that the differences in attitude with regard to the use of technology could be as a result of multiple factors, including the general conceptions that technology is a male-dominated arena, that males are more competent users of technology, and other social and cultural norms and factors. It would be imperative for ODeL institutions to consider policies and educational opportunities to counteract any unfavourable cultural or social preconceptions about technology, focusing on young girls, so as to help females to develop a positive attitude towards using technology (Cai et al., 2017).

7.1.6 Discussion: research aim 5

This section discusses the results obtained for research aim 5.

Research aim 5: To determine whether students from different socio-biographical groups, namely age, gender and ethnicity differ significantly regarding their psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS) and graduateness skills and attributes (as measured by the GSAS).

7.1.6.1 Age

In the current study, the *t*-test procedure and mean scores between age with regard to psycho-technological learning capabilities (technological skills and technical self-efficacy), self-directedness learning orientation-related variables (ALSDS) and the graduateness skills and attributes-related variables (GSAS) did not report any significant differences. The findings could be attributed to the fact that all students, specifically in the online modules included in this study, had to use a computer and internet to access their study material and complete their online assessments.

7.1.6.2 Gender

The study sample showed significant mean differences for the gender groups on success orientation (refers to the internal dispositions of adult learners that facilitate success) and enterprising skills (involve being adventurous and applying critical thinking, initiative and proactivity when engaging in economic activities).

Coetzee (2012a) found that the higher the enterprising skills, the more ODeL students engaged in economic activity which subsequently leads to higher levels of job satisfaction. The male participants also reported higher levels of interactive skills and continuous learning compared to the female participants. Essentially, the male participants seemed to believe that their attitudes and beliefs to influence others (interactive skills) will assist them in making career-related decisions that will subsequently promote their employability (Ismail, 2017). Furthermore, the male participants seemed to believe that they can adapt to situations and promote their graduateness and possible employability through continuous learning (Coetzee et al., 2015)

Overall, the results showed that the male participants scored significantly higher than the female participants regarding their psycho-technological learning capabilities. Essentially, male participants appeared to embrace technology and online learning more than their female counterparts. He and Freeman (2019) found that female students felt less confident about their skills to use a computer because they practised less than men and generally felt more anxious than males when using computers. ODeL institutions may accordingly consider exploring is the needs of these students and design strategies that will address the student’s own learning objectives and learning needs within the e-learning environment (Torun, 2020).

7.1.6.3 Ethnicity

The results showed that the black participants had lower levels of confidence in their psycho-technological learning capabilities such as technological skills and technical self-efficacy than their white counterparts. Low levels of technological skills and technical self-efficacy mean that adult learners have low confidence levels when saving and transferring files on electronic platforms, using electronic search engines to find information and unilaterally downloading software for a computer. With regard to technical self-efficacy, the findings indicate that adult learners in the study had low confidence levels in searching, downloading and sharing information using electronic platforms, as well as typing and uploading documents on electronic submission portals. The black participants also indicated having less access to the internet than the white participants, which could explain their lower levels of confidence regarding their psycho-technological learning capabilities. However, the black participants showed higher levels of confidence than the white participants in their continuous learning orientation. Vimalkumar et al. (2021) postulate that the explanation of personal factors such as age, income and educational factors in understanding the differing perception on the use of technology between gender and ethnicity groups remains largely under researched. Cele (2021) attempts to address this concern by proposing that universities should implement a system that involves understanding students’ personal background, course performance scores and cohort analysis to design more appropriate interventions to succinctly address students’ needs.

The white participants also seemed to have more confidence in demonstrating ethical behaviour that their black counterparts. Ethical behaviour means students take full responsibility for the consequences of their decisions and actions, as well as uphold the ethical code and values of the profession, community and workplace. ODeL institutions will have to embark on strategies to sensitise learners to behave in an ethical manner. Ethical behaviour not only resonates with their graduateness but also in how students behave while using the internet. Wang et al. (2020) highlight that with the emergence of internet technology, internet ethics has become a topical issue for both academics and practitioners. Unethical use of the internet, particularly in the education space, includes concerns such a plagiarism, piracy, dishonesty, falsification, and the misuse of academic material (Wang et al., 2020). To promote the graduateness of adult learners with specific reference to ethical behaviour, ODeL institutions should design policies and offer programmes to sensitise students to ethical behaviour in general and internet ethical behaviour in particular to avoid students engaging in unethical behaviour.

