RELEVANCE OF WORK INTEGRATED LEARNING (WIL) IN THE GEOMATICS PROGRAMME AT THE DURBAN UNIVERSITY OF TECHNOLOGY

BY

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DECLARATION

This is to certify that the dissertation submitted is the student's own original work, except where citations have been included and referenced accordingly. The dissertation has not been submitted for a degree at any other university or institution of higher education.

This research was conducted at the Durban University of Technology under the supervision of Professor Dhiren Allopi.

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ABSTRACT

The Durban University of Technology (DUT) phased out the National Diploma: Surveying and the B-Tech: Surveying qualifications and introduced a new qualification, Bachelor of the Built Environment (BBE): Geomatics in January 2018. Work integrated learning (WIL), which is also referred to as experiential learning (EL), emphasises workplace learning encompassing a career-focused educational strategy, inclusive of classroom-based and workplace-based forms of learning that are appropriate for a professional qualification. WIL has become an integral part of the teaching and learning pedagogy within the surveying profession at a national diploma level across many of the technikons and universities of technology (UoTs) nationally over the past few decades, including the DUT. WIL has become widely recognised as the cornerstone of student development because this interaction with industry encourages students to understand and appreciate the mechanisms of real WPL and the dynamics of a professional working environment, with the opportunity to reflect on their strengths and weaknesses while inculcating a sense of work identity and professionalism. Sattler (2011) explained that the term WIL is often used interchangeably with work-based learning, practice-based learning, work-related learning, vocational learning, experiential learning, co-operative education, clinical education, internship, practicum, and field education etc. For the purposes of this study, the terms ‘experiential learning’ and ‘work integrated learning’ will be used interchangeably.

WIL has now been excluded from the new BBE: Geomatics qualification, as this qualification seeks to be more academically oriented and aligned. However, the lack of a WIL component could possibly result in a graduate who exhibits deficiencies in practical knowledge, technical skills, and work-related proficiencies when compared to the traditional survey technician/technologist that industry has become accustomed to over the years, which may have further detrimental consequences for the learner and the industry sector. The aim of this study was therefore to investigate and evaluate the historical impact of EL in terms of the impact on the student’s personal and professional development, in the National Diploma: Surveying programme, and to evaluate the relevance of WIL in the geomatics programme at the DUT.

Data was collected through interactions with industry practitioners within the surveying and geomatics fraternity in the KwaZulu-Natal (KZN) region. The motivation for the study was to increase our understanding of industry's perspectives on WIL to assist in terms of informed decision making and best practices, which will be beneficial to all stakeholders. There is an abundance of supporting literature highlighting the relevance and benefits of WIL which has been widely acknowledged as a vehicle for contributing to student development and increasing graduate employability outcomes. Dressler and Keeling (2011, cited in Baker 2014), summarised over 100 research publications on the benefits of WIL, regarding academic, personal, professional, and work skill development aspects. Smith (2012, cited in Wingrove and Turner 2015) explains that WIL creates the opportunity for higher education institutions (HEIs) to design, refine and teach curricula that are responsive to current and future workplace requirements, equipping students with the knowledge and capabilities to actively engage with industry and community partners, and improve work readiness.

The study was conducted by employing a mixed-method approach incorporating quantitative and qualitative methods. The quantitative method however was the predominant technique since it constituted a significant part of the study. Quantitative techniques involve data collection, organisation, analysis, interpretation, and presentation of numerical data in both tabular and graphical formats. Appropriate statistical techniques were applied through the use of SPSS data analysis software. The qualitative method involved brief analysis of employer comments from the experiential training (ET) report data set and feedback from the open-ended question on both questionnaire surveys. The findings confirmed that the EL in the National Diploma: Surveying had a positive and meaningful impact on the development of the Diploma graduate. Further, the findings are that there is significant consensus from industry and students regarding the importance and relevance of WIL in promoting an enriching career focused education, and in facilitating the acquisition of discipline knowledge, practical proficiency, graduate attributes, employability skills, and core competencies that will culminate in an all-round holistic graduate to meet the needs of a modern workforce for the various industry sectors. Some of the recommendations arising from the study to support informed decision making going forward include: implementation of a six or twelve month WIL programme, increase in industry engagement and collaboration, implementation of WIL simulation methods, establishment of a survey camp, WIL staff industry secondment, and reintroduction of the WIL empowerment project.

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4IR:	Fourth industrial revolution
BBE:	Bachelor of the Built Environment
B-TECH:	Bachelor of Technology
CDL:	Career development learning
CHE:	Council for Higher Education
CPD:	Continuing professional development
CWIE:	Cooperative and work-integrated education
DHET:	Department of Higher Education and Training
DRDLR:	Department of Rural Development and Land Reform
DUT:	Durban University of Technology
EIP:	Employability Improvement Project
EL:	Experiential learning
ET:	Experiential training
ES:	Engineering surveyor
FEBE:	Faculty of Engineering and the Built Environment
GIS:	Geographic information systems
GISs:	Geographic information science
GPr:	Geomatics professional
GTc:	Geomatics technician
GTg:	Geomatics technologist
HEI:	Higher education institution
HEQF:	Higher Education Quality Framework
HEQSF:	Higher Education Quality Sub-Framework
HR:	Human resources
IREC:	Institutional Research Ethics Committee
KZN:	KwaZulu-Natal
LiDAR:	Light detection and ranging
MoU:	Memorandum of understanding
NQF:	National Qualifications Framework
OLUMS:	Online University Management System
PBL:	Problem-based learning

PJBL:	Project-based learning
PLS:	Professional land surveyor
PS:	Professional engineering surveyor
PSET:	Post-school education and training
SAGC:	South African Geomatics Council
SAGI:	South African Geomatics Institute
SANRAL:	South African National Roads agency
SAQA:	South African Qualifications Authority
SDA:	Skills Development Act
SDL:	Self-directed learning
SDLA:	Skills Development Levies Act
SETA:	Sector Education and Training Authority
SPSS:	Statistical Package for the Social Sciences
SSA:	Sub-Sahara Africa
ST:	Survey technician
STEM:	Science, technology, engineering, and mathematics
TVET:	Technical and vocational education and training
UNESCO:	United Nations Educational, Scientific and Cultural Organization
UoT:	University of Technology
US:	United States
WACE:	World Association for Cooperative Education
WBL:	Work-based learning
WDTL:	Work directed theoretical learning
WEF:	World Economic Forum
WIL:	Work integrated learning
WOW:	World of work
WPL:	Workplace learning

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Introduction and background to the study

The Durban University of Technology (DUT) is one of the leading institutions of higher learning in South Africa. It was initially known as the Durban Institute of Technology which resulted from a merger of two previous established Technikons namely, Technikon Natal and ML Sultan Technikon in April 2002.

The intention of the Department of Education at the time was to ensure that South Africa's tertiary education institutions were able to position themselves in relation to global benchmarks to attract the finest students and staff, to provide a complete set of practical and academic campuses, to offer an optimal mix of academic and vocational qualifications, and to provide for the development of skills required by the country (DUT 2008). As a result, in 2006 the Durban Institute of Technology (DIT) changed its name to 'Durban University of Technology' (DUT) in order to align the institution with the rest of the technology higher education sector which adopted the new nomenclature.

DUT now has a total of seven campuses, comprising five campuses in Durban and two in Pietermaritzburg. DUT's accelerating growth over the years in the higher education sector has been rewarded with the university being ranked in the Top 5 of all South African universities in 2020, as well as amongst the Top 500 universities globally by the *Times Higher Education* World University Rankings. This achievement was enhanced in 2021 with DUT being ranked in the Top 100 universities in emerging economies by the *Times Higher Education* Emerging Economies World University Rankings 2021, as well as ranked 2nd in South Africa and 102 globally by the 2021 *Times Higher Education* Young University Rankings. DUT is now also a renowned member of the International Association of Universities. This vibrant institution is a multi-campus University of Technology and is strategically positioned to be at the forefront of higher education, technological training, research, and innovation. The university also aspires to be a preferred university for developing leadership in technology and productive citizenship and is committed to making knowledge useful. With a student population of approximately 33 000 students, the DUT has become a well-recognised institution both locally and internationally for producing well rounded graduates with the purpose of providing a career-focused education and preparing learners for the world of work (WOW).

The DUT's ENVISION2030 strategy aims to develop its community of staff and students to become entrepreneurial and innovative. The strategic map makes reference to four perspectives, namely, Society, Sustainability, Systems and Processes, and Stewardship. It refers to a "society that leads to mutually beneficial collaborations, the practical application of knowledge and future-ready graduates". It elaborates on further key strategic objectives including amongst others: "An engaged university", "Innovation and entrepreneurship", "Adaptive graduates", Digital environment", "Lived values", and "Creativity" with the definitive goal of making an impact on society at large (DUT 2020b). The strategy places emphasis on the UoT's responsibility of educating and training knowledgeable and capable graduates who are equipped with the necessary employability, graduate, and entrepreneurial attributes to adapt and succeed in an evolving labour market and knowledge driven society, and to fulfil the economic needs of broader society through community engagement and partnerships.

1.1.1 The Department of Civil Engineering and Geomatics

The Department of Civil Engineering and Geomatics at DUT is under the umbrella of the Faculty of Engineering and the Built Environment (FEBE). According to the department handbook DUT (2021a), the departmental vision is "to be a quality driven department that provides a well-rounded, professional education that ensures that graduates are innovative and have a competitive edge". During the Technikon era and early merger years, the Department had already established and developed a solid reputation and partnership with industry over the years for producing high quality of graduates that had extensive theoretical and practical knowledge in their various disciplines. The industry exposure enabled graduates to develop competency and proficiency in applying their knowledge and skills to the various spheres of engineering and surveying, and to make an important and meaningful impact on the built environment and community at large. This is demonstrated in the Department's mission statement:

> As a progressive department, our mission is to contribute innovatively to the socioeconomic development of South Africa by:
>
> - Offering a portfolio of relevant programmes.
> - Producing well-rounded graduates who are attuned to the needs of the profession.
> - Generating, integrating, and applying knowledge to stimulate socio-economic development.
> - Partnering stakeholders in sustainable development.
> - Acting as an incubator for advanced study in clearly defined areas of strength.
> - Being student centred and quality driven.
> - Providing an enabling environment for continued staff development. (DUT 2021a)

1.1.2 History of previous qualifications:

The Department has previously offered the National Diploma: Surveying and Bachelor of Technology: Surveying (B-Tech) which were both fully accredited programmes by the statutory body, the South African Geomatics Council (SAGC). These were well established and recognised qualifications by the various sectors and stakeholders in industry. Table 1.1 shows the structure of the two qualifications.

Table 1.1: Previous phased out qualifications

Qualification	*SAQA No.*	*SAQA Credits*	*NQF level*	*WIL*
National Diploma: Surveying	72264	360 credits	Level 6	12 months
Bachelor of Technology: Surveying	72161	120 credits	Level 7	Not applicable

The National Diploma was offered on a full-time basis and the B-Tech was offered on a part-time basis both at the Steve Biko Campus, Durban. The National Diploma: Surveying included one year of mandatory and monitored ET which was WIL embedded in a subject called 'Survey Practice II' which constituted 120 academic credits towards the qualification, and comprised the following compulsory requirements as per the SAGC rules for training and registration:

a) Quantitative portion: A total of 220 days of monitored training in various prescribed categories of work, inclusive of 85 days in compulsory categories.
b) Qualitative portion: A total of four industry projects.
c) Driver's licence: Compulsory (either code 08 or code 10).

The ET was conducted in year two of the Diploma, with at least six months of compulsory training required to be eligible to register and complete the final year subjects (semester 3 and 4) of the qualification. This approach ensured that learners arriving back from their internship were in tune to the dynamics of the work environment and displayed a more professional and enthusiastic attitude and approach to their studies, which contributed to a more academically oriented and focused learner. Additionally, only Diploma graduates who had a minimum of one year of post-diploma survey experience would be permitted to enrol for the B-Tech: Surveying programme. As a result of the industry exposure, students were adequately prepared to handle the academic requirements of the B-Tech and perform according to expectations of the industry after completing the qualification. The National Diploma: Surveying and the B-Tech: Surveying combined produced a 480-credit programme.

1.1.3 The Higher Education Quality Sub-framework (HEQSF) and new qualifications

The Council for Higher education (CHE) is recognised as the statutory body and quality council for higher education in South Africa. It advises the Minister of Higher Education and Training on all higher education issues and is responsible for quality assurance and promotion through the Higher Education Quality Committee.

The higher education landscape changed in 2010 when the CHE under the mandate of the Department of Higher education and Training (DHET) launched a review of the existing Higher Education Quality Framework (HEQF). The intention was to consider the need for new qualification types to facilitate access and to ensure that the HEQF meets evolving skills and knowledge requirements as well as enhancing the coherence of the higher education system. This involved a consultative process with various higher education stakeholders including public and private institutions, higher education associations and professional bodies in an attempt to seek greater flexibility in relation to avenues for vocational and professional qualifications. This included the introduction of new types of qualifications as well as variations of existing types. As per the previous framework, the revised Higher Education Quality Sub-Framework (HEQSF) provided the basis for integrating all higher education qualifications into the National Qualifications Framework (NQF) and was published in the Government Gazette in August 2013 (South Africa. Department of Higher Education and Training 2014) (Figure 1.1).

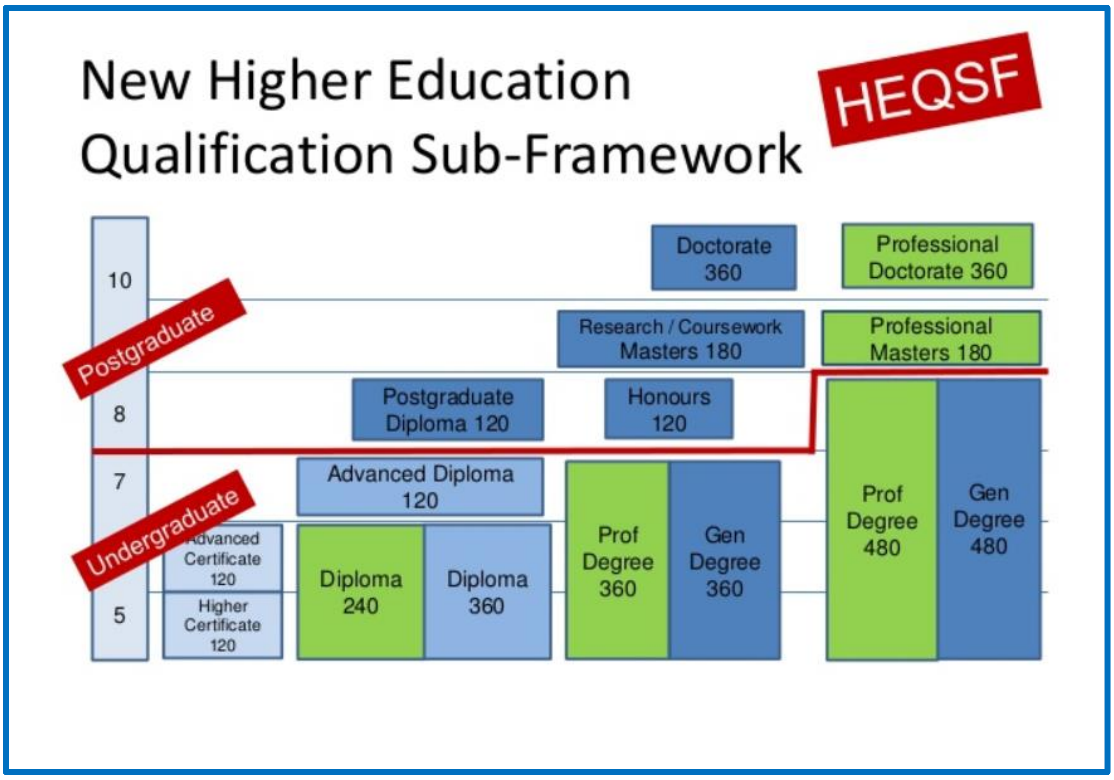

Figure 1.1: Higher Education Qualifications Sub-Framework (HEQSF)
Source: Adopted from Van Ryneveld (2016)

Figure 1.1 above shows the new HEQSF model. Figure 1.2 below attempts to map out the articulation paths between the various qualifications on the HEQSF. Since WIL is characteristic of both vocational and professional based qualifications, it is possible to incorporate it into qualifications at all levels of the HEQSF. Subsequently all Universities of Technology (UoTs), including the DUT, were given a mandate to introduce new qualifications which included new ‘Diploma’ and ‘Degree’ programmes that were to align with the new HEQSF for increased programme articulation and for portability and progression within education and training career paths for students.

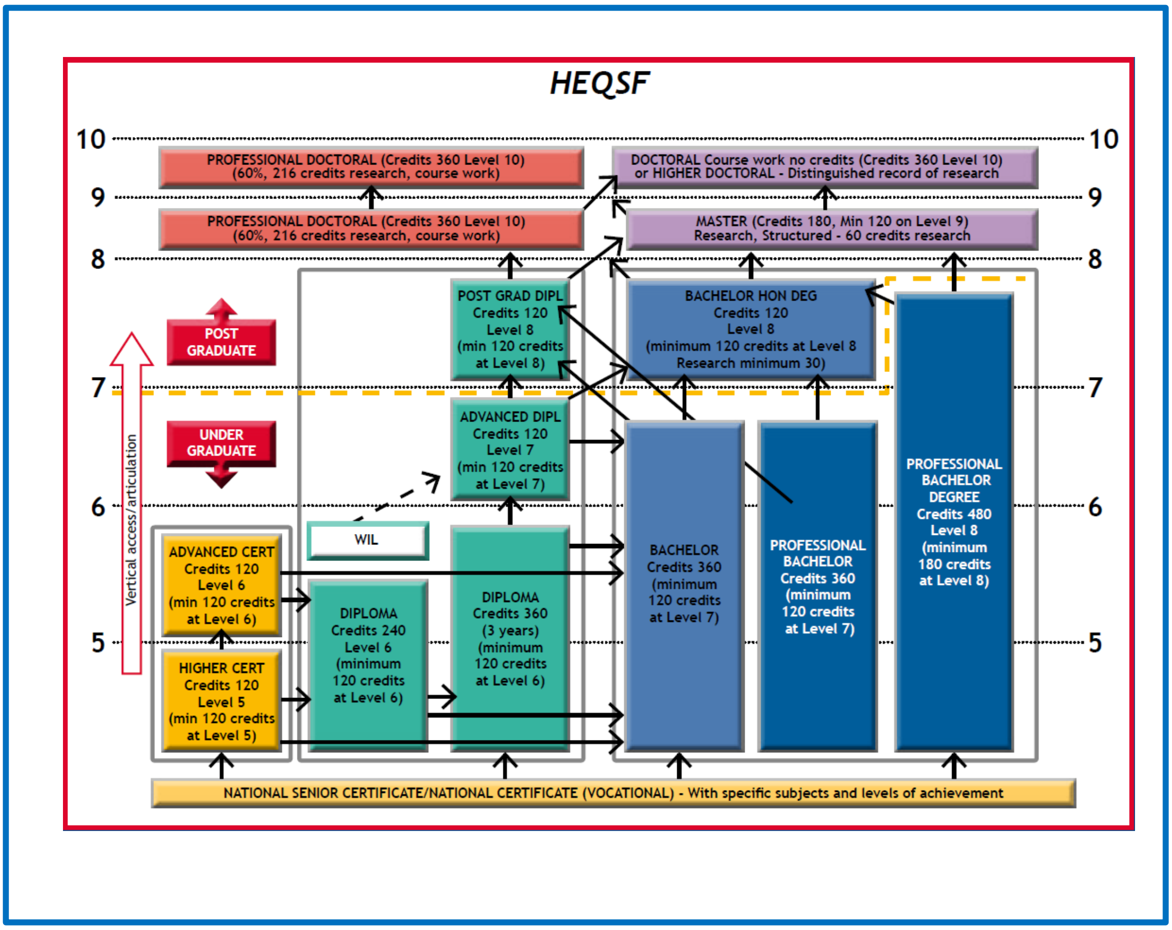

Figure 1.2: **Articulation paths on the HEQSF**
Source: Adopted from TUT (2021)

1.1.4 Curriculum renewal

DUT at the time engaged in a series of internal dialogues at institutional, management, faculty, and departmental levels to plan the structuring and implementation of the new aligned qualifications. Departments, under the leadership of executive management then decided between offering the new ‘Diploma’ or ‘Degree’ programmes based on various factors including strategic position, potential demand, student numbers, staffing resources, sustainability, etc. In keeping with the mandate of the Department of Higher Education and Training (DHET), the new programmes would have to conform to the requirements of the HEQSF.

South African higher education institutions (HEIs), including UoTs, were given a mandate to initiate a process of phasing out their current academic programmes within a prescribed period and on a gradual basis, in order to transition to the new degree and diploma programmes in accordance with national and institutional requirements and within allocated timeframes and deadlines. DUT then officially embarked on a strategic approach termed the ‘curriculum renewal project’ to plan for a transitioned phase out of existing programmes and the implementation of the new HEQSF aligned qualifications. In the geomatics department, this essentially meant phasing out the existing National Diploma: Surveying and the B-Tech: Surveying qualifications to introduce a new qualification. The National Diploma was phased out over a period of 3 years (2017 – 2020) while the B-Tech qualification commenced a gradual phase out in 2018 and is due to terminate in the year 2022.

After some internal discussion and deliberation, the Department of Civil Engineering and Geomatics was advised by the DUT executive management at the time to pursue the ‘Degree’ option instead of the ‘Diploma’ as it was seen to be a more attractive and lucrative option, which culminated in the ‘Bachelor of the Built Environment (BBE): Geomatics’. This then subsequently obtained approval by the CHE and the South African Qualifications Authority (SAQA). Some consultation with the statutory bodies, including the South African Geomatics Institute (SAGI) and the South African Geomatics Council (SAGC) regarding the proposed qualifications were conducted. The SAGC provisionally endorsed the introduction of the new Bachelor’s degree subject to an accreditation visit, and further recommended a new diploma offering for the education of technicians. The SAGI recommended that two courses be offered, including a new 360 credit diploma for the registration as a Survey Technician (ST) and then a further advanced diploma, of 120 credits, for registration as a Surveyor (S). SAGI further emphasised the strong need for articulation between UoTs and academic universities for those deserving students who wished to pursue the educational path to become a professional land surveyor (PLS). Both recommendations above suggested that there was still an emphasis on the need to educate and train responsible and competent technicians/technologists, who would possess essential technical knowledge and skills required for the mapping of the country's assets and infrastructure and be involved with activities that facilitate and support projects within the built environment, as well for the development of the country and the advancement of society.

The proposed qualification was also discussed at the DUT Survey/Geomatics Advisory Board. The Advisory Board is composed of several industry representatives from public and private sectors which meet once annually to discuss industry, educational and training matters. The item was tabled, and some feedback was obtained from industry and academic representatives with the intention of providing some constructive input into the new qualification. This however was not a large-scale consultative process, but merely a brief consultation forum to gauge some industry input on the proposed qualification.

The relevant stakeholder representatives approved the new qualification in principle subject to it meeting the requirements of the SAGC registration model in the various categories. The new proposed curriculum was initially drafted, around the SAGC registration model as the definitive guideline in developing content in the various specialised knowledge areas. A FEBE ‘curriculum renewal project’ was undertaken with the purpose of revising the existing curricula to be more current, relevant, and indicative of modern-day professional practice, while aiming to introduce technological and innovative methods into the various sub-disciplines of work. The aim was to cover both theoretical and practical aspects of the course. The new degree however did not make provision for the inclusion of EL or WIL which is a significant difference compared to the previous qualifications.

The phased out National Diploma: Surveying and B-Tech: Surveying qualifications permitted graduates to register in the following categories with the SAGC as shown in Table 1.2.

Table 1.2: Diploma and B-Tech registration categories

Qualification	***SAGC Registration category***	***Remarks***
National Diploma: Surveying	*Survey Technician (ST)*	
Bachelor of Technology: Surveying	*Engineering Surveyor (Technologist) (S) or (ES)*	
Bachelor of Technology: Surveying	*Professional Engineering Surveyor (PS)*	Valid until Dec 2014

1.1.5 New qualifications

The Department officially launched the three-year Bachelor of the Built Environment (BBE): Geomatics programme in January 2018. The purpose of the programme as per the Department handbook is as follows:

> The purpose of the BBE: Geomatics programme is for students to assimilate the necessary knowledge, understanding, and skills in geomatics and the ability to make a contribution to the economy, infrastructure and national development of the country. This combined with a period of post qualification mentored work experience will enable them to become competent practicing engineering surveying technologists (engineering surveyors), able to apply geomatics knowledge to make judgement, work independently and responsibly. The qualification also provides students with the educational base required for registration with SAGC as an Engineering surveyor. To contribute to the critical mass of engineering surveyors educated specifically for the World of work and research, and who also play a pivotal role in the infrastructure development of our country. (DUT 2021a)

The BBE: Geomatics programme differs in academic structure and to some degree in content from the industry recognised National Diploma: Surveying which was offered by the Department over the past two decades. The new qualification appears largely to be combination of the National Diploma: Surveying and the B-Tech: Surveying re-modelled with a partly revised and updated modern curricula. The definitive difference of course is the exclusion of WIL in the geomatics degree. During the curriculum renewal project, a module titled ‘Survey project 3B’ was included in Year 3 of the geomatics degree and was envisaged to be a WIL type of industry-oriented project-based module to make up for this deficit. However, this is likely to be changed to an academic research type component sighting transition to the honours programme as the main reason. The consequential effect of this is that there is a lack of remedial action for the exclusion of WIL in the new degree, and graduates will now enter the work sector, much like their academic university counterparts, with little to no practice-based experience or industry exposure. UoTs were not originally designed to be competing with traditional academic universities in the similarity of their course offerings.

Table 1.3: New qualifications

Qualification	*SAQA No*	*SAQA Credits*	*NQF level*	*WIL*
BBE: Geomatics	101432	420 credit	Level 7	Not included
BBE (Honours): Geomatics	Pending approval	140 credit	Level 8	Not included
MBE: Geomatics	96844	180 credit	Level 9	Not included

The new degree consists of six academic semesters over a three-year programme. As indicated the new qualification does not make provision for the inclusion of an EL or a WIL component as it was considered to be a more academically oriented degree aligned to the HEQSF. One could perhaps argue then that the majority of industry members are somewhat oblivious to this new qualification and its core purpose, which may lead to some confusion in the industry, with other closely related programme offerings at other tertiary institutions, as well as regarding professional registration with the statutory bodies.

The BBE: Geomatics and the proposed 'Bachelor of the Built Environment (Honours): Geomatics' degree, provides graduates with the educational qualifications to register with the SAGC in the specified categories shown in Table 1.4 below. However, eligible candidates require mandatory post qualification work experience in the form of a period of industry practice/training or internship, under the supervision and mentorship of registered geomatics practitioners. It is worth noting that post qualification work experience for registration purposes is not considered as WIL, since it is conducted outside the professional qualification and does not have an academic credit. Post qualification experience therefore cannot add direct value to the academic qualification as it is a separate component external to the qualification. The BBE (Honours): Geomatics involves a further one year of academic instruction and this will then be adequate for registration in the category of Geomatics Professional (GTp).

Table 1.4: Geomatics degree registration categories

Qualification	*SAGC Registration category*	*Remarks*
BBE: Geomatics	*Geomatics Technician (GTc) or Survey Technician (ST)*	Structured post qualification work
	Geomatics Technologist (GTg) or	

	Engineering Surveyor (Technologist) (S) or (ES)	experience required for registration purposes
BBE (Honours): Geomatics	*Geomatics Professional (GPr) or*	
	Professional Engineering Surveyor (PS)	
MBE: Geomatics	*Geomatics Professional (GPr) or*	
	Professional Engineering Surveyor (PS)	

The Master of the Built Environment (MBE): Geomatics is a research-based qualification requiring further studies and a full dissertation. The MBE: Geomatics is also accepted for registration in the category of Geomatics Professional (GTp).

1.2 Experiential learning and work integrated learning (WIL)

The educational concepts of EL and WIL has been studied extensively throughout the history of co-operative education and the industry work sector. The terminology within these learning processes are closely related and sometimes used synonymously.

1.2.1 Experiential learning

EL is regarded as the process of learning through experience. However, it is important to note that it is not just about learning a skill through practice, but also involves reflection on the learning process and critically thinking of new ideas to improve upon, based on observation and experience.

Some of the earliest available literature relating to experiential learning as an effective medium of delivering knowledge, was one of the first educational theorists, John Dewey in 1938, who regarded experience as an essential component of the educational process. He suggested that learning occurs because of problem solving and requires thinking and reflection under the guidance of educators and learning facilitators. He believed that 'vocation' refers to a deeply felt and ethically grounded identity in a chosen career, and that essential scholarly engagement with the key issues of public life that connect professional and vocational competence, goes beyond learning by doing (Winberg *et al.* 2011).

Drawing from the works of Dewey (1938), Lewin (1951) and Piaget (1978), Kolb's (1984) theory (cited in Stirling *et al*. 2016) outlined a scientific process for learning through experience which is founded on the belief that the acquisition of knowledge occurs when an individual's affect, perceptions, cognitions, or behaviours are intentionally transformed by recognising a personal experience. Figure 1.3 demonstrates Kolb's four major modes of learning, namely: *experience, reflection, conceptualisation, experimentation*. According to Kolb, when each mode is adequately represented, an optimum level of learning occurs (Stirling *et al*. 2016).

Experiential learning is the application of theory and academic content to real-world experiences within the classroom, community, or workplace, which improves course-based learning outcomes that are specifically focused on employability skills.

While engaging in the experience activity, the student is required to also reflect on their learning and how their academic skills can be applied beyond the classroom scene (Carlton University 2020). Sattler (2011) stated that it is possible to facilitate EL through WIL, which refers to a variety of educational opportunities that integrate academic knowledge and practical application with real-world experience in a particular workplace setting. EL is considered as a representation of the specific techniques or mechanisms that one can implement to acquire knowledge or meet learning goals or outcomes (Roberts 2012).

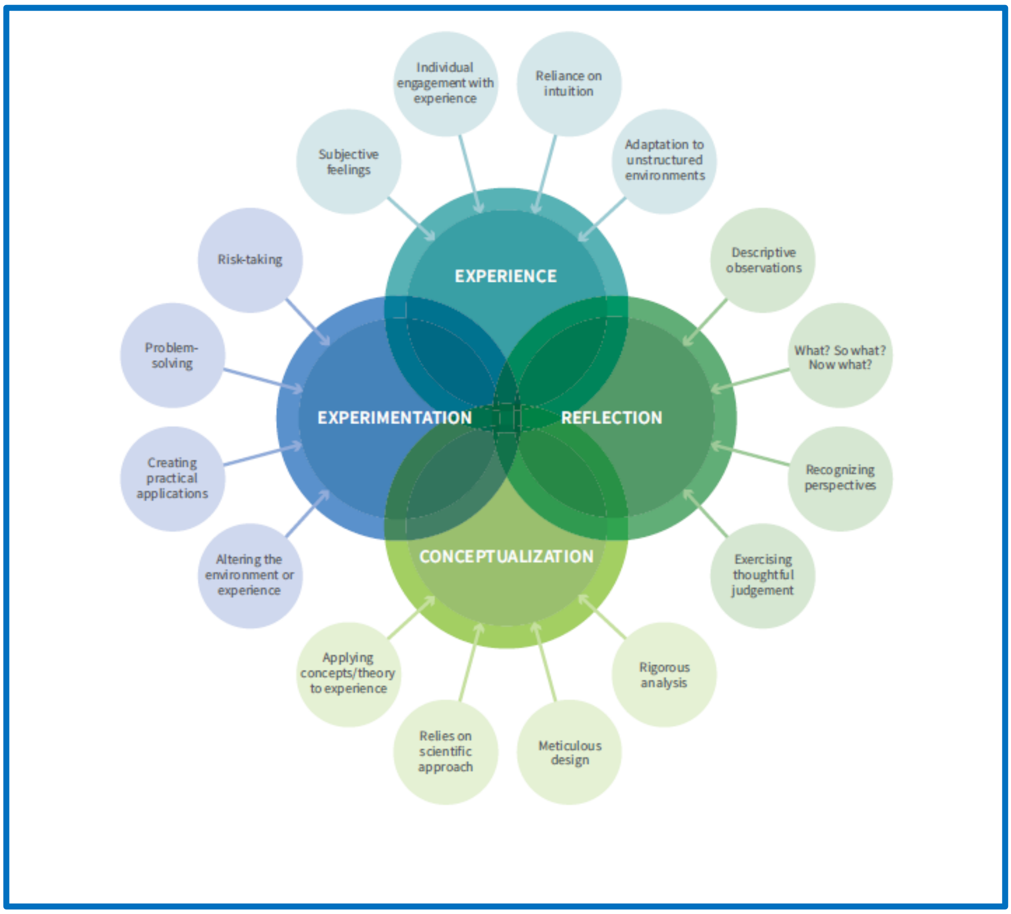

Figure 1.3: Kolb's (1984) modes of experiential learning
Source: Adopted from Kolb (1984, cited in Stirling *et al*. 2016)

1.2.2 Work integrated learning (WIL)

WIL, on the other hand, also occasionally referred to as EL, emphasises WPL which encompasses a career-focused educational strategy, inclusive of classroom-based and workplace-based forms of learning that are appropriate for a professional qualification. A more specific type of industry learning called 'co-operative education' is an integration of theoretical classroom-based education and actual practical work experience delivered in a structured manner. Some practitioners regard classroom industry-oriented projects with the objective of exposing learners to real work environment concepts as WIL, but others are dismissive about this notion, as the work is not conducted in an industry-controlled setting, so simulation is currently not greatly favoured by some experts. It may require academics and industry practitioners to re-evaluate the integrated approach of WIL in terms of a modern education system.

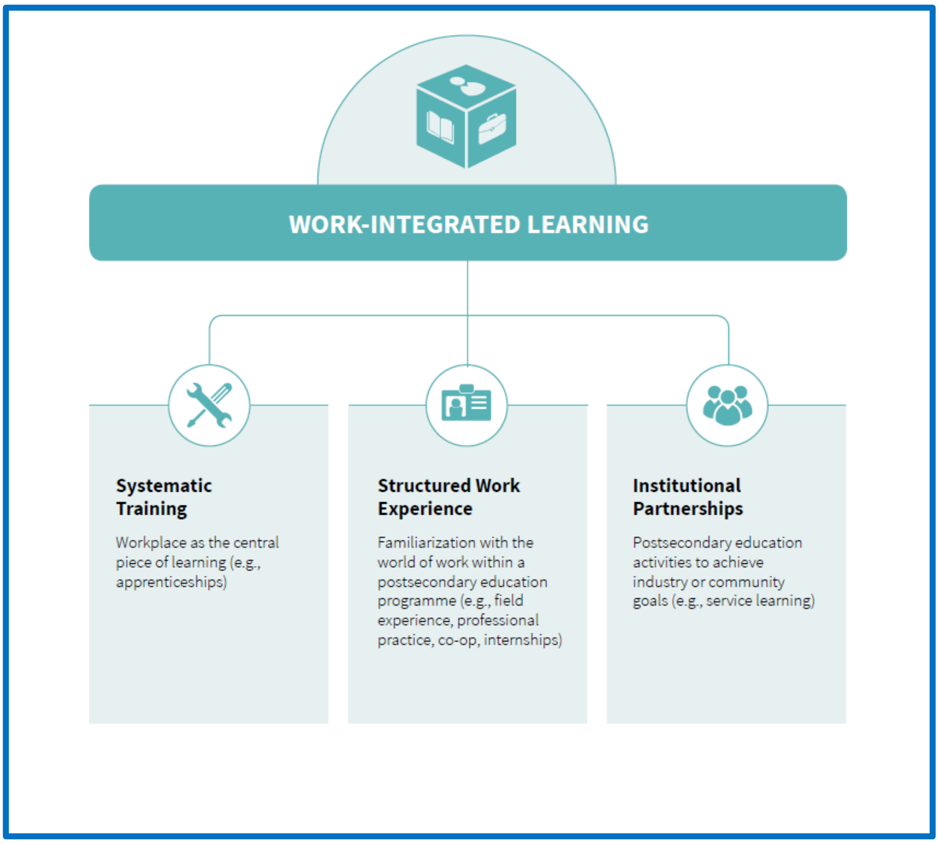

Figure 1.4: WIL typology
Source: Adopted from Sattler (2011)

According to Sattler (2011), "the term 'work-integrated learning' is often used interchangeably with work-based learning, practice-based learning, work-related learning, vocational learning, experiential learning, co-operative education, clinical education, internship, practicum and field education, to name but a few". The author outlined a WIL typology to explain the various types of WIL experiences in institutions of higher learning (Figure 1.4).

In addition to the models and typologies, Figure 1.5 illustrates the key dimensions of WIL programming that have been suggested. Cooper, Orrell and Bowden (2010) identified seven key dimensions, namely: "*purpose, context, the nature of the integration, curriculum issues, learning, institutional partnerships*, and the *support* provided to the student and the workplace". Cantalini-Williams (2015) further expanded on this list by proposing her 'CANWILL' framework for developing effective WIL internships which involves *"curriculum, assessment, networking, workplace,* *integration, learning and logistics".* Assessment and logistics are included as components in the delivery of WIL experiences.