However, considering the lack of scalar equivalence of the PTLCS alludes to caution in interpreting the significant mean differences among the biographical groups for the present sample.

7.2 CONCLUSIONS: LITERATURE REVIEW

This section highlights the conclusions based on the literature research according to the research aims, as outlined in Chapter 1.

The general aim of this research was to operationalise the various constructs that constitute psycho-technological learning capabilities, namely computer and internet self-efficacy (as measured by the newly developed PTLCS), into a valid and reliable measure and to explore the relationship dynamics between ODeL students' psycho-technological learning capabilities, self-directed learning orientation, socio-biographical characteristics (i.e. age, gender and ethnicity) and their graduateness skills and attributes. The research also aimed to establish and conceptualise the graduateness of adult learners, the constructs that constitute psycho-technological learning capabilities (computer and internet self-efficacy) and a self-directed learning orientation from a theoretical perspective. The theoretical relationship dynamics between psycho-technological learning capabilities (computer and internet self-efficacy), self-directed learning orientation and graduateness and how the socio-biographical characteristics (i.e. age, gender and ethnicity) influence these constructs were also conceptualised in the research literature. Furthermore, the research aimed to outline the implications of the relationship between psycho-technological learning capabilities (computer and internet self-efficacy), self-directed learning orientation and graduateness for online learning design practices for enabling adult learner graduateness and employability of adult learners.

Psycho-technological learning capabilities encapsulate adult learners' perceived psychological and technical capabilities (skills to use a computer and self-efficacy in using the internet) to successfully achieve their academic goals in e-learning environments. The conceptualisation of the constructs of psycho-technological learning capabilities were subsequently informed by human agency and social cognitive theory (Bandura, 1977, 1982). Essentially, in pursuing e-learning adult learners must have confidence in their ability to use a computer (Kuo et al., 2020) and to execute internet-related tasks (Eastin & LaRose, 2000; Kuo et al., 2014, 2020; Romero Martinez et al., 2020).

Pertinent to the literature review are the contributions of Bandura's (1989) human agency perspective on the social cognitive theory and Knowles' (1975) theory on andragogy and subsequent self-directed learning orientation (Botha, 2014). As elicited from the literature, in order for online learners to be successful in ODeL environments, they must have confidence and belief in their ability to use a computer and the internet, to work autonomously and take the initiative and responsibility for their studies (Andradea & Bunker, 2009; Blaschke, 2012; Botha, 2014; Knowles, 1975, 1990; Lin et al., 2020; Mclean, 2016). Essentially, individuals who have a positive attitude towards technologies are more likely to have greater internet self-efficacy compared to those who have a negative attitude towards technologies (Kuo et al., 2014; Rafiola et al., 2020). Additionally, if an individual has a positive evaluation of their confidence in using a computer (computer self-efficacy) they are more likely to view e-learning with ease and perceive their interaction with a computer system as low effort (Thongsri et al., 2020).

As the current study focuses on adult learners, a review of the literature on self-directedness and the principles of andragogy was conducted. In the context of online learning, varying views were identified with regard to the importance of self-directed learning (Gokcearslan, 2017). The model developed by Botha (2014) and Coetzee and Botha (2013) was deemed relevant to the current study as it is based on four cognitive-behavioural dimensions that can be used to conceptualise a self-directedness learning orientation within the HE and ODeL context in a multicultural South Africa.

The 4IR and the digital age have resulted in ICTs playing a major role in people’s lives (Mian et al., 2020). The increase in the use of ICTs has cascaded down to the education environment with adult learners having to be agile in embracing technology in their learning process (Sagnier et al., 2020). In response to this trend, the principles of the TAM, as conceptualised by Davis in 1989, were relevant to the current study. The construct of “perceived ease of use” was also pertinent to the current study, as adult learners need to perceive technology to be low effort in order to embrace it and successfully engage in e-learning (Lazim et al., 2021; Sagnier et al., 2020).