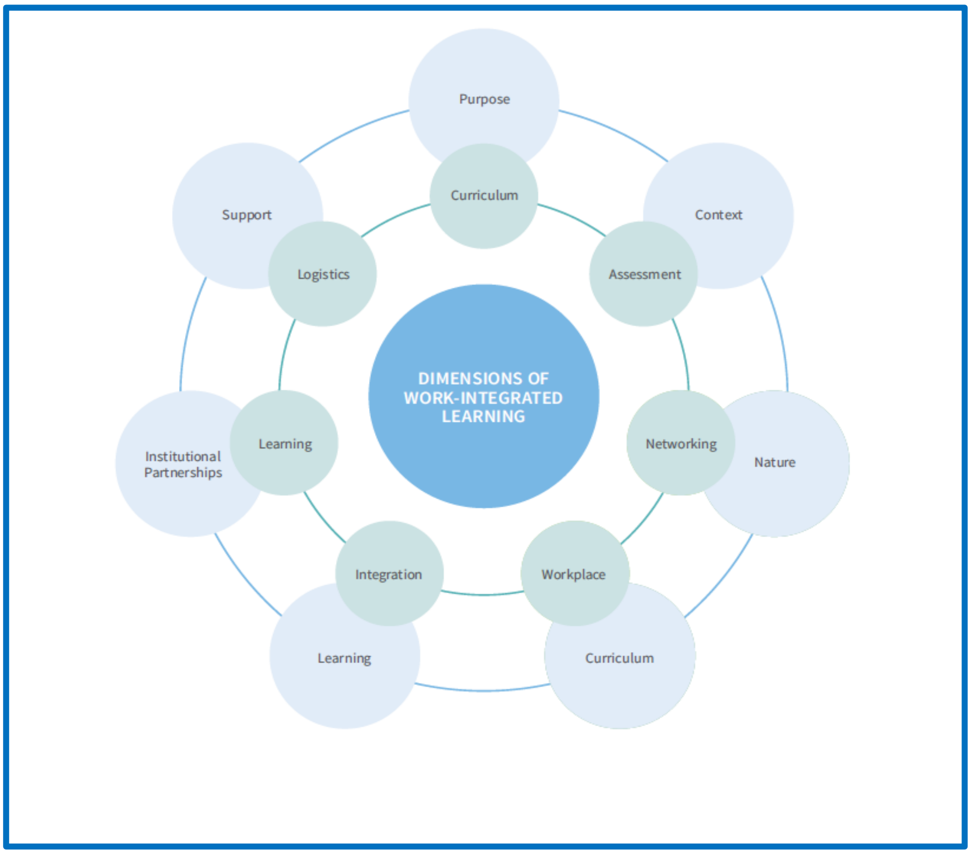

Figure 1.5: **Key dimensions of WIL**
Source: Adapted from Cooper, Orrell and Bowden (2010) and Cantalini-Williams (2015)

According to Von Treuer *et al*. (2010, cited in Jackson 2015), WIL is a program that combines traditional academic study with student exposure to the WOW within their desired profession, with a core purpose of preparing undergraduates for entry into the workforce. WIL involves various forms, each one encouraging learners to experience authentic work practices while learning and practicing the application of knowledge and skills in a real-world context. Work placements, internships, job shadowing, field work, sandwich year degrees, and cooperative education are amongst the variants considered (Jackson 2015).

Martin, Rees and Edwards (2011) describe the pedagogical approach to WIL which uses a variety of methods to provide students with content knowledge and theory, linked to practical work, through placements or projects.

The CHE published a WIL good practice guide document in 2011 to provide clear and concise guidelines on WIL. The authors explain: "University teachers should be concerned to ensure that the students that graduate from their programmes are prepared for the world in which they will live and work". A more comprehensive explanation for WIL aimed at academic scholars, extracted from the document is as follows:

> WIL is used as an umbrella term to describe curricular, pedagogic and assessment practices, across a range of academic disciplines that integrate formal learning and workplace concerns. The integration of theory and practice in student learning can occur through a range of WIL approaches, apart from formal or informal work placements. WIL is primarily intended to enhance student learning, and to this end several innovative curricular, pedagogical and assessment forms have developed in response to concerns about graduateness, employability and civic responsibility; examples include: *action-learning, apprenticeships, cooperative education, experiential learning, inquiry learning, inter-professional learning, practicum placements, problem-based learning, project-based learning, scenario learning, service-learning, team-based learning, virtual or simulated WIL learning, work-based learning, work experience, workplace learning, and so on*" (Winberg *et al.* 2011).

The Government Gazette document on the HEQSF, published in 2014, also provides insight into the objective of WIL in terms of student development:

> Some qualifications will be designed to integrate theory and practice through the incorporation of work-integrated learning (WIL) into the curriculum. WIL is characteristic of vocational and professionally-oriented qualifications and may be incorporated into programmes at all levels of the HEQSF. In the HEQSF, WIL may take various forms including simulated learning, work-directed theoretical learning, problem-based learning, project-based learning, and workplace-based learning. The selection of appropriate forms of WIL depends on the nature and purpose of the qualification type, programme objectives and outcomes, the NQF level at which the WIL component is pegged, institutional capacity to provide WIL opportunities, and the structures and systems that are in place within professional settings and sites of practice to support student

> learning. Where WIL is a structured part of a qualification the volume of learning allocated to WIL should be appropriate to the purpose of the qualification and to the cognitive demands of the learning outcomes and assessment criteria contained in the appropriate level descriptors. Where the entire WIL component takes the form of workplace-based learning, it is the responsibility of institutions that offer credit bearing programmes to place students into appropriate workplaces. Such workplace-based learning must be appropriately structured, properly supervised and assessed (South Africa. Department of Higher Education and Training 2014).

The above statement makes it a legal requirement and obligation for HEIs to place students where WIL is a structured part of a qualification. This may have deterred some programmes from incorporating WIL into the new qualifications on the HEQSF, to avoid a dilemma as suitable placements are not always readily available and are dependant on the willingness and corporation of employers to accommodate such students. Although officially gazetted, there are still some challenges in convincing academics to fully embrace co-operative education, as well as convincing the management of UoTs, who are prone to more academic research driven initiatives and do not fully acknowledge the relevance of practicum in the greater context of service learning and societal upliftment.

According to Govender and Wait (2017), through the WIL strategy students are encouraged to embrace prospective future careers, thus contributing to economic growth and innovation. It is the responsibility of the higher education sector to integrate WIL into curricula and qualifications as a means of promoting student career development. In this way, academics not only have the opportunity to integrate theory and practice, but also to expose future graduates to the WOW and assess their experiential learning. It is noted, however, that many academics are wary of implementing WIL due to perceived increased workload, denying themselves and their students the advantages of WIL, especially for their career prospects (Govender and Wait 2017).

1.2.3 The importance and relevance of WIL in higher education and industry

The CHE has identified numerous advantages for students who engage in WIL which include:

- Academic benefits, including improved general academic performance, enhancement of interdisciplinary thinking, increased motivation to learn;
- Personal benefits, such as increased communication skills, teamwork, leadership and co-operation;
- Career benefits, such as, career clarification, professional identity, increased employment opportunities and salaries, development of positive work values and ethics; and
- Skills development, including increased competence and increased technical knowledge and skills.

  (Winberg *et al.* 2011)

A study conducted in the DUT Department of Information and Corporate Management on the National Diploma: Office Management and Technology (OMT) programme, concluded that WIL provides numerous benefits to students including reaffirming concepts and skills acquired in a classroom setting, obtaining workplace skills, learning a variety of industry software applications not taught at the university, and improving student efficiency. It was determined that the acquired skills enabled students to contribute to the productivity and development of the organisations in which they worked. While many graduates were affected by an increasing unemployment rate, this however was not so for OMT graduates, as it was amongst the first qualifications to effectively integrate WIL into its curriculum (Ngwane 2016).

Figure 1.6 highlights the key benefits of WIL for all stakeholders within the higher education and industry sectors.

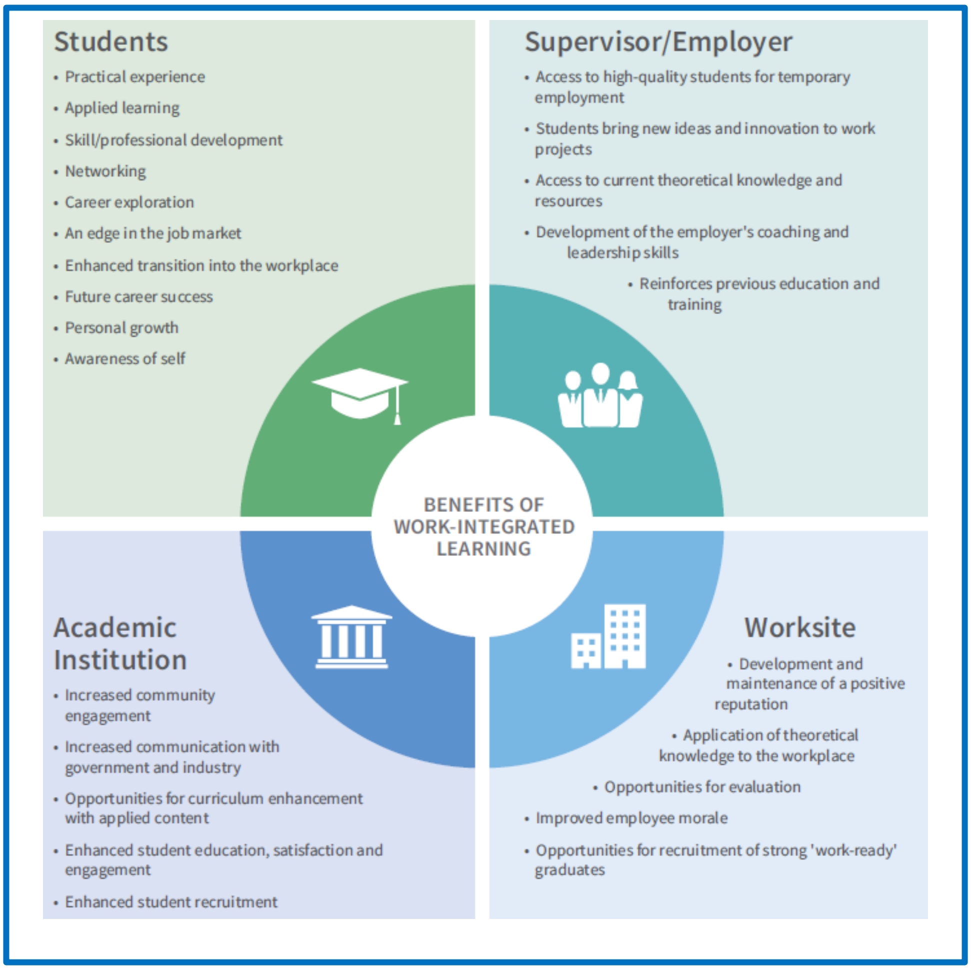

Figure 1.6: Benefits of WIL
Source: Adopted from Stirling *et al.* (2016)

It is clear that the DHET and the CHE highlighted the importance of, and encouraged the inclusion of, various forms of WIL into academic programmes. The relevance of WIL in a global context is acknowledged both in the higher education and employment sector, as it exemplifies collaborative efforts to enhance student learning through facilitating the application of theory into real-life practice, which has been known to yield remarkable results in holistic student development and progression.

This again reaffirms the notion from educational practitioners, that WIL experiences are very much part of the essential core knowledge that graduates should possess upon exiting the university system, and speaks to the DUT philosophy of “Learn, Think and Do”. The DUT Department of Co-operative Education is largely responsible for implementation of WIL programmes via academic departments and encouraging WIL initiatives throughout the university. This has however been reduced due to many programmes moving away from the traditional form of WIL work placement to other varied forms, and in some cases abandoning it all together. Co-operative education has been described as an integrated approach to higher education which combines academic learning with associated workplace experience achieved via the relationship between the university, students, industry and the community (DUT 2020a).

Du Pré (2009) argues that at a technological university, the emphasis is on the study of technology from the perspective of various fields of study, rather than a specific field. The term ‘technology’ refers to the human arrangement of nature with the aid of tools for human purposes. It refers to the effective and efficient utilisation of the accumulated knowledge, skills, and expertise that, when applied, produces value-added products, processes, and services. The purpose of technology, therefore, is to improve the quality of lives of citizens. In a UoT, the author explained, all teaching and learning programmes and research projects are related to technology, adding that technology is therefore a key aspect inherent in all UoT academic activities. As a result science, engineering and management should be highly prioritised (Du Pré 2009).

It may be somewhat irrational then, to believe that technologically evolving professions such as geomatics and engineering can function efficiently, effectively, and productively without some significant and appropriate vocational and practical instruction in the form of WPL, embedded in the academic programme for graduates to develop into responsible, competent and productive knowledge practitioners. Specific university programmes such as the BBE: Geomatics qualification, which produces technicians and technologists may benefit from an intensive career-oriented education with the emphasis on actual (WPL), in conjunction with other forms of WIL such as project-based learning (PJBL) and problem-based learning (PBL), due to geomatics been regarded as a highly practical, technical, and technological discipline. This coupled with a revised modern curricular, may be regarded by practitioners as an advantage to learners, since they would grasp real world concepts, and be able to identify and appreciate the link between theoretical learning content and practical based knowledge. Workplace learning may also encourage students to reflect on their experiences and develop and refine their own conceptual understanding. This approach may complement and reinforce the DUT’s objective of educating and training graduates for the real working world.

According to Griesel and Parker (2009), there is a common misinterpretation about the roles of higher education and the workplace. Employers express concern about the quality of graduates produced by universities, while higher education believes that industry employers do not fully acknowledge or appreciate the skills and qualities that graduates possess. Higher education has long played an important role in human capital development and contributing to economic growth and societal progress. In the South African context, the Joint Initiative for Priority Skills Acquisition has acted as a powerful catalyst in highlighting the skills needs of the economy as well as the role and contributions of higher education. Various views on a "skills revolution" have in the past been expressed due to the dire needs of the economy, including the then former Deputy President Phumzile Mlambo-Ngcuka‘s efforts to mobilise high level support for priority skills development. Moreover, in many countries, government initiatives have also focused on bridging the gap between higher education and workplace employment. Both the government and employers put pressure on higher education to produce graduates who are employable in the sense that they have the skills, abilities, and dispositions to succeed in the workplace, and who can compete and participate usefully and productively in an increasingly globalised world and economy (Griesel and Parker 2009).

The concept of employability has in fact been evolving as a legitimate outcome of the higher education sector for some time globally, in a bid to deliver productive global citizens that can live, work, and adapt to the evolving labour market. As a result, there is a growing expectation for higher education institutions to deliver graduates with well-developed work preparedness skills. The aim of the current study was to explore WIL as a possible instrument that can nurture employability skills and key graduate attributes, thereby enhancing the likelihood of a successful and enriching career for graduates.

According to Dell (2018), in the higher education space, WIL has been dubbed a "silver bullet" for effectively combating societal inequality by increasing graduate employability. However, the challenge lies in its implementation, as the concept continues to be a source of contention among stakeholders (Dell 2018).

1.3 Research problem

WIL became an integral part of the teaching and learning pedagogy within the surveying profession at a National Diploma level across many of the Technikons and UoTs nationally over the past few decades, including Technikon Natal, ML Sultan Technikon, Mangosuthu Technikon and the Durban Institute of Technology all based in KwaZulu-Natal. It has become widely recognised as the cornerstone of student development and the interactions with industry has led students to understand and appreciate the mechanisms of real WPL and the dynamics of a professional working environment. Students have been known to develop on various scales, which is not limited to discipline specific knowledge but also in character building, life skills, teamwork, collaboration, communication and literacy skills, IT skills and work ethic. WIL presented an opportunity for students to reflect on their strengths and weaknesses while inculcating a sense of work identity and professionalism. This further allowed them to develop into mature young adults at a much faster pace ready to venture into a working community of professionals for them to make their mark on their profession and a contribution to the national economy and society at large. For the purposes of this study, the term ‘experiential learning’ and ‘work integrated learning’ will be used interchangeably.

Winberg *et al.* (2011) articulate the benefit and the challenge of WIL at the ex-technikons:

> The ex-technikons acknowledged and valued experiential learning, understanding that students develop important knowledge and skills in workplaces. They tended, however, to defer to the practices and requirements of work and industry, often valuing these over academic disciplines. The challenge WIL offers is to develop students employability in a broad, rather than a narrow, sense that includes and aligns theoretical learning with practice-based learning.

The impact and success of WIL in the National Diploma: Surveying programme was also highlighted during the department's SAGC 2018 accreditation visit with the following remarks:

> Although the NDipl is being phased out, it presented an opportunity for students to reflect on their strengths and weaknesses and also inculcate a sense of professionalism. The quality of the WIL reports submitted for review confirm the success of placing students with employers that have the in-house capacity to provide and supervise prescribed learning programmes during internships. Department/university staff to engage with the relevant persons in industry to generate a common understanding of the roles and responsibilities of all those who are involved with students in the work context. The experiential learning component of the programme contains an appropriate mix of assessment opportunities to enable students to recognise strengths and weaknesses in their work. More emphasis should be in place in the programme to promote the professionalism and ethics as part of the eco-system of the geomatics practitioner. Understanding the needs of employers and changes in technology are important factors to consider during curriculum design. *(*SAGC 2018*)*.

The SAGC accreditation visit in 2018 further elaborated on the importance of the Diploma and B-Tech qualifications in producing competent graduates: "The focus of the NDipl and BTech is on Geomatics technicians in the surveying environment who can apply their skill sets in various occupations to address the advanced technical workforce needed in South Africa and in the profession particularly" *(*SAGC 2018*)*. This extract underpins the importance of 'technicians' and 'technologists' to a greater extent, since the BBE: Geomatics qualification has superseded the previously phased out qualifications to make provision for registration in the 'technologist' category where graduates will still function in similar and perhaps more advanced roles fulfilling the requirements of the industry sector. The knowledge and application of emerging technologies is also considered as a key attribute for the new technologist.

As stated previously, the National Diploma: Surveying included one year of compulsory and monitored WIL embedded in the qualification. The diploma also included a skills (competency) test component, which formed module 2 of the surveying courses. This individual assessment was conducted every semester since the year 2000 to ensure that all students attained a reasonable level of proficiency in operating the equipment; and was actually formulated at the request of the civil engineering and surveying industry after members expressed concerns, about the lack of hands-on practical capabilities of learners entering the work sector. The test was then devised to ensure that students arriving in the employment arena had the basic essential surveying skills necessary to make a transition and adapt into real work environment. The Department also received constructive input from the Surveying/Geomatics Advisory Board and through experiential training student/employer visitations, regarding the skills testing component with favourable outcomes in terms of the students' practical development and proficiency in executing tasks. Furthermore, the national diploma had a significant component of practical work embedded in the survey subjects, which enabled learners to gain an adequate level of practice while increasing the level of proficiency in the designated tasks and activities to better prepare them for the WOW.

However, WIL in the form of actual WPL has now been excluded in the BBE: Geomatics qualification nor is it considered a mandatory requirement, and the qualification appears to be more academically oriented, structured and aligned. The lack of a WIL component with emphasis on career-focused education, could possibly result in a graduate who may exhibit deficiencies in practical knowledge, technical skills, and work-related proficiencies when compared to the traditional survey technician/technologist that industry has become accustomed to over the years, which may have further detrimental consequences for the learner and the industry sector.

This may impact on the public and private sector as companies and organisations will have to invest significant time, financial and human resources to equip graduates with the required skill sets and competencies to function effectively, responsibly, and productively in a professional workplace setting. Furthermore, skills competency tests are no longer being conducted in the new programme to measure, monitor, and evaluate the student's skills and capabilities prior to entering the industry sector. Cooper, Orrell and Bowden (2010) reiterate that combining curricular learning with work experience allows students the opportunity to integrate theory and practice in a real-world work setting, improving students' knowledge and understanding, and enhancing job-related capacities.

Another source of concern is that industry partners and stakeholders may doubt the credibility of the ‘university product’ in terms of quality, capabilities, attributes, competencies, and the overall type of graduate that they seek to employ to satisfy the requirements of a modern workforce that will meet performance expectations. The downside and possible reality are that potential employers may start to lose confidence if they are not convinced about the type of graduate entering the work sector. Historically, upon graduation, technician and technologist graduates from former Technikons and UoTs have collaborated with their professional counterparts i.e. land surveyors and qeomatics professionals in industry, to provide the necessary support in executing fieldwork and site activities, thereby facilitating the end product and deliverables. Engineering surveyors have a pivotal role to play in the built environment in terms of infrastructure development in the country. The industry relied on a well-rounded, skilled, and accountable graduate who could work to some degree independently, and with minimum supervision to produce accurate detailed surveys and deliverables of a high quality and standard. This contributed to sustained workflows and profitable business operations, as it was deemed more feasible to recruit survey technicians than traditional (professional) university graduates who were, to some degree, somewhat deficient in practical and technical skills, and lacking in sufficient experience to effectively cope with the industry demands from the first day of work.

A further notable concern in recent years has been the significant decline in the number of available bursaries, learnerships, internships, and scholarships, that are generally awarded by government and municipal organisations such as the Department of Rural Development and Land Reform (DRDLR), South African National Roads agency (SANRAL), Transnet, Eskom, Ethekweni municipality, Msunduzi municipality etc, to support WIL programmes and skills development for a number of deserving students seeking work experience and placement. This could very well be further exacerbated by the Covid-19 pandemic, so skills acquisition to drive economic growth and recovery may become a top priority for local and national government departments, where the influence of WIL in knowledge, and specialist skills and expertise development may be considered to support such interventions.

The importance of employability skills and graduate attributes are now receiving greater attention and urgency in the current South African economic climate, due to the impact of the Covid-19 pandemic, which has disrupted economies nationally and globally, led to liquidation and closure of businesses resulting in significant job losses, increase in unemployment rates, and which will now further compromise future job prospects for new graduates entering the labour market. The economic decline will also result in an increase in competition for jobs, which reflects the urgency for graduates to have the necessary capabilities and attributes to cope and succeed in the workplace, and to also contribute to the economic recovery and growth. WIL work placements may be a means by which these skills and attributes can be attained. Knowledge and skills acquisition can not only propel and support economic growth in South Africa, but also meet the needs of future infrastructural development in the built environment and associated sectors.

At the third annual WIL Africa Conference in Umhlanga, South Africa in 2018, Fazal Safla, the general manager of the Provincial Public Service Academy based in the premier's office, addressed key concerns expressed by conference organisers that WIL was quietly being dropped or reduced significantly at many of the country's UoTs, the very institutions essentially mandated to focus on practical skills and produce work-ready graduates. Safla stated with concern:

> We shouldn't even be discussing this possibility. We recently conducted a policy trend analysis and in terms of the National Development Plan, the White Paper for post-school education and training, the National Skills Development Plan and others, the silver bullet in all of those documents to deal with inequality is WIL: linking industry to education and strong partnerships. It is in policy, it is clearly articulated and what we should be talking about is how we can be more effective in integrating it. (Dell 2018).

Therefore, constructive dialogue around the possible future of WIL in academic programmes and its relevance to the higher education and industry sectors, is an important step to address the concerns voiced by industry members and possibly find common ground that will be mutually beneficial for all stakeholders concerned.

1.4 Motivation and significance of the study

The motivation behind the current study is to determine an industry perspective on the relevance of WIL in the BBE: Geomatics degree programme, to ascertain: whether the absence of WIL will create a vacuum of skilled and competent technicians in industry thereby affecting productivity, workflow and output; whether it will influence the type and quality of graduate entering the industry; whether it will affect the employability skills and job prospects of the graduates, and; whether it will affect the economic growth in the country. The issue of how graduates could be accommodated and monitored in the employment sector will also be considered as part of the study.

One may argue that the purpose of higher education is not merely to produce work-ready graduates for employers who can deliver from day one, but to also stimulate knowledge generation, personal and professional academic growth and encourage intellectual curiosity in graduates. This is perhaps true to some extent, however it is also apparent that the employment sector is a major contributor to the economy, so the rationale is that all universities and institutions of higher learning have a shared responsibility to equip students with the necessary employability skills to succeed in an evolving labour market and technological driven economy to improve their job prospects and hopes of becoming responsible and productive members of society.

According to Du Pré (2009), due to a transforming world, career education on its own cannot provide sufficient knowledge to sustain a lifelong career in a particular field. UoTs should provide the opportunity for a continual upgrading of knowledge and skills and be designated as specialists in ‘just-in-time’ education. The author envisaged that practical knowledge should be provided to graduates in a range of modules with variations in contact and distance learning programmes as and when required, saying: “Re-skilling, upskilling and multi-skilling activities would have to be creatively distributed over the careers and lifetimes of students, and in the process new and interactive relationships would have to be forged with local and international employers and knowledge providers”. Further, the added notion of making knowledge useful, together with responsiveness and relevance would be the influential factors. The author believed that "just-in-time" education would become the UoTs' signature and strength in the future. However, this visionary concept has not materialised at DUT, with the university leaning more towards a research-driven approach rather than a career-oriented educational strategy encompassing technical, technological, and vocational education on which its predecessors established their industry reputation.

The need for an educated, skilled, and motivated workforce cannot be undervalued. Most career professions like those in geomatics require specialist practical and technical knowledge, however all jobs also require some generic employability skills. WIL work placements may be one way of providing a means by which these essential skills can be achieved so graduates are able to market themselves, secure employment, and contribute to the economic sector. It is worth noting that skills development and workplace training are at the forefront of economic development. It is anticipated by economists that the battered economy will gradually recover in time, but in order to be well prepared for the upturn, universities need to ensure that they are producing graduates with relevant graduate attributes, higher level skills and a broad range of abilities so that they can make a smooth transition to the workplace, a readiness which employers value highly. It has been suggested that HEIs should explore ways of assisting students to gain these core skills alongside the specialist academic discipline knowledge to become globally competitive players in the labour market. Educational experts however further recognise that government, employers, and stakeholders need to also take collective responsibility and initiative for training the graduates they recruit, adding that industry partners should increase engagement with universities and offer high quality placements and work experience to encourage positive attitudes and facilitate the progression of graduates in the WOW.

Figure 1.7: Key industry partners and stakeholders in geomatics

Figure 1.7 above illustrates some of the key partners and stakeholders that contribute to the surveying and geomatics sectors in the KwaZulu-Natal region, and who have recruited a significant number of DUT students and graduates over the past two decades. In the interest of engaging, educating, and empowering future surveyors and geomatics practitioners to tackle the challenges of tomorrow and contribute to a growing demand in the geospatial industry, it is widely accepted that mutual partnerships with employers be established to sustain future collaborative WIL initiatives.

The reality is that HEIs have a significant role in shaping young minds and producing responsible and productive members of society who can further develop the country's infrastructure and assets and prepare graduates for the global stage while also addressing the skills shortage issue in the country. An investment in ensuring that graduates are equipped to tackle the challenges they will face in the work sector and maximising the available opportunities to them, will contribute towards economic prosperity, and enable the country to be well-placed in the future.

Additionally, the arrival of the fourth industrial revolution (4IR) or industry 4.0 requires individual skills sets and competencies to promote technology transfer and innovation, as we enter an age of digitalisation. It is understood that geomatics is the science and technology of gathering, storing, processing, analysing and delivery of geographic information, or spatially referenced information. New advanced emerging technology in the field such as GNSS, robotic total stations, reality capture (mixed reality, augmented reality, virtual reality), building information modelling (BIM) and point clouds, digitalisation (3-D scanning technologies, digital twins, smart cities, LiDAR systems), mobile mapping technology (UAV, UAS, drones), remote sensing, machine learning, artificial intelligence (AI), smart sensors, big data, internet of things (IoT) amongst others are disrupting the geomatics and geospatial industry. UoTs have to be prepared to produce a new generation of graduates that will not only possess the essential foundational academic knowledge, but equally important, possess the technological skills required in a professional work practice setting to remain relevant and competitive in this evolving world. Another necessary skills set is research capacity to adapt to changes and solve problems connected to the geomatics, engineering and the built environment. These technological skill sets may prove crucial in the realisation of smart urban cities, as well as in asset and infrastructure management, as one attempts to navigate through new virtual environments in a seamless integrated workflow.

The DUT ENVISION2030 strategic map refers to three statements of intent:

> Our people will be creative, innovative, entrepreneurial and adaptive to changes in the world;
> Our people will participate productively in the development of our region, country and the world;
> Our state-of-the-art infrastructure and systems will enhance an ecosystem created to achieve this vision (DUT 2020b).

The above statements broadly support the strategic aims of the university and appear to be somewhat aligned to meet the needs and demands of 4IR, with the expectation that UoTs will be to produce capable and productive graduates with enhanced technology and innovation expertise to identify and solve problems related to the geomatics, engineering, and the built environment sectors.

Reinhard and Singh (2011, cited in Reinhard *et al*. 2016), commented that WIL programmes should design strong learning objectives and outcomes that represent the perspectives and requirements of students, employers, and academics, and that the relationship between these three stakeholder groups is an important aspect of cooperative education. The author mentioned that students are likely to learn concepts in one semester that they may apply in the next semester at their designated partner companies, and as a result, it is critical that learning be practical, purposeful, and experiential (Reinhard *et al.* 2016).

This study seeks to increase our understanding of employers' and students' perspectives on WIL workplace learning, to assist in terms of informed decision making and best practices, and to establish whether WIL is relevant in the BBE: Geomatics programme. If so, to further establish if WIL could be effectively integrated into the new qualification, in accordance with industry and institutional requirements to produce knowledgeable, skilled, and competent practitioners for the country's workforce and the associated industries. This study will therefore be beneficial to all stakeholders including the university, employers, government, professional bodies, communities, and students, through means of increased collaboration. The study may further encourage lecturers, academic scholars, WIL co-ordinators, researchers, technical staff, and administrative personnel to further explore the concept of 'employability' amongst students in preparation for the WOW.

Feedback from industry practitioners may also provide useful information in terms of formulating refreshed, modern, and relevant training schedules, consistent with the latest technological developments, innovation, and professional work practices to ensure that learners are exposed to modern instrumentation, sensors, and advanced software, to meet and adapt to the needs and demands of 4IR.

1.5 Research aim and objectives

The overall aim of this study is to investigate and evaluate the historical impact of experiential learning or work integrated learning (WIL) in terms of the effectiveness and impact on students' overall personal and professional development in the National Diploma: Surveying programme; and to evaluate the relevance of WIL in the geomatics programme at the DUT, through interactions with industry practitioners within the surveying and geomatics fraternity, in the KwaZulu-Natal region.

The key objectives of the research, based on the perceptions of the geomatics industry and students/graduates are as follows:

Objective 1: To determine whether the experiential training (workplace learning) conducted in the National Diploma: Surveying, had a meaningful and positive impact in terms of the student's personal and professional development, and work placement.

Objective 2: To determine whether the absence of WIL will influence the type and quality of graduate entering the industry sector and if they will be perceived to be lacking substantive practical knowledge, skills, and technical expertise to cope with the industry demands and expectations.

Objective 3: To establish whether the absence of WIL will create a vacuum of knowledgeable, technically skilled, and competent technicians/technologists in industry thereby affecting industry productivity, workflow, output, and economic growth.

Objective 4: To determine whether the absence of WIL is perceived as an inhibitor to student's personal growth and professional development; and if this absence will affect the employability skills, graduate attributes, employment opportunities and job prospects of the graduates.

1.6 Overview of the Department student empowerment project

At the turn of the new millennium (early 2000), the then Durban Institute of Technology, Department of Civil Engineering and Surveying identified the need to create experiential learning opportunities for students to enable them to fulfil the requirements for the National Diploma qualification. The National Diploma: Surveying and National Diploma: Civil Engineering qualifications both contained one year of experiential learning embedded in the respective qualifications. Students were required to undergo twelve months work experience comprising structured and monitored training in a variety of tasks in order to graduate. The lack of experiential learning opportunities in a constrained industrial sector made it difficult to secure work experience and ultimately affected graduate throughput. Although limited experiential learning opportunities existed within the consulting and contracting disciplines at the time, these opportunities were simply not adequate for the number of students seeking placements. In many instances, employers required students to have “experience” before they would consider employing them. This resulted in considerable frustration for the students who needed a job, specifically to gain the experience – a catch-22 situation.

This prompted and inspired the department to devise an innovative student empowerment programme to address these specific needs which became known as the *Singakwenza Ndawonye – Together we Can* project initiative and led to the establishment of an in-house experiential training unit within the department.

The experiential training unit was designed with the following objectives in mind:-

- Provide students with a variety of quality work experiences.
- Teach students good work ethics and entrepreneurial skills.
- Give students the opportunity to establish contact and foster relations with numerous prospective employers/clients.
- Facilitate the ability of the students to obtain the necessary practical experience to complete their qualifications.
- Encourage the students to think big and aim high in their dreams for a productive and enriching career.

1.6.1 Goal of the empowerment project:

The ultimate goal of the empowerment project was to have a number of civil engineering and surveying students participating, preferably through joint ventures with established businesses including surveyors, engineers, consultants and contractors and to further facilitate the supply and placement of ‘student temps’ through a process of student secondment to established businesses, to enable a real transfer of skills with the elements of quality, productivity and accountability in mind. The actual number of students depended on the demand and work opportunities made available by the department. Approximately 60 students participated in the project over the years, and benefited enormously in a multitude of ways from this initiative. In fact, each student that participated in the project not only received the essential experiential learning to complete their chosen qualification, but they were also awarded an in-house bursary from the department to progress with their academic studies upon completion of their training.

1.6.2 Funding

The Department of Civil Engineering and Surveying initially funded the project. The department subsidised the purchase of vehicles, computers, software, consumables etc. to support the initial running of the unit. After a few months of productive projects, it eventually reached a stage where the work being undertaken by the students in collaboration with industry partners, generated enough income for the project to become self-sustainable. The project however was dependent on continued support from industry stakeholders and the institution.

1.6.3 Departmental support

The department initially appointed two contract staff in the designated capacities of Surveying Project Assistant and Experiential Training Co-Ordinator to oversee and facilitate the administrative management and marketing, as well as the skills training, mentoring and supervision of students on various projects. The researcher was one of the designated personnel at the time. Secondary support was also available from experienced academic staff from within the department when required, who were able to direct and guide students while they navigated through their formalised industrial practice requirements.

1.6.4 Researcher’s observations and experiences

The empowerment programme was well received by various stakeholders in the engineering and surveying sectors. Since students were generally appointed in groups of five to ten at a time, it became evident that there was a transfer of knowledge and skills from the current students in the programme to the new incoming students by overlapping the intake process, in preparation for the WOW. This process was successfully implemented and benefited learners as their work interactions and onsite experiences would facilitate a quicker grasp of industry tools and techniques to effectively complete the designated tasks and projects timeously to the required standards. Exposure to various workplace scenarios enabled them to develop a professional identity early in their careers by inculcating essential values that assisted in terms of responsibility, character building, leadership, teamwork, work ethic, integrity, accountability etc.

For many, it seemed to be an awakening that set them on a path to personal and professional progression. There was a notable increase in their level of understanding and competence, as well as a greater appreciation for civil engineering and surveying as a career. In subsequent semesters that followed their training, department lecturers would often report that students from the empowerment programme were grasping theoretical content more quickly and demonstrating a range of practical capabilities that set them on a path to success for their remaining studies. Past empowerment students who acquired valuable work experience and professional practice have become successful entrepreneurs in the establishment and management of their own survey business practices. Remarkably some of these practitioners now employ and train current DUT students and graduates.

The student empowerment programme demonstrated the influence that WIL had on students’ personal development and professional identity in the WOW. Below are some of the views expressed by previous students that participated in the empowerment project in 2006:

> a) Working at Singakwenza has provided me with invaluable experience. It has prepared me for the real world of survey with an experienced supervisor and survey assistant guiding us along-what more can a student ask for. In terms of equipment we are fortunate, as we have access to a wide range of sophisticated equipment, including Total stations, Digital levels, GPS etc. For me, the best part about working at Singakwenza is the exposure to different Surveyors and the different surveying methods and styles.
>
> b) It’s informative, a great initiative, that exposes you to the standards and work ethics of the industry in general.
>
> c) When looking back at the first day till today, I realise that I’m a completely different person, with the experience and all other things I have learnt i.e. work ethics, responsibility, and communication with other colleagues. I feel I can face the work industry and excel with all the experience and skills I have achieved at the training unit.
>
> d) I think this is a good training. It has prepared me as a person and as a future surveyor. I am satisfied with the training I have gained in all aspects.
>
> e) I have learnt a lot here, and the most fascinating thing is that it is easy to learn cos we learn from the more experienced students. Everyone gets a fair chance to gain some practice. We also have a good atmosphere at work

1.7 Brief overview of the research methodology

The study was conducted by employing a mixed-method approach incorporating quantitative and qualitative methods. A combination of both research techniques provided a holistic and rigorous approach to achieving the aims and objectives of the study and add credibility to the findings. However, emphasis was primarily on quantitative research techniques and data collection methods. Appropriate statistical techniques were applied, involving the organisation, analysis, interpretation, and presentation of the numerical data utilising either SPSS software or other appropriate data analysis software. Qualitative research techniques were utilised in analysing the employer and student perspectives arising from the experiential training report data set. Additionally, the open-ended question appearing at the end of both quantitative questionnaires allowed respondents an opportunity to express their views, opinions, and experiences, and to further elaborate on any aspect pertaining to WIL.

1.7.1 Research limitations:

This study was limited to the KwaZulu-Natal region and only considers the survey results pertaining to the National Diploma: Surveying and the BBE: Geomatics programme both at the Durban University of Technology, Durban campus. Other HEIs and programme offerings were not considered in this study, and therefore no comparative studies can be reported on.

1.7.2 Overview of chapters

Chapter 1: Introduction and background

Provides a brief overview and background to the study, states the research problem, motivation and significance of study and aims and objectives of the research.

Chapter 2: Literature review

A review of relevant literature pertaining to the significance of WIL, experiential training and co-operative education, and their relevance to the higher education and industry sectors.

Chapter 3: Research methodology

A mixed-method approach discussing quantitative and qualitative research design techniques, including population, sample selection, data collection methods and retrieval, recruitment processes, informed consent, confidentiality, limitations, ethical considerations etc.

Chapter 4: Data analysis and discussion of results

This chapter presents the evaluation and presentation of the measured data using descriptive and inferential statistics, including development of summaries, determining patterns, and applying statistical techniques which involves the organisation, analysis, interpretation, and presentation of the numerical data, and fulfilling the aims and objectives of the study.

Chapter 5: Conclusion and recommendations

Overall summary, conclusion and recommendations based on the results and findings of the study, as well as future research considerations.

References

All relevant literature used in the study are arranged in alphabetical order utilising the DUT Harvard referencing style and *EndNote X8.2* software referencing tool.

Appendices

This includes supporting documents, e.g., participant letter of information and consent form; questionnaires; gatekeeper approval letters; IREC approval certificate etc.

CHAPTER 2: LITERATURE REVIEW

2.1 Co-operative education on the international stage

In simple terms, co-operative education is regarded as a form of WIL whereby periods of academic study at the university are alternated with periods of work experience in various disciplines of business, commerce, industry, and government.