Industry 4.0 has inadvertently had an impact on everyone across all spheres of life (Briede & Popova, 2020; Mian et al., 2020), influencing the skills demands of the knowledge economy (Burke et al., 2020). The changes that have been brought about by Industry 4.0 have inadvertently increased the use of technology, meaning that graduates entering the 21st century world of work in the digital era must have the skillset required by the labour market (Burke et al., 2020). Tseng et al. (2020), Oz and Ozdamar (2020) and Xing and Marwala (2017) highlight that adult learners in the digital era need to possess a specific skillset relevant to the digital era in order to ensure their employability. Therefore, graduates need to formulate their employability identity so as to present themselves as relevant to both employers and to society (Tomlinson & Anderson, 2020).

The following section provides conclusions on the empirical aims and the research hypotheses underpinning the study.

7.3 CONCLUSIONS: EMPIRICAL STUDY

The following section provides conclusions on the empirical aims and the research hypotheses underpinning the study.

7.3.1 Conclusions regarding the research aims

7.3.1.1 Conclusions regarding research aim 1

Empirical research aim 1 was to operationalise constructs that constitute psycho-technological learning capabilities (computer skills and internet self-efficacy) into a valid and reliable measure, namely the PTLCS. The following empirical research sub-aims were formulated for research aim 1:

Sub-aim 1.1: To assess the psychometric properties (internal consistency reliability and construct validity) of the newly developed PTLCS.

Sub-aim 1.2*:* To establish the nature of the interrelationships between the subscale dimensions (computer skills and internet self-efficacy) of the PTLCS.

Sub-aim 1.3**:** To establish the factorial equivalence (i.e. measurement invariance) of the PTLCS for the various socio-biographical groups, namely age, gender and ethnicity.

The first aim was achieved in Chapter 6, which provided supportive evidence for research hypothesis 1 (H1).

Based on the empirical results, the following core conclusions were drawn:

- The PTLCS is a valid and reliable assessment instrument to measure the psychological and technical learning skills of adult learners in an ODeL HEI within the multicultural South African context.
- Valid inferences may be made on students' confidence levels in some items of technical self-efficacy, namely, in downloading information from the internet for their assignments and in sending emails. The study sample showed lower confidence levels indicating possible challenges experienced by adult learners in ODeL. As such, these findings may assist academics in ODeL HEIs to provide support for adult learners in the form of detailed guidelines on how they can develop their technical self-efficacy.

7.3.1.2 Conclusions regarding research aim 2

Research aim 2: To investigate the nature, magnitude and direction of the relationship between psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS), socio-biographical characteristics (age, gender and ethnicity) and graduateness skills and attributes (as measured by the GSAS).

The second aim was achieved in Chapter 6, which provided supportive evidence for research hypothesis 2 (H2).

The study findings indicate that students' psycho-technological learning capabilities, adult learning orientation and graduateness skills and attributes are significantly related. Based on these findings inferences can be made on the development of online material specifically for ODeL environments. Academics and practitioners in the development of learning material for online learning may consider including activities that not only promote the development of adult learners' confidence levels in their technical self-efficacy and technological skills, but also encourage the development of their self-directed learning orientation in order to promote overall graduateness. Activities should therefore be practical and tap into the real-life experiences of the adult learners to ensure that the learning experience is meaningful to them.

Inferences can be made on the focus of support strategies in that academics and practitioners provide support for adult learners pursuing further studies in ODeL HEIs by providing access to the internet and a computer and providing detailed guidelines on basic computer literacy skills for students. Additionally, HEIs providing ODeL should offer basic computer literacy courses or presentations to sensitise students to the way they can develop their confidence levels in using a computer for their studies.

7.3.1.3 Conclusions regarding research aim 3

Research aim 3: To assess whether psycho-technological learning capabilities and self-directed learning orientation significantly predict graduateness skills and attributes.

The third aim was achieved in Chapter 6, which provided supportive evidence for research hypothesis 3 (H3).

Based on the empirical results, it can be inferred that the students' self-evaluation of their psycho-technological learning capabilities (access to the internet and technical self-efficacy) and self-directed learning orientation (academic activity; success orientation and academic motivation) significantly explain their graduateness skills and attributes generally. To enhance the graduateness of adult learners, support should be provided regarding access to the internet and possible tutorials on basic computer literacy skills. Additionally, practitioners and professionals in HEIs offering ODeL may include assessment activities that will keep adult learners engaged and motivated in their studies. Lastly, the manner in which feedback is provide to students can be re-visited. In order for students to make meaning of their learning, practitioners in HEIs could consider providing timely and meaningful feedback. This may encourage students to engage with the feedback which, in turn, may result in them succeeding in the modules undertaken and subsequently completing their studies.