Co-operative Education and Work-Integrated Learning Canada (CEWIL) states that co-operative education is a structured method of integrating classroom-based education with practical work experience. A co-operative education experience provides academic credit for structured work experience and falls under the umbrella of WIL together with internships, service learning and clinical placements. It is however distinct as it alternates a college or university term with a workplace term in an organised manner which involves a formal structured partnership between the academic institution and the company/employer with the intention of advancing the education of the student (CEWIL 2020).

The World Association for Cooperative Education (WACE) is an international professional organisation, based in Canada, dedicated to promoting WIL by conducting research involving HEIs, business sectors, and governments. It is the only international organisation devoted to the development, expansion, branding, and advocacy of cooperative and work integrated educational programmes in industry and educational institutions. WACE coined the term cooperative and work-integrated education (CWIE) to acknowledge and encompass all forms of experiential learning used by business and educational institutions to produce the next generation of global professionals. “CWIE is an encompassing term that includes: Cooperative education, Internships, International co-op exchanges, Study abroad, research, Clinical rotations, Service learning and community service”. WACE aspires to develop, implement, and sustain events, initiatives, and services that support and expand the global industry and institutional partners network as well as the CWIE community as a whole (WACE 2020).

Co-operative education as an educational strategy is highly valued internationally and remains a key global driver to advance all forms of WIL where academic studies are to be integrated with professional work experience. This approach may yet prove useful and effective in the newly aligned degree programmes at the DUT, with the appropriate constructive engagement and support of the various stakeholders within the geomatics and built environment professions.

2.2 Co-operative education at DUT

The DUT has a dedicated Department of Co-Operative Education. The Department through its experiential learning policy, is active in driving the importance and philosophy of WIL throughout the university ecosystem, through collaborative initiatives and partnerships between the university, public and private sectors, in an effort to enhance workplace practice and prepare graduates for the WOW. They provide assistance to students seeking WIL opportunities and may facilitate the placement of students with employers on their database, and through programmes such as the Employability Improvement Project (EIP).

The DUT co-operative education website states that:

> Co-operative education is an integrated approach to higher education which combines academic learning with associated workplace experience achieved via the relationship between the university, its students, industry and the community. Industry includes all sectors of commerce and industry as well as small business and the informal sector and regional, provincial, and state departments. Co-operative education includes liaison between the university, employers, professional bodies, professional societies, and other relevant organisations, including student bodies. It includes experiential learning/in-service training which requires the placement of a student in a relevant industry for integrated workplace learning, with the emphasis being on the student learning by doing. To this extent relevant industries and communities will be involved extensively in the development of curricula to ensure that curricula are relevant to industries needs and the university student is employable, i.e., that the students have the relevant skills and practical ability required by industry. Partnerships with industry are not limited to placement of students for

> experiential learning. Applied/industrial problem-solving research as well as innovative industrial research will also be strong components of these partnerships, as will the funding aspects of specific projects that will ultimately enhance the training of the students and the partnership generally. (DUT 2020a)

The EIP is a joint collaborative initiative which started in 2011 between the DHET and the Japanese International Co-operation Agency, and is funded through the National Skills Fund. Its purpose is to promote the employability skills of university students as part of the national development plan. There are several participating universities in South Africa including the DUT where the Department of Co-Operative Education is responsible for the administration and implementation of the programme. This innovative project is aimed at equipping students with communication skills, interpersonal skills, employability skills, work ethics and competencies to enable the student to adjust to new environments and to bridge the gap between tertiary institutions and the workplace. It covers various attributes such as creativity, teamwork, leadership, communication, self-management, critical/logical thinking, and problem identification, and is usually conducted over a week-long course in the final year of study. The programme comprises theoretical components and hands-on practices in a simulated workplace environment in the classroom and is assessed in three sections, namely theory, practical and overall competency. Students are expected to participate and complete several tasks consisting of assignments, practicals, calculations, discussions, and presentations with a certificate being awarded at the end of the session.

As part of the EIP programme, workshops are conducted to improve the skills of staff and students to address the needs of the 21st-century employment demands. The Director of Co-Operative Education at DUT, Shakeel Ori, indicated that many DUT staff and students have benefited from the EIP training and the department aspires to continue their fruitful association with Japanese International Co-operation Agency and their respective industry partners (DUT 2019).

The DUT is also fostering new relationships by expanding its footprint into technical and vocational education strategic partnerships. At a virtual breakfast engagement meeting in April 2021 involving selected partners and representatives from the DHET, Technical and vocational education and training (TVET) colleges and Sector Education and Training Authorities (SETAs), DUT reaffirmed its commitment to forming sustainable partnerships and MoUs with TVET colleges. This venture underpins the value of technical and vocational education in a UoT ecosystem.

Mr Zwakele Ngubane, Director: Advancement and Alumni Relations highlighted that DUT is a very keen participant and stakeholder in the higher education environment, in terms of ensuring that it is an engaged university. He said:

> We want to ensure that we engage with all possible stakeholders, in ensuring that we maximise the benefits to our society, to our community and to our stakeholders. We will be discussing some critical issues around how the TVETs and the universities, in this particular instance DUT itself, can engage more meaningfully so that we are able to work together in fostering and facilitating that collaboration that would allow and benefit our students in terms of ease of movement and articulation between the TVETs and the universities. (Zuma 2021).

Prof. Netswera, DUT's Executive Dean at the Faculty of Management Sciences further elaborated that the intention is to make sure that DUT has engagements that are mutually beneficial, so that they can discuss a variety of issues pertaining to how they could work together in order to ensure that matters of articulation between TVET colleges and the DUT are smoothly facilitated. Such matters include how the curriculum can respond to the interests and needs of industry; capacity development for the TVET colleges and for DUT; and making sure that this arrangement can be sustainable. He emphasised that in the near future, DUT must have an MoU that articulates all of those interests and how they will mutually engage. This is to ensure that WIL is smoothly facilitated between TVET colleges, industry, supported by the SETA and other stakeholders who are highly interested in these development initiatives. Prof. Moyo highlighted that DUT's policies at a national level encourage it to work with the TVET sectors. She indicated the importance of SETA in playing a role in bridging the gap through WIL, which is linked to skills training, job creation and making sure that the graduates are able to find and/or create jobs. All speakers expressed the importance of collaboration in producing purposeful graduates (Zuma 2021).

2.3 WIL in the higher education sector

The role of HEIs has always been to educate and train university graduates to become responsible and productive members of society, who will contribute to social cohesion, economic growth, and the creation of a quality workforce through the professional development of relevant industry skills.

Kramer and Usher (2011) and Peach and Gamble (2011) (both cited in Ngwane 2016), explained that WIL broadly refers to educational programmes that comprise a workplace component as well as classroom instruction or an individual programme of study. The WIL strategy has expanded substantially in recent years and is currently used in major universities around the world with the goal of combining learning opportunities with real-world experiences in one integrated package. Universities, for example, are increasingly emphasising not only the acquisition of pure academic information, but also the development of relevant skills that can assist students in achieving success in real-world circumstances (Ngwane 2016). The historical footprint of the EL component in previous diploma qualifications which facilitated student placement and exposure to a professional practice environment did not deter some academic departments from abandoning the WIL strategy in the new HEQSF aligned degrees. It would appear that an academic research-oriented approach was prioritised over a career-focused educational approach for the next generation of emerging graduates.

Atchison *et al*. (cited in Freudenberg, Brimble and Cameron 2011) commented that WIL programmes are typically described as “educational programmes which combine and integrate learning and its workplace application, regardless of whether this integration occurs in industry or whether it is real or simulated”. WIL programmes are receiving increased global attention with universities being encouraged to implement them. One of the advantages is that “WIL has provided universities with an opportunity to offer a better product that students will appreciate as a pay-off for their investment" (Abeysekera 2006, cited in Freudenberg, Brimble and Cameron 2011).

International trends indicate that since classroom-based instruction alone does not generate future-fit graduates who are adequately equipped for industry, WIL and education-industry partnerships are on the increase in HEIs. The importance of WIL, or learning for performance, in the formation of the ideal graduate profile, cannot be overstated. A graduate's competency profile should comprise both discipline-specific knowledge, skills, and attitudes, as well as general cognitive, behavioural, and technical abilities, attributes, and qualities (Govender and Taylor 2015).

Winberg *et al*. (2011) elaborate that WIL can also influence the work preparedness of graduates to enter and contribute to South African society and the work sector. They explain that universities are in the business of providing a wide and critical education that allows students to actively engage with both the world of science and the workplace.

The South African higher education system comprises research-intensive universities, comprehensive universities, and universities of technology, all with a tradition of providing a career-focused education. Since WIL, in its various forms, has always formed an important part of technical, vocational, and professional higher education, universities found it beneficial to prepare students for the WOW, and to assist students to acquire practical experience through internships or service-learning projects. The WIL approach seeks to establish solid connections between the world of teaching and learning, and the world of professional practice. There are four distinct curricular modalities that can be drawn on in developing a WIL programme, namely: "Work-directed theoretical learning (WDTL), problem-based learning (PBL), project-based learning (PJBL), and workplace learning (WPL*)".* It should be noted, that WPL is commonly referred to as WIL in a South African context (Winberg *et al.* 2011).

Jackson (2013) highlighted that in the higher education sector, WIL refers to on-campus and WPL activities and experiences that combine theory and practice in academic learning programmes. This includes work placements, internships and practicum; PJBL; and service learning. It is the product of a partnership between industry and higher education to improve student learning by facilitating the application of theory to real-world situations.

The literature acknowledges the significance of WIL in terms of a professionally oriented education in the higher education sector. It reaffirms the importance of all stakeholders in the WIL programme, i.e., universities, students/graduates, government and public and private sector employers. This is of relevance to the geomatics profession, which requires capable and work-ready graduates to perform competently in the engineering and built environment sectors.

2.4 WIL at a University of Technology (UoT)

Universities of technology (UoTs) were established in the year 2003 and have a specific role to play in the higher education landscape. Their primary goal is to enhance technical and vocational education and deliver "work-ready" graduates with the latest and relevant skill sets and knowledge, to make a smooth transition to the employment sector.

Du Pré (2009) provided an appropriate narrative of what UoTs should be focusing on. HEIs such as UoTs specialises in making knowledge useful and constitute a dynamic and appropriate higher education system for South Africa. He explained that UoTs should provide more learning opportunities for students, such as addressing what students need to become more skilled, competent, and employable, being more employer-centric, providing continuous upgrading through short learning programmes and courses, bringing the institution into the workplace, and liaising directly with employers on a regular basis to ensure that prospective employees receive relevant education. A UoT should develop innovative strategies to attract employers to present practical issues and problems for students to tackle during their internship. "The *Technology* refers to the effective and efficient application of the accumulated know-how, knowledge, skills and expertise that when applied will result in the output of value-added products, processes, and services" (Du Pré 2009).

The author further elaborated that universities of technology were characterised by some of the following traits:-

- A strong corporate orientation focus.
- Concerned primarily with the development of vocational and professional education.
- Technological capabilities as important as cognitive skills.
- Educating and training a new generation of knowledge workers.
- Designing a curriculum around graduate profiles outlined by the industry and professions.
- Service to industry and the community.
- Relevant programme offerings.
- Responsiveness to and the realisation of the requirements of industry, community, and society.
- Emphasis on scholarship innovation and R&D for the development of new technologies.
- Transfer of technology.
- Research-informed.
- (Du Pré 2009)

According to Du Pré (2009), WIL is an applied learning technique that entails a structured educational curriculum that incorporates productive relevant work experience, academic study, and 'professional reflection'. Embedded in the technological higher education sector is compulsory experiential learning which provides students with opportunities to gain relevant and meaningful work experience. The principal benefit is that students receive experience in a professional practice setting during their formal studies and enter the workforce with an understanding of the marketplace, corporate sector, organisational structures, and employer expectations.

Students are provided with practical and creative scope, and potential for career advancement and personal growth in their chosen field. WIL has the added benefit of allowing students to "hit the ground running" when they enter the workplace, which is advantageous to both students and companies. Employers therefore do not have to invest valuable time and resources training employees who only possess theoretical background knowledge. It is expected that WIL will become even more relevant in UoT programmes because of the increased desire, demand, and necessity in industry for graduates who are already conversant with the WOW before they are offered employment. The author stated that graduates who are work-ready are in high demand among small and medium businesses, who do not necessarily have the capacity, money, or resources to invest in experiential or on-the-job training for graduates (Du Pré 2009).

What was envisaged by Du Pré has not transpired which has led some educational specialists to question whether the UoTs have lost their way and deviated from their core mandate, and in doing so, lost their purpose and identity somehow in the transition phase from technikon to university. These specialists further question if they are perhaps failing in their obligations of creating a 'work-ready product' for the industries, economies and societies that they serve, as well as in their responsiveness to the broader national community.

2.5 The impact of WIL on student work readiness

WIL has, over a period of time, become a central aspect of the holistic development of students, enabling them to make the transition from the higher education sector to the workforce sector. Numerous studies have revealed that WIL makes a significant contribution to the work preparedness of students.

Freudenberg, Brimble and Vyvyan (2010, cited in Govender and Wait 2017) state that employers expect HEIs to provide a solid knowledge base for their graduates and are concerned should those graduates be unable to apply the acquired knowledge in the workplace. A growing number of reports argue that a strong disciplinary knowledge base alone does not necessarily secure employment for the graduate. WIL can improve a student's work readiness and ability to transfer theoretical knowledge into the practical implementation (Govender and Wait 2017).

Borg, Turner and Scott-Young (2017) explain that student work job preparedness refers to the acquisition of relevant skills and information that enable students to contribute meaningfully to industry and aid them in their transition from student to practitioner. An employee's smooth transition into the workforce leads to increased interactions in the workplace, which is beneficial to both the employee and the business. Employees in the built environment are subjected to high levels of work-related stress, highlighting the necessity for built environment professionals to be adequately prepared to join the workforce. While work preparedness is usually designated for graduates who have completed their qualifications, but there has been a noticeable increase in the number of built environment undergraduates who combine work and study before graduation. This practice challenges HEIs to consider that these students need to be work ready prior to the completion of their academic instruction. Research notes that student work readiness can be achieved through collaboration between HEIs, industry and students. Work readiness is recognised as a graduate attribute that is commonly used in reference to graduates who have completed their qualifications and have commenced their professional career in the employment sector. According to Nettleton, Litchfield and Taylor (2008) and Caballero and Walker (2010) (both cited in Borg, Turner and Scott-Young 2017), work readiness as a concept has various labels, including: "work preparedness, graduate employability, transferable skills, key competencies, and generic attributes".

Smith *et al*. (2009, cited in Peach and Gamble 2011) are of the view that the educational worth of WIL is through the development of so-called generic employability skills and capabilities that support graduates to become effective in remunerated employment, irrespective of specific occupational and workplace requirements. From this perspective, a key objective of WIL is to combine and complement academic instruction, knowledge, and skills, while integrating some aspects of personal career awareness and development. Career development learning entails students learning about themselves, and the manner in which they interact with the WOW (Peach and Gamble 2011).

Moreover, work readiness has also been recognised as a growing topic of interest amongst businesses and employers globally, and so preparing work ready graduates is perceived as an industry wide objective. Further, due to the evolving climate of the workplace, the degree to which graduates are "work ready" is viewed as an indicator of their potential for job performance, success, and career advancement. A work ready graduate is regarded as one that is equipped with the necessary knowledge, skills and expertise in the chosen occupation to make a smooth and successful transition into the workforce, and is therefore able to make a positive contribution to his or her new organisation, employer, industry, communities and society at large (Borg, Turner and Scott-Young 2017).

According to Watts and Pickering (2000, cited in Borg, Turner and Scott-Young 2017), integrating work and study has a number of advantages for students, including the development of transferable employability skills such as organisational, interpersonal, and time management abilities. Savage, Davis and Miller (2010, cited in Borg, Turner and Scott-Young 2017) state that the "university plays a crucial role in ensuring graduates develop lifelong learning skills and attributes that can carry them onto a long and fruitful career." However, Cranmer (2006, cited in Borg, Turner and Scott-Young 2017) highlights that while it is acknowledged that tertiary institutions play a critical role in building graduate work preparedness, it has been questioned whether educational institutions are the primary locations for students to gain employability skills. Mason, Williams and Cranmer (2009, cited in Borg, Turner and Scott-Young 2017) suggest that universities should motivate for more involvement from industry in the selection and development of employability criteria.

The need for work ready graduates is gaining global traction. Employers advocate for the integration of practical skill development into university programmes, arguing that that this would bring graduate work readiness and desired employability skills closer together. It was also established that "to prepare work ready students, university curricula should be designed by universities through corroboration both with industry employers and the students themselves" (Cavanagh *et al.* 2015).

Smith, Ferns and Russell (2014) confirmed in their study that WIL placements do have an impact on student work-readiness and contribute to employability capabilities, as do simulated activities. The authors noted that the impact of work placement exceeds that of simulation. The data revealed a number of key elements of the WIL placement experience that were essential for ensuring quality student outcomes, as follows:

> Given the dynamic nature of both the labour market and the higher education sector, it is both prudent and timely that the sector gathers evidence to support the inclusion of WIL in curriculum. An experiential curriculum enhances the student experience and facilitates the development of work-ready graduates considered pivotal to a sustainable, innovative, and globally competitive economy.

While the principal findings may not come as a surprise to WIL practitioners, the aspects of curriculum design and student experience that emerged from Smith, Ferns and Russell's (2014) study provide direction for decision making around the development and implementation of WIL programmes.

It is public knowledge that in the labour market candidates who possess workplace readiness skills are more in demand than those who lack the necessary work readiness skills. Employers aim to recruit candidates who display the appropriate level of aptitude and skills to perform the necessary tasks. The preference is for workers who can make sound decisions, exercise critical thinking, have the capacity to acquire new knowledge and easily adapt to various work situations. These types of candidates are better equipped to succeed in an evolving job market. Workplace readiness skills also provide employees with the confidence and proficiency to pursue work advancement opportunities to progress professionally. Companies who hire skilled and proficient workers achieve higher levels of productivity because employees perform their jobs efficiently and effectively, meeting targets and accomplishing corporate goals and objectives.

2.6 WIL and graduate attributes

Graduate attributes are considered as essential characteristics and qualities that graduates should possess upon exiting the university system in order to secure gainful or lucrative employment, to integrate into the country's workforce, and to contribute to economic development, community upliftment and societal impact.
According to Bowden *et al*. (2000),

> Graduate attributes are the qualities, skills and understandings a university community agrees its students should develop during their time with the institution. These attributes include, but go beyond, the disciplinary expertise or technical knowledge that has traditionally formed the core of most university courses. They are qualities that also prepare graduates as agents for social good in an unknown future.

McCabe (2010) describes graduate attributes as the skills, knowledge, and abilities of university graduates, beyond disciplinary specific knowledge, as applied to a variety of contexts. They are regarded as skills, abilities and dispositions that translate and facilitate higher education knowledge and learning, which must be transformed into a discipline context in order to make meaningful and logical sense (McCabe 2010). Furthermore, the University of Stirling explains that graduate attributes are the high-level qualities, abilities and understandings that a student should obtain, derived from the learning and experiences they encounter while at university. This 'graduateness' distinguishes them from individuals who do not possess a formal education and is the added value that graduates can enjoy and share with companies and the wider community. They equip students and graduates for life long personal development, professional learning and to make a successful impact on society (University of Stirling 2021).

The impact of WIL on achieving and promoting graduate attributes are evident in existing literature. It is apparent that WIL can prepare students with the essential generic skills by offering an enriching, active and contextualised learning experience.

Powell, Tindal and Millwood (2008), Coll and Zegwaard (2006) and Ishisaka *et al*. (2004) (all cited in Govender and Wait 2017) argue that classroom-based instruction on its own is insufficient to produce future-fit graduates. The objective of WIL is to encourage learning for performance which is considered as an essential aspect in the development of the preferred graduate profile. A graduate's competency profile should therefore comprise discipline-specific knowledge, skills, and attitudes, as well as generic cognitive, behavioural, and technical abilities and attributes relevant to the workplace. WIL and WPL are gaining momentum within HEIs, including South Africa.

as there are definite academic, personal, professional, career and work ethic benefits (Govender and Wait 2017).

Hager and Holland (2007) elaborate further, stating that the workplace can provide individuals and groups with opportunities to expand on and integrate what they have learned in the classroom, lecture, or laboratory. In certain circumstances, workers at any level can continue to expand their knowledge, comprehension, as well as their repertoire of skills and dispositions. Work-based learning is recognised as an important component of lifelong learning since it provides a setting for both personal and general forms of learning, as well as the advancement of technical and/or professional knowledge. On a global scale, what is referred to as 'generic skills', 'core skills', or 'basic skills' or, more recently, 'employability skills', has received increased educational focus. Sometimes they are referred to as ‘competencies’ rather than skills. Generic skills usually cluster around key human activities such as communication, collaboration, knowledge acquisition and problem solving. The emphasis on generic skills has expanded across education systems where they are now often referred to as ‘graduate attributes’. In the higher education landscape, a range of these graduate attributes has received attention. These have been identified by Hager and Holland (2007) as thinking skills, such as

> logical and analytical reasoning, problem solving, and intellectual curiosity, effective communication skills, teamwork skills, and capacities to identify, access and manage knowledge and information, personal attributes such as imagination, creativity and intellectual rigour, and values such as ethical practice, persistence, integrity and tolerance.

This group of various qualities, abilities and capacities differs from the discipline-specific knowledge and technical skills that have historically been linked with higher education (Hager and Holland 2007).

Fleming and Haigh (2017) comment that students, workplace supervisors and mentors, and academic supervisors share a general understanding that the student’s development of employability skills and their acquisition of experience in industry are the principal intended outcomes of WIL programmes. Cooperative education experiences, on the other hand, should ideally allow students opportunities to learn to combine theory and practice, to further develop their personal and professional identities, and to traverse the critical ethical aspects of being a professional (Fleming and Haigh 2017).

For students, acknowledging that they need to maintain high standards, a sound work ethic and a professional attitude, and collectively inspire and motivate others, improve the overall enjoyment and experience of the placement. Fleming *et al*. (2009, cited in Martin and Rees 2018) comment that being in the workplace environment provides opportunities to grasp concepts about professional work ethics and demonstrate values that support an organisation's culture of honesty, trustworthiness, courtesy, and conscientiousness.

According to Ferns, Campbell and Zegwaard (2014), WIL is an effective technique for illustrating authentic learning and providing evidence of student outcomes, varying from low to high degrees of authenticity and engagement. For students, the advantages of workplace-based WIL include career clarification, industry linkages, speedy employment following graduation, as well as critical thinking, research abilities, time management, disciplined thinking, ability to engage with workplace norms and professional behaviour, and improved overall academic performance.

Graduate attributes, also known as employability skills, are transferable, non-discipline specific learning outcomes that a university graduate should achieve via their university education and which can be applied in study, employment, and life (TEQSA 2012, cited in Hall, Pascoe and Charity 2017). WIL provides a platform for students where the application of knowledge and skills in a professional work environment is attained while under supervision, which allows for the development of key graduate attributes that are transferable across an industry (Tinning *et al*. 2012, Huq and Gilbert 2013, cited in Hall, Pascoe and Charity 2017).

A study conducted in the Exercise and Sports Science programmes at Federation University Australia, established that the key graduate attributes of communication, discipline specific knowledge and skills, and to some extent, global citizenship were achieved throughout WIL experiences, regardless of whether the experience was positive or negative. Lifelong learning, the fourth most common graduate attribute, was not identified as being obtained through WIL experiences by Exercise and Sports Science students, and will be the subject of future investigations to determine when it is recognised or acquired (Hall, Pascoe and Charity 2017).

Another relevant study conducted by the School of Tourism and Hospitality Management at Southern Cross University, established that students obtained key employability skills and graduate attributes during their studies. The study aimed to demonstrate how the process of engaging employers to provide feedback on student proficiencies could be embedded in WIL to assist students, employers and the university. This strategic approach allowed for a better understanding of how skills learned in the classroom might be further enhanced and utilised in the workplace, as well as ensuring that educational programmes and labour market demands were well aligned with each other. By identifying the skills, proficiencies and attributes that could be evaluated by industry partners, the university's decision to involve industry in developing student's employability and graduate attributes contributed positively to a broader evidence base on which to make crucial future curricular decisions. This information can be used to foster improved relationships between industry and academia while improving curriculum, overall graduate learning outcomes and quality assurance processes. The findings revealed that the employers scored students highly on their attainment of graduate attributes and employability (Baker 2014).

Griesel and Parker (2009) revealed in a South African study that there is a growing call from businesses for graduates to have extended exposure to the workplace while at university. There is also a need to improve students' career literacy while they are studying at the university, which should address a multitude of issues from life skills to soft skills, from instilling a work ethic to personal initiative. This aspect of 'graduateness' deserves much greater attention. From the perspective of higher education, the study concluded that employers' perspectives encompass an understanding of the demands of a changing WOW and, implicitly, the demands that the future will place on new graduates entering the workplace. Therefore, the function of higher education cannot be treated in isolation and must assume responsibility for producing logical, responsive and intellectually well-grounded individuals who are flexible, adaptable and can rapidly adjust to new demands, expectations and challenges (Griesel and Parker 2009).

Further research on WIL programmes have also demonstrated increases in student work related knowledge and skills, improved attitudes and behaviours towards work readiness, significant personal development of students and the development of generic skills. This has prompted HEIs to start developing their own set of graduate attributes, utilising generic skills research to develop WIL curricula (Freudenberg, Brimble and Cameron 2011).

At the DUT, as part of their curriculum renewal project initiated in 2010, the university embarked on a mission towards the development of a profile of graduate attributes that would produce a holistic well-rounded graduate and result in responsible and productive citizenship in a changing economy and world. The intention to develop Graduate Attributes at DUT was first evident in the Strategic Goals and Objectives for 2009 – 2018.

The ambition to develop graduate attributes gained further momentum with Prof. Ahmed Bawa, the then Vice-Chancellor, declaring the following goal:

> If DUT wants to produce globally portable citizens, able to engage effectively with knowledge generation and management in increasingly diverse and globalised workplaces, then DUT's curriculum and pedagogy must be intentionally designed to prepare our graduates for employment, while simultaneously preparing them for critical citizenship in an emergent and still fragile democracy. (General Education Guidelines, Senate 2012, cited in Sattar and Cooke 2014).

The official graduate attributes that were developed after consultations within the DUT academic community appear in Table 2.1 below.

Table 2.1: DUT graduate attributes

Graduate Attributes:	Employability skills:
1. Critical and creative thinkers who work independently and collaboratively	Problem solving (critical thinking: inquiry and analysis; creative thinking); teamwork; leadership; relationship management; resourceful and responsible; flexibility and adaptability; positive attitude
2. Knowledgeable practitioners	Knowledge and professional practice; integrative learning; problem solving (discipline); quantitative reasoning; project management; digital and information literacy; research literacy; academic literacy; modern tool usage – technology applications; leadership; flexibility and adaptability, positive attitude
3. Effective communicators	Written and oral communication; technology mediated learning
4. Culturally, environmentally and socially aware within a local and global context	Ethical reasoning; intercultural knowledge and competence; civic engagement; social responsibility; global learning; global citizenship; environment and sustainability
5. Active and reflective learners	Lifelong learning; reflection and evaluation; personal and intellectual autonomy; career management; integrative learning; flexibility and adaptability; positive attitude

Source: Adopted from Sattar and Cooke (2014)

Furthermore, as an integral part of the curriculum renewal project, DUT decided that General Education (GE) would also become a key focus of all curricula in an endeavour to assist students to think critically, develop values, understand traditions, and respect diverse cultures and opinions. The guideline for General Education identifies a list of competencies that are pivotal to the attributes of the graduates of the university as shown in Table 2.2 below.

Table 2.2: DUT general education competencies

Education competency:	Description:
1. Basic proficiency and competencies including:	a) Information literacy
	b) Communication (oral and written)
	c) Numeracy
	d) Technology applications
2. Innovation, including:	e) Entrepreneurship
	f) Leadership
3. Social responsibility, including:	g) Ethics
	h) Diversity
	i) Critical and engaged citizenry embedded
	in a local and global context
4. Personal development, including:	j) Self-awareness
	k) Self-directed and life-long learning
5. Broad understanding of their chosen	l) An appropriate discipline or professional
discipline and/or profession, including:	approach to knowledge production
	m) Workplace adaptability'

Source: Adopted from Sattar and Cooke (2014)

Many of the desired attributes and general education competencies mentioned above may be achievable through innovative, well-structured and relevant WIL programmes to add value to the curricula. The supporting literature explains how some international HEIs have successfully integrated WIL into their curricula and received favourable and constructive reviews from industry partners and stakeholders, with beneficial outcomes for holistic student development.

DUT may have to re-think and re-evaluate their position and strategy on vocational and technical education with relevance to their new programmes, for economic and societal impact in line with the latest strategic plan, as it is expected that a graduate developed at a university should, ideally, be reputable, well recognised, acknowledged and accepted by the work sector, as having a suitable foundation of educational knowledge, relevant skill sets and attributes to adapt and function effectively and productively in a modern professional work environment.

2.7 The influence of WIL on 'employability'

WIL contributes significantly to the aspect of 'employability', which is an essential attribute for graduates to secure employment and discover new career opportunities in a changing and competitive labour market.

Hillage and Pollard (1998, cited in Jollands 2017) describe 'employability' as a concept that encompasses discipline knowledge, abilities and personal attributes that empower an individual graduate with the ability to gain or maintain work or employment (Jollands 2017). It is widely accepted that work experience in a specific discipline or profession is the best way to develop employability.

As Ngwane (2016) points out,

> the national debate on graduate employment has moved from the narrow focus on a set of essential core skills within the undergraduate curriculum. WIL programmes are becoming popular with students, government, employers, and universities. A major benefit of a WIL programme is the increased employability of students, and this matches well with the present trend whereby students expect a pay-off from their investment in education. Various initiatives have been introduced to prepare students for graduate jobs rather than for any job. This includes developing critical, reflective abilities, skills for self-career management and the maintenance of employability and career progression.

WIL and its obvious contribution to employability is not a new approach, as many fields demonstrate a long proud tradition of work placements and simulated work experiences to develop graduate competency. For many professional qualifications, some type of practice-based activity that develops and reinforces abilities, or evaluates the application of theory in practice, has become the norm rather than the exception (Smith, Ferns and Russell 2014).

Spowart (2011) and Gamble *et al*. (2010) (both cited in Iipinge, Batholmeus and Pop 2020) reported that employers depend on HEIs to develop graduates who not only have a theoretical understanding of their chosen professions, but also the practical skills and expertise to think independently, critically and adapt to new and demanding situations. Employability skills including communication, teamwork, interpersonal skills, and problem solving, tend to be highly valued by employers. Hence, universities need to prepare students with not just intellectual capabilities but also applied practical soft skills which make them more employable. Furthermore, HEIs should provide WIL programmes that promote the enhancement of the student's capability to secure employment and perform to the required work expectations (Khalid *et al*. 2014, Lowden *et al*. 2011 cited in Iipinge, Batholmeus and Pop 2020).

Knight and Yorke (2004) and Peach and Matthews (2011) (both cited in Ferns, Campbell and Zegwaard 2014), explain that "Work integrated learning (WIL) is internationally recognised and nationally endorsed as a strategy for ensuring students are exposed to authentic learning experiences with the opportunity to apply theoretical concepts to practice-based tasks, ultimately enhancing graduate employability" (Ferns, Campbell and Zegwaard 2014).

Rowe and Zegwaard (2017) further emphasise that WIL is a key strategic approach for promoting graduate employability, a concept that has expanded in recent years, and which encapsulates a diverse range of abilities, qualities, attributes, and other indicators such as networks, professional identity, and active citizenship.

Globally, there has been an increasing emphasis on the role of HEIs in facilitating employability and graduate employment, as indicated by the rise of university graduate employment destinations, as a major proxy measure of the value of a university education. An increasing number of universities in New Zealand, Australia, and the United Kingdom are now incorporating WIL programmes in their degree qualifications with the purpose of improving graduate employment prospects (Burke *et al.* 2017). Holmes (2013, cited in Rowe and Zegwaard 2017), commented that this perspective is based on the premise that universities can and should produce 'work-ready' or 'employable' graduates.

Education and training build human capital, which translates into improved income for individuals and therefore national economic growth. To increase such effects of education and training, an interface between classroom-based knowledge and skills and workplace-based skills is required to convert the value of knowledge and technical skills into added economic value. This interface is called employability skills. The improvement of employability skills is essential for human capacity development and for national development (DUT 2021c).

According to Griesel and Parker (2009), a more holistic and cognitively based approach to skills acquisition has emerged, focusing on graduates' capabilities and dispositions, and in particular their ability to learn and continue learning in a professional work setting. Yorke (2006, cited in Griesel and Parker 2009), suggests:

> … employability goes well beyond the simplistic notion of key skills, and is evidenced in the application of a mix of personal qualities and beliefs, understandings, skilful practices and the ability to reflect productively on experience … in situations of complexity and ambiguity.

Yorke and Knight (2006, cited in Griesel and Parker 2009) state:

> Employability is influenced, by four broad and inter-related components: skilful practices (communication, management of time, self and resources, problem-solving and lifelong learning); deep understandings grounded in a disciplinary base (specialised expertise in a field of knowledge); efficacious beliefs about personal identity and self-worth; and, metacognition (self-awareness and the capability to reflect on, in and for action).

According to Butcher *et al.* (2011), it is accepted practice that improving undergraduate employability is an important part of degree programmes, and that students graduating from tertiary institutions should be confident not only in their knowledge, skills, and abilities required for the WOW, but also in their ability to articulate these to future potential employers. The Centre for Employability at the University of Central Lancashire describe employability as: “A set of skills, knowledge and personal attributes that make an individual more likely to secure and be successful in their chosen occupation(s) to the benefit of themselves, the workforce, the community and the economy”. The UK Commission for Employment and Skills formulated a framework for essential skills it considers significant for employability, which include: developing a positive attitude to work and employment; utilising numbers, language and information technology effectively; self-management; problem solving and critical thinking; teamwork and communication; and understanding the nature of business (Butcher *et al.* 2011). Therefore, one of the major aims of WIL, according to the National WIL Strategy (2015, cited in Sachs, Rowe and Wilson 2016), is to improve student employability outcomes, namely supporting students in the transition from university to work and enhancing productivity outputs for companies and the wider economy.

Furthermore the Confederation of British Industry (2009), reports that the development of employability skills should be a core part of a student's university experience. HEIs and employers must advise and enlighten students that obtaining a formal degree is inadequate on its own, as the labour market can be highly competitive. If students understand what companies are seeking for in an employee, and work towards developing and refining those much-valued skills and attributes, graduates will have a competitive edge in the labour market. Additionally, a student who engages in a work placement programme or internship, is submerged in the experience of being in an authentic workplace environment and determining what it is to work at graduate level. The Confederation of British Industry (2009) have also identified key employability skills as being: *self-management, team work and collaboration, positive attitude, entrepreneurship, communication and literacy, problem solving, application of numeracy and information technology, business and customer awareness*.

Figure 2.1 illustrates a framework comprising 10 skills and 40 constituent behaviours as developed in relation to Jackson and Chapman (2012, cited in Jackson 2015) framework of non-technical competencies required in new graduates. The derived framework was based on an extensive literature review of employer perceptions of industry-relevant skills in graduates entering the job market.

Skill	Behaviour
Working effectively with others	Task collaboration; team working; social intelligence; cultural and diversity awareness; influencing others and conflict resolution
Communicating effectively	Verbal communication; giving and receiving feedback; public speaking; meeting participation; written communication
Self-awareness	Meta-cognition; lifelong learning; career management
Thinking critically	Conceptualisation; evaluation
Analysing data and using technology	Numeracy; technology; information management
Problem solving	Reasoning; analysing and diagnosing; decision making
Developing initiative and enterprise	Entrepreneurship/intrapreneurship; lateral thinking/creativity; initiative; change management
Self-management	Self-efficacy; stress tolerance; work/life balance; self-regulation
Social responsibility and accountability	Social responsibility; accountability; personal ethics; organisational awareness
Developing professionalism	Efficiency; multi-tasking; autonomy; time management; drive; goal and task management

Figure 2.1: Employability skills framework

Source: Adopted from Jackson and Chapman (2012, cited in Jackson 2015)

Du Pré (2009) acknowledges that as we progress into the age of the knowledge economy, a more sophisticated educational and training system will be required by the workforce to sustain its competitiveness. The need and demand for advanced education and training opportunities will significantly increase. Furthermore, an individual's education and skills set are influential factors in their personal quality of life as well as their impact on broader society. One's educational level has always been a primary determination of one's economic well-being. In present day this is still very much the case, however the work sector is being flooded with individuals with degree qualifications, of which many are irrelevant to the marketplace. Employers may then consequently set additional criteria for lucrative employment. This will only serve as a further barrier to student development and progression.

In addition to the solid skills and formal qualifications, companies are equally concerned about the job-related practical skills or competencies that current or prospective new employees can use in order to perform a range of work-related tasks effectively and successfully. A World Economic Forum (WEF) 2016 report identified a core set of 35 work-relevant skills and abilities that are widely utilised across numerous industry sectors and derived from the same classification as the occupation-level data, however it concluded that these practical skills, too, will also be influenced by accelerating change and significant disruption in the immediate future (Figure 2.2).