7.3.1.4 Conclusions regarding research aim 4:

Research aim 4: To assess whether socio-biographical characteristics, namely age, gender and ethnicity, significantly moderate the relationship between (1) psycho-technological learning capabilities, (2) self-directed learning orientation, and graduateness skills and attributes.

The fourth aim was achieved in Chapter 6, which provided practical supportive evidence for research hypothesis 4 (H4).

The study findings indicate that white participants believed that their psycho-technical learning capabilities predict their graduateness skills and attributes, while the black participants did not align their graduateness skills and attributes and employability with their levels of psycho-technical learning capabilities. Inferences can be made that practitioners in HEIs need to provide students with more information on the importance of having basic competence in the use of computers and the internet in the 4IR. Adult learners' psycho-technological learning capabilities (technological skills and technical self-efficacy) promotes graduateness and employability; accordingly, support services developed and implemented by HEIs offering ODeL should consider the influencing role of ethnicity and socio-cultural background when assessing students' levels of psycho-technological learning capability.

7.3.1.5 Conclusions regarding research aim 5:

Research aim 5: To determine whether students from different socio-biographical groups, namely age, gender and ethnicity, differ significantly regarding their psycho-technological learning capabilities (as measured by the PTLCS), self-directed learning orientation (as measured by the ALSDS) and graduateness skills and attributes (as measured by the GSAS).

The fifth aim was achieved in Chapter 6, which provided partial supportive evidence for research hypothesis 5 (H5).

The study findings indicate that ethnicity influences the way in which adult learners perceive their self-directed learning orientation and psycho-technological learning capabilities. The black participants seemed determined to succeed in their studies, while the white participants seemed open to new learning experiences and had higher confidence levels in using computers and performing internet-based tasks. Essentially, practitioners and academics in HEIs offering ODeL should consider the ethnicity and socio-cultural background of the students when designing learning material and assessment activities.

7.4 LIMITATIONS

The limitations of the literature review and the empirical study are discussed below.

7.4.1 Limitations of literature review

The exploratory research into the psycho-technological learning capabilities of adult learners, self-directed learning orientation and graduateness and sociodemographic characteristics (age, gender, and ethnicity) in the South African context was limited by the following factors:

- There is a paucity of studies exploring psycho-technological learning capabilities, namely, technological skills and technical self-efficacy, in ODeL environments in HEIs offering online courses. For this reason, the study was unable to provide a holistic indication of other factors that could influence the definition of psycho-technological learning capabilities of adult learners in ODeL in South African higher education institutions.
- There is a paucity of studies within the South African context exploring the self-directed learning orientation and graduateness of adult learners. The dearth in research also had an impact on the discussion on the influence of sociodemographic factors on these variables. As such, the discussion on the effect of the sociodemographic factors on these variables was based on the available studies in South Africa and those conducted globally.

7.4.2 Limitations of research design

The generalisability of the findings could be limited for the following reasons:

- Although the sample consisted of N = 378 participants, a larger sample would be required to establish a definite relationship between the PTLCS, ALSDS and GSAS and the socio-biographical variables in this study. In addition, the findings can only be generalised to the group of participants.
- In the current study there was an absence of full-scale (or scalar) equivalence in the PTLCS. It is recommended that further studies be conducted with larger representations of age, gender and ethnic groups to further explore the full-scale equivalence of the PTLCS, in order to test for meaningful differences among age, gender and ethnicity groups in larger populations.
- The socio-biographical variables explored in the current study were limited to age, gender and ethnicity. Owing to a dearth of research exploring the influence of socio-biographical variables on the PTLCS, ALSDS and GSAS, it is recommended that studies be conducted among larger study populations in different HEI contexts to explore and ascertain the influences of these socio-biographical variables as reported in the current study. Furthermore, other socio-biographical variables, such as employment status, geographic location and income status, may be considered to ascertain whether they have a different influence on the research findings.
- Common method bias was noted for both the ALSDS and GSAS, which was considered in the interpretation of the study findings.