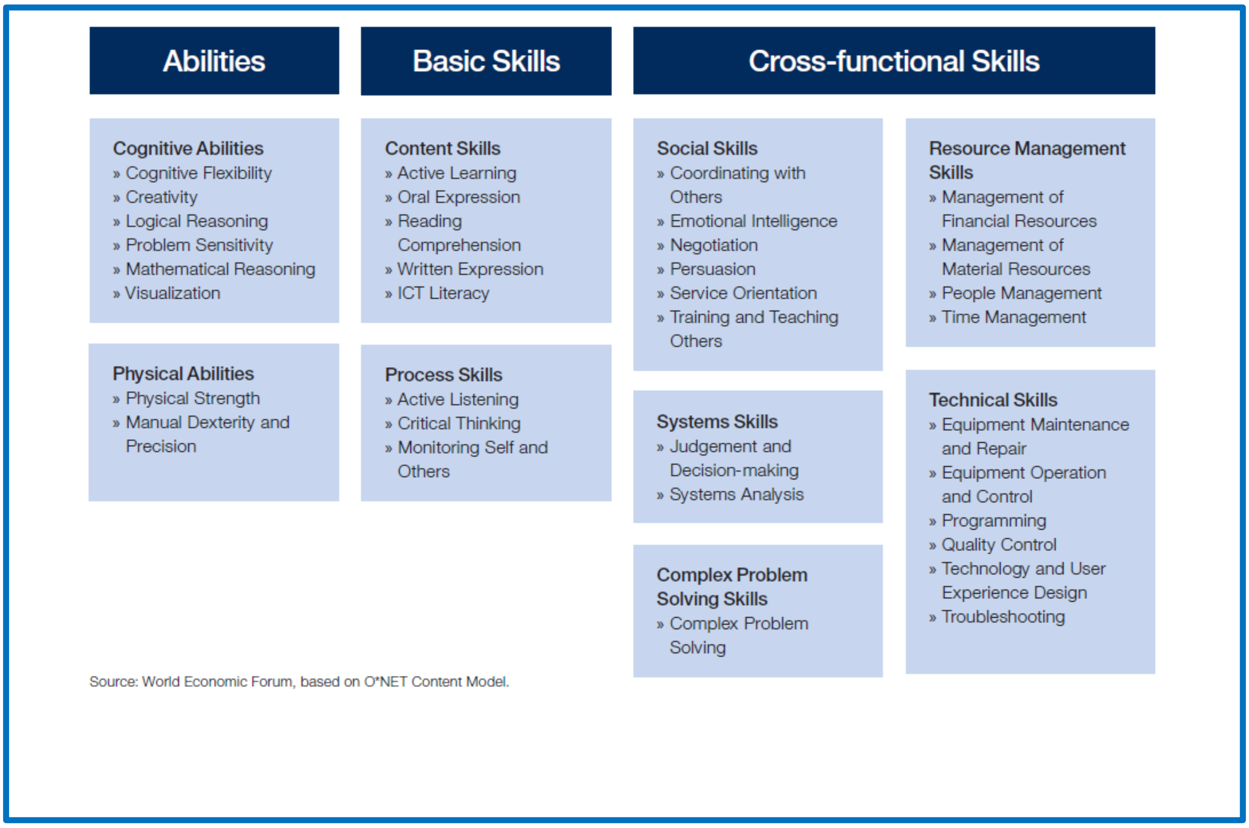

Figure 2.2: Core work-related skills
Source: World Economic Forum (2016)

Today's employment markets and in-demand skills are significantly different from those of five or even ten years ago, and the rate of change is only expected to intensify. The government sector, businesses and individuals are all increasingly concerned with identifying and predicting skills that are relevant not just for present day but also for the immediate future, to satisfy industry demands for talent and to further encourage those who possess them to maximise emerging opportunities (WEF 2016).

Du Pré (2009) commented that the relevance of knowledge and applicability of skills are among the key criteria that are becoming increasingly critical determining factors of employability. In fact, a certificate of competency in many instances is sought after more than an academic degree or tertiary qualification with employers demanding ongoing training and upskilling of staff. A relevant higher education qualification that makes provision for transferable skills and ensures competency, will become the primary requirement for economic security in the age of knowledge (Du Pré 2009).

For over two decades the surveying industry relied on a well-rounded, skilled, and accountable technikon (UoT) graduate (technologist), who could work independently, with minimal supervision, to produce accurate work of an acceptable industry standard. Will this perception perhaps change with the new qualification offering? The concern with the current geomatics degree is that employers and stakeholders may doubt the credibility of the 'university product' in terms of quality, capabilities, graduate attributes, employability skills, and the overall type of graduate that they seek to employ to fulfil industry expectations. A possible dismal scenario is that potential employers may lose some confidence or interest if they are not convinced about the type and quality of graduate entering the work sector, which may influence the sustainability of the geomatics programme. The study aimed to achieve an industry perspective into some of these concerns.

Martin, Rees and Edwards (2011) reaffirm the notion that WIL provides the opportunity for a student to develop in both a personal and professional capacity, essential attributes to enhance employability upon qualification. It adds a professional element to academia and builds professional networks. They explained that student learning is facilitated via appropriate industry and academic supervision, with each individual receiving some form of supervision from the university. The level of supervision and method of approach could vary from on-site, hands-on direct supervision of a task or activity, through to an off-site supervisor offering regular telephonic advice from a distance, perhaps participating in formative assessment, reinforcing theories, and overall general support. The university supervisor or training co-ordinator provides a point of contact or reference where the learner can obtain assistance, advice, support, and reinforcement, related to WIL activities while on work placement (Martin, Rees and Edwards 2011). In the national diploma programme, the supervision and mentoring of learners during the EL phase was conducted with a similar approach in which there was some engagement between the student, employer, and university representative to ensure that the quantitative and qualitative aspects of the training, quality assurance standards, and the statutory body requirements were all met. The current geomatics degree does not include a WIL component or skills competency assessment. It remains to be seen whether this exclusion will influence industry's perceptions on the type and quality of graduate entering the work sector.

Winberg *et al.* (2011) commented that the workplace is an environment where students can learn from experts in the chosen fields, not a place to just practice basic-level skills. The workplace is also where students can share new knowledge or information with industry, which should be at the forefront of their discipline. WIL is therefore a mutually beneficial initiative for students and employers, since students can provide new knowledge, fresh ideas and insights, while employers provide experiential opportunities for students to observe industry experts in their field, and to work under their guidance, supervision and mentorship.

Realistically, this practice could complement the geomatics sector, as 4IR is set to dramatically change the industry landscape on how traditional surveyors and geomatics practitioners function to map the world and produce the deliverables to clients. After acquiring the necessary academic knowledge at the university, students in a professional practice environment should be able to observe first-hand how the experts in the field utilise the latest tools, instrumentation, sensors and emerging technologies to complete projects accurately, efficiently, and economically thereby enhancing productivity levels. The integration of theoretical and practical knowledge may yield a greater sense of clarity and appreciation for their chosen career path, inspire new dimensions of thinking, and boost confidence levels.

Du Pré (2009) explains that the labour market has effectively transformed into a skills market and if education only led to knowledge, it would sustain an obsolete system. The economy will benefit, and the challenges of change will be managed more effectively, only if learning leads to the development of new skills and the active application of such skills. Relevance in higher education should therefore be evaluated in terms of the fit between what society and the modern WOW expect of HEIs, and what they can actually deliver (Du Pré 2009).

CEO of the CHE, Narend Baijnath, stated that Canada's Waterloo University was able to ensure almost a 100% employment rate for its graduates through its cooperative learning programmes. He highlighted that South African universities had limited resources which restricted their ability, together with other factors such as capacity and lack of adequate working agreements with industry, to achieve enabling conditions for success. He stated that the dreams of young graduates in possession of what they believed to be door-opening certificates were being "shattered" and public resources were effectively being wasted. He stressed that the employability of graduates was one of the "central priorities" in the post-school education and training (PSET) sector, and WIL's role was a "tried and tested strategy" to enhance that employability. He further urged stakeholders to consider how best to achieve the goals of WIL within the limited capabilities, capacities and resources at the country's disposal (Dell 2018).

The DUT ENVISION2030 strategic map refers to four perspectives, namely, S*ociety, Sustainability, Systems & Processes, and Stewardship.* One of the highlighted perspectives is S*ociety,* which is one of the ultimate aims of the strategic plan. It speaks of, "a dynamic and innovative solutions-focused interaction with, and impact on, society at both local and global levels" and a "Society that leads to mutually beneficial collaborations, the practical application of knowledge and future-ready graduates". Furthermore, one of the key strategic objectives referred to here is *"Adaptive graduates"*, which aims to address the need to produce relevant graduates who are responsible, competent, productive and accountable knowledge practitioners to serve the needs and interests of communities and broader society (DUT 2020b).

It is evident from existing literature that tertiary institutions have a distinctive role and obligation to educate, train and equip capable, proficient, and knowledgeable graduates with the necessary employability skills required to succeed in a dynamic labour market and economy driven society. The need is much greater in a highly technical, technological driven and evolving field such as geomatics, in order to improve graduate job prospects and make them more appealing to the marketplace. It begs the question of whether some UoTs such as DUT, have perhaps deviated from their core mandate and objectives, and social responsibilities, by failing to actively explore the potential opportunities offered by WIL more effectively throughout the university's academic offerings.

2.8 The Impact of 'employability' on the economy

Hajkowicz, Cook and Littleboy (2012, cited in Ferns, Campbell and Zegwaard 2014), believe that economic, cultural, social, and environmental changes will have a profound global impact in the upcoming decades, and as a result the higher education sector will be subjected to pressure to transform the way in which it functions in response to these forces of change (Ernst and Young 2012, cited in Ferns, Campbell and Zegwaard 2014). A proficient, skilled, innovative, and competitive labour force is required by the emerging knowledge economy, progressing technology capabilities, increasing global mobility, and increased demands for economic output. Education is viewed as an essential mechanism for equipping the mass population to meet the worldwide demands of the twenty-first century (Ferns, Campbell and Zegwaard 2014).

WIL integration into the curriculum is critical for universities to produce work-ready graduates, solving the skills deficit and contributing to robust economic growth and sustainability (Smith, Ferns and Russell 2014). Stakeholders such as the government, industry, and students are demanding that university curricula contain authentic work experiences that will enable students to be more employable after graduation (Cooper, Orrell and Bowden 2010).

In 2018, at the third annual WIL Africa Conference in Umhlanga, South Africa, Chris Gengan, learning development manager at Sappi reminded the conference participants that part of funding for WIL comes from mandated grants in the private sector. He defended the industrial sector's commitment to WIL, stating that it was motivated not by the need to comply with the Skills Development Act (SDA) or even black economic empowerment regulations, but that "It's essential for our business". His sentiments were further backed by Nivesh Lutchman, education manager at SIEMENS, who stated in similarly direct terms that institutions that drop WIL would not remain as strategic partners of the company, and their students would have "no value" to the company. Lutchman reiterated that the implementation of WIL and the production of graduates and workers with relevant skills required “working together”. “We would not want WIL to be dropped,” he said. “It is definitely something that will take our country forward” (Dell 2018). This highlights the commitment and urgency by business partners and other industry stakeholders towards the inclusion of WIL programmes in addressing skills acquisition and economic growth.

According to the financial website Investopedia (Pologeorgis 2019), the significance of employability on a country’s economy is quite crucial:

> Employability is the life-long, continuous process of acquiring experience, new knowledge, purposeful learning, and skills that contribute to improving one's marketability for enhancing their potential to obtain and maintain employment through various shifts in the labour market. It is based on a set of individual characteristics. The ability to obtain, maintain and switch employment over time is imperative to one’s success in life, so one has to be able to possess a set of skills that are usable in the labour market. For labour or human capital to be used efficiently, it warrants the acquisition of knowledge, skills, and capabilities that employers need in our current economic times and knowledge-driven economy.

Employability is extremely important since it not only provides lucrative employment, but it also contributes to an individual's personal well-being and growth. In terms of macroeconomics, a lack of employability leads to both frictional and structural unemployment, as well as affecting labour force productivity, which subsequently influences a country's standard of living, measured by the gross domestic product (GDP) per capita. An element of employability that impacts it directly is the ability of workers to fulfil the requirements or demand of the workforce. “It requires the continuous upgrading of skills, especially in sectors that experience rapid technological and organisational change, to help avoid obsolescence of their human capital or labour force” (Pologeorgis 2019).

A major challenge faced by WIL presently is the limited opportunities for WIL in the public and private sectors as the country grapples with economic growth, which is further compounded due to the ongoing economic aftermath of the Covid-19 pandemic.

As a result, industry practitioners may be somewhat reluctant to recruit new graduates due to limited projects, and a stagnant civil engineering, construction and built environment industry, owing to an uncertain economic climate. This could well aggravate the current unemployment crises of students that have recently qualified and are looking for employment and work-based learning opportunities.

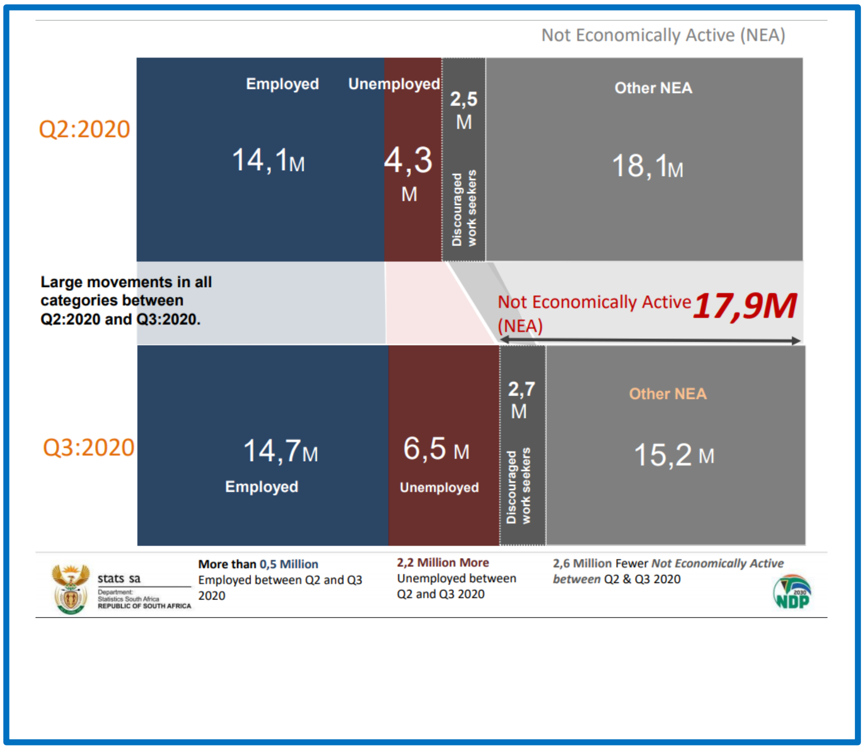

Figure 2.3: SA Third quarterly labour force survey 2020
Source: (Businesstech 2020)

The reality is that the impact of Covid-19 has exacerbated an already fragile economy. According to an article published by *Businesstech* (2020) with statistics supplied by Stats SA for the third quarter of 2020 (refer to Figure 2.3):

> Unemployment increased substantially by 2.2 million (52.1%) to 6.5 million, compared to the second quarter of 2020. Stated simply, of the 2.85 million people who ‘left’ the country’s workforce during lockdown, only 543,000 managed to get their jobs back, leaving 2.2 million unemployed, and 225,000 joining the group of discouraged work seekers. Most job losses were observed in trade (400,000), manufacturing (300,000), community and social services (298,000) and construction (259,000) (Businesstech 2020).

Unemployment figures have continued to escalate during the fourth quarter of 2020, reflecting the urgency of the economic situation (Figure 2.4). The *Business Maverick* Mahlaka (2021), with reference to statistics published by Stats SA for the fourth quarter of 2020, reported that:

> SA's official unemployment rate hit a fresh high in the fourth quarter of 2020, with signs emerging that even though Covid-19 lockdown rules were substantially eased during the period, the country's labour market faces permanent and worrying damage. Although many sectors of the economy were open during the fourth quarter, which paved the way for economic activity to pick up and unemployed people to search for jobs, SA's unemployment crisis continued to worsen. According to Statistics SA, the country's official unemployment rate during the fourth quarter of 2020 rose by 1.7 percentage points from the previous quarter to a record high of 32.5%. Statistics SA said the official unemployment rate of 32.5% is the highest since the data collection agency began measuring unemployment trends in 2008 through a redesigned survey called the Quarterly Labour Force Survey (QLFS). These unemployment figures suggest that the Covid-19 lockdown has made it more difficult for job seekers to find an entry point into the labour market and for struggling businesses to create employment (Mahlaka 2021).

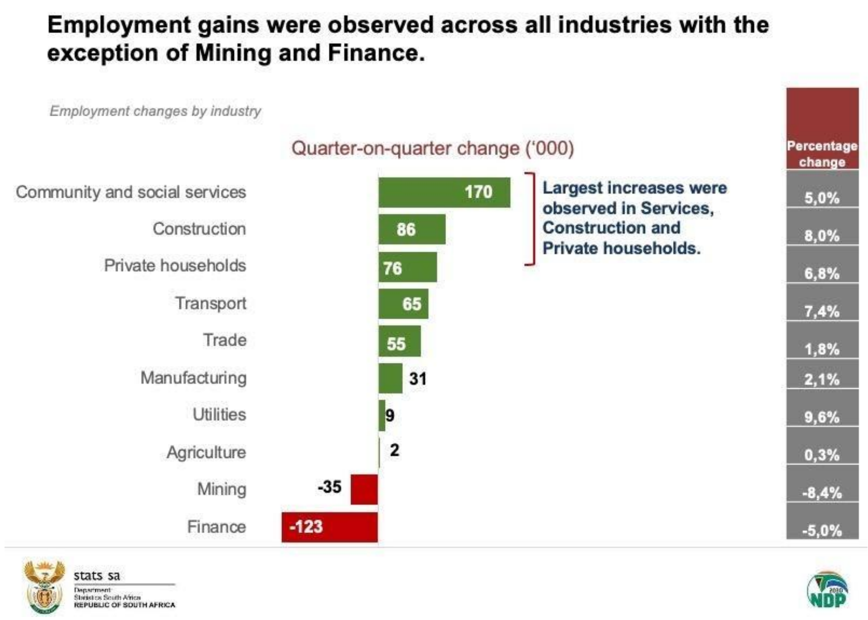

Figure 2.4: SA Fourth quarterly labour force survey 2020
Source: Business Maverick Mahlaka (2021)

According to Mncayi (2021), global labour markets, including those in South Africa, are undergoing substantial changes, particularly in non-tech sectors. The country is experiencing high levels of unemployment by international benchmarks, both at national level and among the youth. Higher education, according to some theories, leads to improved labour market outcomes and increases future earnings through lucrative career options. However, in nations with high rates of unemployment, where even graduates have difficulty securing employment, these views have been criticised. Accessibility to higher education it seems, is no longer an assurance of employment. When compared to 30 countries, including India and Russia, South Africa in 2019 demonstrated the highest percentage of mismatched workers, with skills mismatches exceeding 50% as well as the lowest productivity levels. 25% of the respondents were over-educated while 27% were under-educated for their occupations. The mismatches between educational qualifications and work requirements contribute to under-employment, whereby an individual is employed in a position that is lower by some standard, perhaps in the working hours, income, skills, and qualifications. These mismatches and skills shortages have been prevalent, and hence the emphasis needs to shift from skills demand to skills supply. Focusing on the supply side of the youth labour market, beginning with the basic educational curricula, will ensure that graduates are appropriately skilled to satisfy labour market demands. If mismatches are not addressed, it will escalate and be camouflaged by increased access to higher education and low graduate unemployment rates (Mncayi 2021).