- Tests for the construct validity of the ALDS and GSAS indicated a less optimal fit with the data in the current study. As such, caution was exercised in the interpretation of findings in relation to the construct validity of both the ALSDS and GSAS.
- In the current study, low internal consistency reliability coefficients were reported for two of the ALSDS subscales, namely, academic activity, and resource utilisation and academic motivation. Accordingly, caution was exercised in the interpretation of findings in relation to the reliability coefficients of these subscales.
- The current study adopted a cross-sectional research design. Because of this the researcher was unable to control the research variables thereby restricting the evaluation of causality in the significant relationships.
- In the current study the predictive validity of PTLCS was tested only in terms of the GSAS. Further studies could test the predictive validity of the PTLCS in relation to both the ALSDS and the GSAS. More studies need to be conducted to further test the discriminant and predictive validity of the PTLCS in relation to other technology acceptance scales and socio-biographical variables.
- Lastly, the current study was conducted at only one ODeL higher educational institution. The study could have provided more value had more ODeL HEIs been involved in the study.

Taking the above-mentioned limitations into account, the study still showed the potential of developing the PTLCS for adult learners in an ODeL higher educational institution within the South African context. The results of this study could be regarded as a first step in stimulating and advancing further research into the psycho-technological learning capabilities of adult learners in ODeL environments.

7.5 RECOMMENDATIONS

The following section provides the recommendations, based on the study findings, for future research and for practice.

7.5.1 Recommendations for research

The following section provides recommendations, based on the current study findings, for future research.

In the current study, the results revealed an absence of full-scale (or scalar) equivalence, meaning that caution should be taken when exploring the mean differences among the age, gender and ethnic groups. Further replication studies with larger representations of age, gender and ethnicity groups are recommended to further explore the full-scale equivalence of the newly developed PTLCS.

The current study reported limited influence of the socio-biographical variables on the PTLCS, ALSDS and GSAS. In South Africa, there is a dearth of research on the influence of these elements on the constructs underpinning the current study. It is recommended that further studies be conducted to explore the test discriminant and predictive validity of the PTLCS in relation to other technology acceptance scales and also to assess the influence of socio-biographical variables on the PTLCS, ALSD and GSAS in ODeL environments.

The current study consisted of first year students comprising the study sample. Considering that the university under study has implemented online learning at a university wide scale in response to the challenges posed by Covid-19, it would be valuable to replicate the current study with 2nd and 3rd year students. Using a different cohort of students may provide valuable information in further validating the PTLCS.

7.5.2 Recommendations for practice

This section makes recommendations, based on the current study findings, for practice.

The current study found that participants from the different age, gender and ethnic groups seemed to have similar experiences of difficulty with regard to their technical self-efficacy, namely, their confidence in downloading information from the internet and in sending emails generally. Nketiah-Amponsah et al. (2017) reported similar findings in their study among university students in Accra. A positive attitude toward the use of email was found have a positive impact on the learners' academic performance. The findings point to a possible lack of experience and less confidence in navigating one's way on the internet. ODeL institutions should consider providing effective support to meet the unpreparedness of students (Shikulo & Lekhetho, 2020) by offering basic computer and literacy skills online. Additionally, ODeL institutions should consider providing support in the form of access to a computer and the internet to assist students to bridge the gap in access to basic resources for online learning.

To encourage adult learners to stay focused and motivated in their online studies, ODeL institutions should consider providing support in the form of guidance on time management and effective learning strategies, as well as how to handle frequently faced technical challenges so as not to become despondent in their studies. Sato et al. (2017) propose strategies such as orientation programmes, student guides and ongoing support and guidance.

7.6 EVALUATION OF CONTRIBUTION

The following section provides an evaluation of the contribution of the current study to theory and the subject field, as well as to research and practice and to the doctorateness and graduateness of the researcher.

7.6.1 Contribution to theory and subject field

At a theoretical level, the study contributed by revealing the theoretical elements of psycho-technological learning capabilities (technological skills and technical self-efficacy) in order to be able to construct the PTLCS. From the review and synthesis of the literature, it was established that it is essential for adult learners to not only develop but also to have high self-evaluations of their psycho-technological learning capabilities (technological skills and technical self-efficacy) so as to both complete their online studies successfully and to enhance their graduateness and employability. This finding is in line with postulations by Bandura (1977) in that positive beliefs about one's capabilities positively influence one's behaviour to perform an activity. The literature revealed that a relationship exists between the constructs of psycho-technological learning capabilities (technological skills and technical self-efficacy), adult learner self-directed learning orientation and graduateness. The literature review indicated that the socio-biographical variables of age, gender and ethnicity could act as predictors of adult learners' psycho-technological learning capabilities, self-directed learning orientation and graduateness.

More specifically, the conceptualisation of the constructs of the PTLCS and the findings of the current study corroborated various propositions on the measurements of psycho-technological learning capabilities (technological skills and technical self-efficacy). With a further review of the literature, it was established that adult learners who accept the use of technology in their studies and have a positive self-evaluation of their technological competencies tend to complete their studies successfully. Successful completion of their studies not only enhances their graduateness but also promotes the employability of adult learners in the technologically driven world of work.

7.6.2 Contribution to research

At an empirical level, the findings of the current study provide valuable contributions based on the recommendations which are underpinned by the empirically tested, validated and operationalised theoretical elements of psycho-technological learning capabilities (as measured by the newly developed PTLCS). The newly developed PTLCS is an instrument that will provide industrial and organisational psychologists and learning and development practitioners with a reliable and valid measurement scale that can be used to assess the level, direction and magnitude of the statistical inter-relationships of the elements of the psycho-technological learning capabilities (technological skills and technical self-efficacy) of adult learners.

Furthermore, the current study took into account the cultural and generational diversity of the adult learners in the study sample in the HEI under study by empirically investigating the individuals from different age, gender and ethnicity groups to ascertain differences with regard to psycho-technological learning capabilities, self-directed learning orientation and graduateness skills and attributes. The findings revealed statistically significant differences in gender and ethnicity groups, with recommendations being made on how adult learners can be assisted in developing their psycho-technological learning capabilities (technological skills and technical self-efficacy) and self-directed learning orientation with the aim of promoting their graduateness and employability in the contemporary world of work.

Lastly, the empirically tested and newly developed PTLCS may be used for future research to assist in providing support to students in the ODeL included in the current study. This will support the significance of conducting such a study, ultimately adding to the existing and growing body of research on the psycho-technological learning capabilities of online learners in ODeL contexts as well as employability in the contemporary world of work and Industry 4.0.

7.6.3 Contribution to practice

On a practical level, this study promoted a better understanding of the concepts of psycho-technological learning capabilities (technological skills and technical self-efficacy), self-directed learning orientation and graduateness skills and attributes as well as the importance and influence of the socio-biographical variables, namely, age, gender and ethnicity.

The newly developed PTLCS provides a starting point for adult learners, academics and learning and development practitioners to understand the unique skills required by adult learners in distance and online learning environments. The study provides insights on the practical and academic support strategies that can be explored and implemented to provide more support for adult learners to assist them in successfully completing their studies. Additionally, the findings point to the need for experts in the field of Industrial and Organisational Psychology and career guidance to understand the employability attributes required by university graduates for Industry 4.0.

7.6.4 Contribution to my doctorateness and graduateness

Throughout this study, the researcher, in her personal capacity, was able to

- acquire knowledge and a systematic understanding of the field of research, especially in terms of the psychological and technical learning capabilities of adult learners in a ODeL HEI
- engage in academic exploration by reading widely and critically examining new and complex phenomena, issues and situations especially concerning the conceptualisation and empirical operationalisation of the constructs of the PTLCS
- follow a systematic process to set goals, to evaluate time constraints and to plan for them
- identify and formulate issues, work independently and creatively, and plan and conduct research using appropriate methods within specified time limits
- work confidently and adapt to changing circumstances and opportunities
- develop and grow at a personal level and in terms of psychological and spiritual awareness
- identify internal motivators and develop determination, especially in the final year, to complete the study successfully, with a sustained level of patience, commitment and passion for the field of study
- appreciate professionalism, collegiality and care from colleagues and peers in the completion of the study, and

- reflect on and appreciate personal experiences of graduateness as an adult learner and enhancing skills to manage and recover from setbacks to achieve the ultimate goal.

In terms of the role of an academic, the journey of conducting and writing up the study contributed to the development of

- in-depth knowledge of research practices, processes and theory
- critical and higher-order conceptual thinking skills
- ethical behaviour in personal and professional interactions
- knowledge and respect for individual differences and diversity in the practice of industrial and organisational psychology
- a comprehensive understanding and application of research and theory, and
- respect for and a deeper understanding of the supervisor–student relationship and challenges and hurdles throughout this journey.

In terms of the role of industrial and organisational psychologist, the study contributed to the development of

- expertise in the development of a psycho-technological learning capabilities scale within the South African context
- knowledge relating to the constructs of psycho-technological learning capabilities of adult learners, namely technological skills and technical self-efficacy, and adult learners' self-directed learning orientation in relation to their graduateness and subsequent employability
- a deeper understanding of the impact of the technological advancements and demands of Industry 4.0 in relation to career guidance and counselling
- critical skills in planning and organising, writing and reporting
- the unique contribution of the newly developed PTLCS to understand the psychological and technological learning needs and skills required by adult learners in online learning.

To conclude, the researcher is optimistic that the study findings will contribute to the development of a deeper understanding and awareness in the field of research and education and in other advanced professional contexts. The findings of the study could also be used to raise awareness of the support adult learners require to successfully complete their online studies, thereby promoting their graduateness and subsequent employability. It is hoped that the study will inspire other scholars and practitioners in the academic fraternity to build on the research and further extend knowledge on ways to understand the psychological and technological learning capabilities of adult learners in online learning environments so at to provide support for these learners in their academic journey to enhance their graduateness and employability.

7.7 SYNTHESIS AND CONCLUSION

This study investigated the theoretical elements of psycho-technological learning capabilities (technological skills and technical self-efficacy) and operationalised these elements into a reliable and valid scale, the PTLCS. The newly developed PTLCS was used to ascertain whether a relationship exists between psycho-technological learning capabilities (technological skills and technical self-efficacy), self-directed learning orientation, socio-biographical characteristics (age, gender and ethnicity) and graduateness skills and attributes. The findings showed that there is a relationship between these variables and their potential contribution to enhancing the graduateness and employability of adult learners within a ODeL HEI.

In the context of the current study, the development of the PTLCS highlighted the unique relationship dynamics between the various constructs. The development of the scale provided insight that contributed to a clearer understanding of the psycho-technological learning capabilities (technological skills and technical self-efficacy), self-directed learning orientation, socio-biographical characteristics (age, gender, and ethnicity) and graduateness skills and attributes. In terms of the current study, the development of the PTLCS also showed the skills required by graduates and adult learners in the fast-paced, technologically advanced world of work.

7.8 CHAPTER SUMMARY

In this chapter, the research findings were discussed and integrated. This was followed by a discussion of the conclusions of the research in terms of the theoretical and empirical aims. Potential limitations and recommendations for future research were also expatiated. The chapter concluded with the contributions of the study, and a reflection on the researchers’ doctorateness.

This chapter achieved the following research aim:

Research aim 6: To formulate conclusions and recommendations for future research and online learning and development practices for enabling adult learners’ graduateness.

This concludes the research project.

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APPENDIX A: Ethical Clearance Certificate – CEMS_IOP_019_Cebile Mensele

UNISA university of south africa

CEMS/IOP RESEARCH ETHICS REVIEW COMMITTEE

07 November 2014

Ref #: **2014/CEMS/IOP/019**
Name of applicant: **Cebile Mensele**
Student #: **32469268**
Staff #:

Dear Cebile Mensele,

Decision: Ethics Approval

Name:	**Mrs Cebile Mensele** **AJH van Der Walt Building, Office 03-75** **Department of Industrial and Organisational Psychology** **College of Economic and Management Sciences** **University of South Africa**
E-mail:	tebelc@unisa.ac.za
Tel:	(012) 429 8809/ 082 724 7511
Supervisor:	Prof M Coetzee
Proposal:	**Development and validation of a measure for assessing the psycho-technological learning capabilities of open and distance online learners.**

Qualification: DCOM IOP

Thank you for the application for research ethics clearance by the **CEMS/IOP** Research Ethics Review Committee for the above mentioned research. Final approval is granted.

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the **CEMS/IOP ETHICS COMMITTEE** *on 07 November 2014.*

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The proposed research may now commence with the proviso that:

1) *The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*
2) *Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the (CEMS/IOP Ethics committee) Ethics Review Committee. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.*
3) *The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.*
4) *[Stipulate any reporting requirements if applicable].*

Note:

The reference number **[#2014/CEMS/IOP/019]** *should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the CEMS/IOP Ethics committee.*

Kind regards,

DR O LEDIMO
Chairperson: IOP Ethics Committee
College of Economic & Management Science
Science
Tel: +27 012 429 8278

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APPENDIX B: Ethical Clearance Certificate – 2015_RPSC_010_ Mensele Cebile Approval Certificate (SRIHDC)

UNISA university of south africa

RESEARCH PERMISSION SUB-COMMITTEE OF SRIHDC

16 February 2015

Ref #: 2015_RPSC_010
Mrs Cebile Mensele
Student #: 32469268
Staff #: 90172795

Dear Mrs Cebile Mensele,

Decision: Research Permission Approval

Name: Mrs Cebile Mensele
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Supervisor: Prof Melinde Coetzee
coetzm1@unisa.ac.za

A study titled: "Development and validation of a measure for assessing the psycho-technological learning capabilities of open and distance online learners."

Your application regarding permission to conduct research involving UNISA students in respect of the above study has been received and was considered by the Research Permission Subcommittee of the UNISA Senate Research and Innovation and Higher Degrees Committee (SRIHDC) on 11 February 2015.

It is my pleasure to inform you that permission has been granted for your study, for the period between 16 February 2015 and 31 December 2015 to:

1. Gain access to and use the UNISA IOP 1501 first year students email list.
2. Distribute a web-based survey, consisting of several questionnaires. The survey must clearly provide opportunity for prospective participants to opt in or to opt out.
3. In line with the Protection of Personal Information (POPI) Act, No. 4 of 2013, the RPSC cannot give you access to the students' demographic data without their prior

Open Rubric

consent. It is recommended that you incorporate this information in your questionnaire and rather let the respondents provide it to you voluntarily.

Note:

The reference number 2015_RPSC_010 should be clearly indicated on all forms of communication with the intended research participants.

We would like to wish you well in your research undertaking.

Kind regards,

PROF L LABUSCHAGNE

EXECUTIVE DIRECTOR: RESEARCH

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APPENDIX C: Newly developed Psycho-Technological Learning Capabilities Scale (PTLCS)

The purpose of this questionnaire is to give you a chance to tell how you feel about your computer and internet skills as required for online learning. The statements are in two broad categories requiring you to first describe your access to a computer and the internet, and then secondly, detail how confident you feel about using a computer and the internet for your studies.

Instructions:

Read each statement carefully; decide **how you feel about your own capabilities** as described in each statement.

- If you feel that your capabilities are *much more* than what is expected, check the box under **"Strongly Agree"**
- If you feel that your capabilities are *more* than you expected, check the box under **"Moderately Agree"**
- If you feel that your capabilities *meet* what is expected, check the box under **"Slightly Agree"**
- If you feel that your capabilities are *fairly less* than what is expected, check the box under **"Slightly Disagree"**
- If you feel that your capabilities are less than what is expected, check the box under **"Disagree"**
- If you feel that your capabilities are *much less* than what is expected, check the box under **"Strongly Disagree".**

- **Mark the relevant box with an X**

General Access **For office use**	**Strongly Disagree** **1**	**Moderately Disagree** **2**	**Slightly Disagree** **3**	**Slightly Agree** **4**	**Moderately Agree** **5**	**Strongly Agree** **6**
1 I have access to a computer for my studies.						
2 I have access to the internet for my studies.						

SELF-PERCEIVED COMPUTER SKILLS **For office use**	**Strongly Disagree** **1**	**Moderately Disagree** **2**	**Slightly Disagree** **3**	**Slightly Agree** **4**	**Moderately Agree** **5**	**Strongly Agree** **6**
3 I can download software for my computer without assistance.						
4 I can create folders to save my documents						
5 I can use search engines to find additional resources on the internet.						
6 I back up my files every week to safeguard my work.						
7 I back-up my files on devices such as an external hard drive to safeguard my work.						
8 I can update the security software on my computer without assistance from the ICT department.						
9 I can transfer files from other devices, for example, camera, smartphone, external hard drive, to the hard drive on my computer.						

INTERNET SELF-EFFICACY		Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
	For office use	**1**	**2**	**3**	**4**	**5**	**6**
10	I am confident in sending emails generally.						
11	I feel confident in typing all my written assignments.						
12	I feel confident in downloading official study material from the module site on myUnisa.						
13	I feel confident in downloading additional resources from the module site on myUnisa.						
14	I feel confident in downloading information from the internet for my studies.						
15	I feel confident in downloading information from the internet for my assignments.						
16	I feel confident in uploading my assignments on the online submission platform (myUnisa).						