This paints a bleak future for young job seekers, as leading economists have further anticipated that the outlook for economic growth is weak, suggesting that unemployment levels will remain high and will likely increase further in the future. However, there is optimism from some in the economic sector, including the South African Reserve Bank (SARB), who expect fluctuations in economic activity. They have forecast the economy to expand by 3.6% in 2021 and 2.4% in 2022. So, the affected industry sectors can gradually recover over a period of time. The reality is that the economic downturn will result in an increase in competition for jobs, which again signifies the urgency for graduates to be ‘work-ready’, to have the necessary employability skills, work attributes, technical skill sets and competencies to adapt, cope and succeed in the workplace. These characteristics can influence and shape a young, vibrant work force and contribute to the economic recovery and growth. Therefore, the future of the country lies with empowering young minds and upskilling of the current generation. Furthermore, studies have revealed that, responsible and productive citizenship starts with a knowledgeable, skilled, and motivated workforce to meet and service the needs of a growing economy.

2.9 WIL and work placement

According to Winberg *et al.* (2011), students' academic knowledge gained in classroom activities should be utilised in professional contexts, be relevant for solving workplace problems, foster interaction and collaboration amongst colleagues and team members, and enhance individual accountability, including self-assessment abilities. Prior to graduation and work placement, students should engage in learning activities that will assist them in developing the skills needed for professional practice.

Moyer *et al*. (2017) highlights that WBL has been widely employed in professional and technical education to allow students the opportunity to practice their classroom knowledge and abilities within a "real-world" organisational or business setting. High-quality work placements supplement school-based or postsecondary education by giving students a context in which to apply academic theory to technical abilities, as well as an authentic environment in which to acquire the work-readiness or employability skills that employers and industry practitioners value (Moyer *et al.* 2017).

As part of the WIL reflection process, Martin and Hughes (2009) indicate that students need to be equipped with the elementary content knowledge required for their discipline of study, exposure to the profession in the form of tours to the workplace or company presentations on-campus and critical thinking abilities in the early phases of WIL. The growth and progression of students as reflective practitioners necessitates a gradual increase in complexity and sophistication. Students must understand the relevance of on-campus learning and how it might be applicable to the workplace prior to embarking on work placement. Practitioners must collaborate with employers and supervisors to build more formal WPL pedagogies. Universities are increasing their networking with professional practitioners, which can enlighten educators of any changes in current workplace practices and explain expected skill standards in emerging graduates, allowing for a better industry-aligned curricula design (Martin and Hughes 2009).

Work placement is a method of attaining "on the job" experience in the actual world and is included in the WIL curriculum design for professional qualifications. The purpose of a work placement is to aid students in development as a professional, through the process of observation, participation, and execution of tasks and activities that demonstrate competency and capability. Several career-oriented higher educational programmes consist of some form of WPL, such as industrial placements, job-shadowing, and professional practice to support a professional qualification, and employer or employment-based schemes, such as learnerships (Winberg *et al.* 2011). Learnerships and Internships are forms of WIL that facilitate work placement, skills acquisition, graduate profile development, and academic progression.

Braunstein (2001) and Valadkhani, Worthington, and Houlbrook (2001) (both cited in Ferns, Campbell and Zegwaard 2014) reported that direct access into the labour market for graduates is achieved through effective work placement programmes. It was noted that WIL students who have acquired relevant work experience prior to graduation had a quicker absorption into the workplace compared to those who have not had any relevant experience. The rapid absorption of WIL graduates is often attributed to the contacts and networks that students have established during their work placement programmes.

> A significant advantage these students have over non-WIL students is that they have evidence of their ability to apply their knowledge and technical skills in an authentic setting while successfully working within a workplace team. Students who have had some workplace exposure tend to make better informed decisions about their career direction and choices. (Zegwaard and Coll 2011, Calway and Murphy 2000, Ferkins 2002, cited in Ferns, Campbell and Zegwaard 2014).

According to Fleming and Eames (2005), students benefit from work placement experiences because they obtain useful skills that equip and aid them to succeed in academic on-campus learning while also improving their research capacity, critical thinking, and time management abilities. Several WIL practitioners have confirmed that students return with elevated levels of enthusiasm for their studies, after successful completion of appropriate work placements. Contextualising on-campus learning in a relevant workplace setting assists students in comprehending and appreciating why specific topics or themes in their studies are important (Fleming and Eames 2005).

Peach and Gamble (2011) elaborate that learning environments such as workplaces, may provide learners with opportunities to combine theory and practice, and to reflect on the WOW while obtaining a sense of cultural awareness and appreciation for their discipline or field of study. Since students are required to engage in activities and interactions, they are expected to apply what they have learnt earlier in their studies to what they encounter in a professional practice setting. Consequently, WPL has the potential to allow students to demonstrate their expertise in authentic real-world settings (Peach and Gamble 2011). WPL is also perceived as a mechanism for enriching career development learning which entails aiding students to acquire knowledge, concepts, skills, and attitudes to prepare them to manage their careers, and their lifelong progression in education and work which ultimately contributes to holistic development.

McIlveen *et al*. (2011) explains that

> career development learning inherently requires a student to (a) engage in processes of self-assessment in terms of individual dimensions (e.g. knowledge, skills, and interests) and (b) perform an appraisal of the context in which the student situates learning in relation to his or her profession.

Career development learning is applicable to educational methodologies that incorporate reflection in higher learning since it is considered as a customised pedagogy of oneself (a process of self-managed learning and progress). The two-way mirror shown in Figure 2.5 illustrates the concept of career development learning being used as a mirror for reflection. There are three core features: the learner, the workplace, and the mirror itself. Career development learning occurs as a result of a range of influences at the personal level and at the contextual level (McIlveen *et al.* 2011).

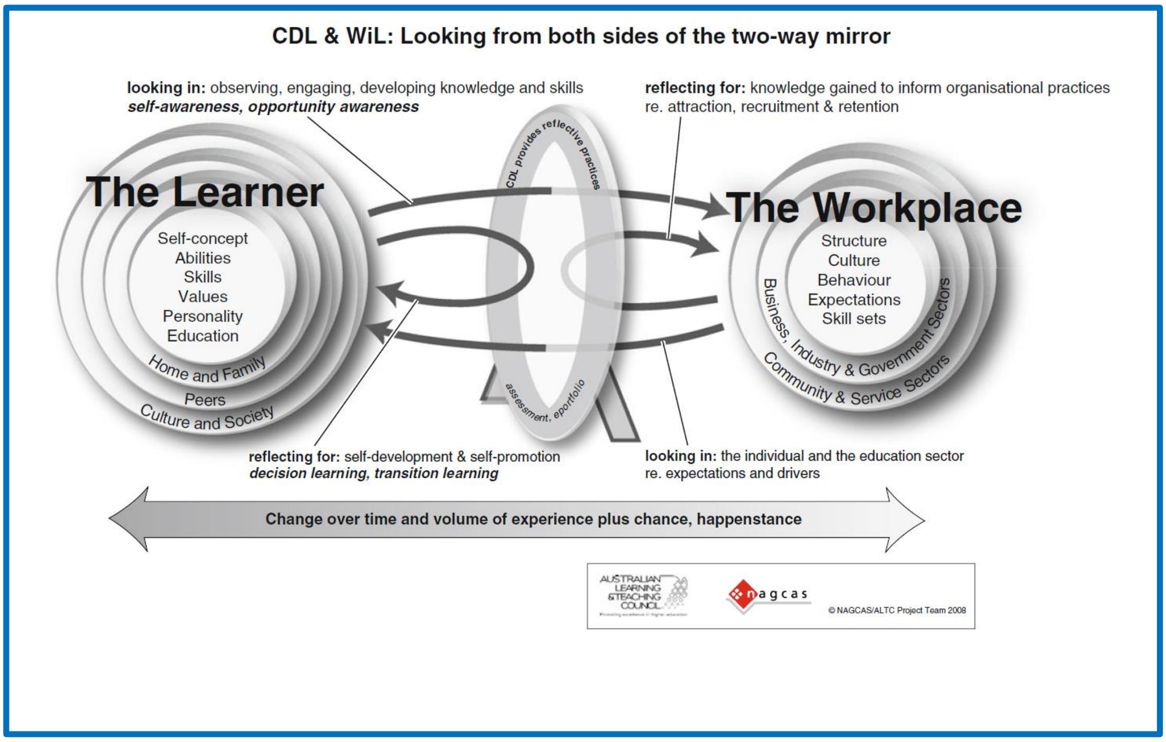

Figure 2.5: Two-way mirror of career development learning and work-integrated learning
Source: Adopted from McIlveen *et al.* (2011)

Further studies by Allen and Peach (2007) and Freudenberg, Brimble and Cameron (2011) (both cited in Ferns, Campbell and Zegwaard 2014) reveal that students who have undertaken work placements have a better capacity to apply theory into practice, are more analytical in solving problems, and have improved disciplined thinking (Ferns, Campbell and Zegwaard 2014). Ngwane (2016) further explains that partnerships amongst diverse groups of employers, lecturers, students, higher education managers, professional bodies, and broker agencies all signal a distinctive feature of an effective work-placement programme. If continued success is to be accomplished, all parties involved must be recognised, with explicit agreements between them.

From the supporting literature, it is apparent that WIL is recognised by educational practitioners as a vehicle for developing employability attributes and key competencies that graduates are expected to possess upon entering the labour market, so there is a growing interest in skills developed through work experience and work placements. Providing students with the opportunity to experience the WOW prior to employment will motivate them to improve academically ensuring they meet required industry standards and expectations. WIL work placements may represent the foundation to achieving these goals while ensuring graduates are attractive to the labour market, securing employment and empowering students to aim high, succeeding and enjoying a fruitful and enriching career. Also, updated employability skills frameworks outlining key attributes and qualities, should be representative of what a modern-day workforce should encompass in the skilful and competent execution of their designated duties in their respective fields of work.

2.10 The matter of skills in South Africa

Addressing the skills deficiency has been high on the national agenda for some time. In fact, since the establishment of the Skills Development Act (SDA) of 1998, the 'learnership' model of workplace training has been advocated for in South Africa as an innovative mechanism for combating high unemployment rates and the scarce skills gap. The then Department of Labour introduced the SDA of 1998 and the Skills Development Levies Act (SDLA) of 1999 to address this issue. All companies and registered employers were required to pay an annual skills development levy, based on their total employee remuneration cost. Furthermore, each of the identified sectors were required to establish a Sectoral Education and Training Authority (SETA), whose function is to produce a sector skills development strategy and disburse grants generated from the levies back to eligible companies for authorised skills development programmes (Davies and Farquharson 2004). In total, there are 21 different SETAs established under the Skills Development Act which covers all sectors of the South African economy. They are concerned with quality assurance training and education in relevant industries. Under the SDA, a total of 21 SETAs covering all sectors of the South African economy have been established. They are focused on ensuring quality assuring training and education in relevant industries.

Since November 2009, the responsibility of skills development has fallen under the ambit of the Minister of Higher Education and Training. The National Skills Authority is the assigned statutory body that was established in terms of the SDA to advise the Minister on the National Skills Development Policies and make inputs, review skills development legislative framework to support integration of education and training and the national priorities of government; and monitor and evaluate the work of the SETAs (South Africa. Department of Higher Education and Training 2015).

This initiative reaffirms the notion of workplace skills acquisition, and that to stimulate the economy remains a high government priority. Geomatics, which forms part of the built environment, and is an important basis for all civil engineering and construction projects, is therefore a very important contributor in terms of infrastructure development and national economic growth. Geomatics is a scare and critical skills discipline, as well as a technologically intensive discipline that requires hands-on practical application, complemented, and reinforced by a firm theoretical understanding of the core principles.

Mlambo-Ngcuka (2006, cited in Griesel and Parker 2009) highlights that after investing three to four years of post-secondary education, the phenomenon of unemployed graduates who lack the ability to self-employ and self-determine is an indication of the issues plaguing the higher education system. The authors commented that curriculum designers are not giving adequate attention to concerns of relevance, and to ensuring that we all pay attention to the skills and competencies that students require when they graduate from higher education, further calling for a skills revolution in the curriculum of higher education (Griesel and Parker 2009).

Du Pré (2009) mentioned that since a UoT must produce suitably qualified graduates for the labour sector, it should therefore be closely connected with the business sector to provide relevant curricula. This necessitates ongoing revisions of educational programmes at the undergraduate and postgraduate levels in order to better meet the demands of industry, business, and communities. This approach gives rise to a curriculum and course design that is tied to outcomes-based education as well as more flexible delivery methods (Du Pré 2009).

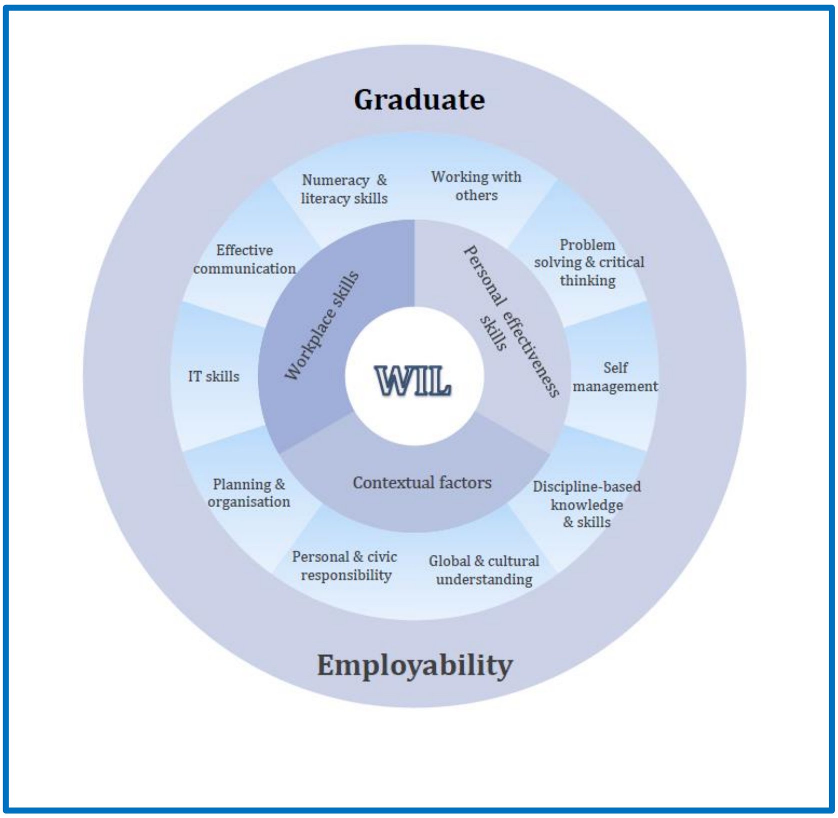

Figure 2.6: WIL skills, capability and graduate employability framework
Source: Adopted from Sachs, Rowe and Wilson (2016)

According to Jackson (2013) and Smith *et al*. (2014) (both cited in Sachs, Rowe and Wilson 2016), following work placements and other WIL activities, several studies have determined direct relationships between students' perceived ability to perform specific employability skills and WIL. Graduate attributes, employability, work-readiness skills, and other proficiencies can be developed through institutional frameworks and policies, as well as through discipline-specific programmes. These typically constitute workplace skills such as information literacy, effective communication, personal effectiveness skills such as problem-solving and self-management, as well as capabilities relating to a range of contextual factors such as discipline specific knowledge, and a global perspective (Sachs, Rowe and Wilson 2016). Figure 2.6 above illustrates Deakin University’s Graduate Capabilities Framework.

Harvey, Geall and Moon (1998, cited in Reinhard *et al*. 2016), state that “WIL programmes can be quite useful when they are strategically planned, organised and appropriately implemented. These curricula provide the perfect platform to create a hands-on learning experience for students as they develop a useful skill-set for today's business environment" (Reinhard *et al.* 2016). The WIL concept, however, has not fully materialised over the years in academic departments throughout DUT, with the university leaning more towards a research-driven approach and seemingly abandoning their focus on technical, technological, and vocational education on which its predecessors established its industry reputation.

Further, a concerning trend in recent years, is the significant decline in the number of allocated bursaries and internships for surveying and geomatics students, that are usually awarded by government and municipal agencies such as the DRDLR, National Geospatial Information, Eskom, Transnet, Ethekweni municipality etc. This has to some degree also impacted on the relationship between HEIs and the government sector as part of their joint responsibilities in providing WIL opportunities for students.

As previously stated, the incentive introduced by government to facilitate skills development in South Africa, is the learnership programme. A learnership is actually a work-based learning programme comprising both structured practical workplace and structured theoretical training associated with a trade, qualification or profession which leads to a NQF registered qualification with the South African Qualifications Authority (SAQA). Learnerships are directly related to an occupation or field of work, for example, civil engineering, hairdressing, project management etc.

According to SAQA (2020), learnerships promote access to education and training, and help learners gain the necessary skills and workplace experience that will provide better employment opportunities. In order to graduate, learners are required to complete a theoretical course in addition to practical training which is conducted at a workplace. The theoretical component of the qualification is offered by an education and training provider, while the workplace component incorporates hands-on, practical learning under the leadership and mentorship of a supervisor, which when combined forms an integrated and comprehensive learning programme. Learnerships are managed by SETAs who ensure that qualifications are relevant to a specific occupation or industry sector. All 21 SETAs have created NQF-aligned programmes to assist learners in obtaining recognised qualifications while gaining valuable on-the-job experience (SAQA 2020).

Govender and Taylor (2015) indicated that the formal state driven WIL partnership model in South Africa is the learnership model, a partnership agreement between the student, employer, and the training provider. According to Davies and Farquharson (2004, cited in Govender and Taylor 2015), including companies in student selection, encouraging intrepreneurship, and connecting learnerships to current business opportunities will promote skills development and economic growth in the country.

Another innovative WIL approach is that of an internship which is a programme designed to provide university graduates with structured workplace exposure and specialised training in order to supplement their academic qualifications. This would be the more appropriate and lucrative option for geomatics students/graduates seeking workplace experience.

> An internship is a professional learning experience that offers meaningful, practical work related to a student's field of study or career interest. An internship gives a student the opportunity for career exploration and development, and to learn new skills. It offers the employer the opportunity to bring new ideas and energy into the workplace, develop talent and potentially build a pipeline for future full-time employees. (University of Maryland, Baltimore County 2020).

With an internship, participants are offered placement in an organisation with the intention of providing the learner with workplace experience that builds on the qualification.

Eilers (2020) has identified numerous benefits of internships, which emphasise the value and importance of internship programmes:

- Gain actual valuable work experience.
- Application of knowledge.
- Networking with professionals in the field.
- Learn first-hand and gain new industry insights and knowledge.

- Field experimentation allows one to acquaint themselves with their chosen field.
- Earn university academic credit upon completion.
- Receive remuneration.
- Increased professional confidence.
- Boost in understanding of how the world of employment works.
- Possibility of future employment. (Eilers 2020)

According to Landey and Silvers (2005), WIL also promotes transparent and regular procedures with standardised skills, proficiencies, and delivery methods in South Africa to prepare students to achieve international performance outcomes for both short- and long-term results.

Du Pré (2009) commented that the increasing relevance of knowledge and usable skills in today's world, as well as the growing number of people who are educated and trained at a higher level, have expanded the role and obligation of higher education and its impact on society. Higher education must therefore adapt in order to completely fulfil its obligation and function, and UoTs must identify and actively fulfil their new and expanding role and responsibility in this regard.

2.11 WIL and ‘entrepreneurship’

WIL is also known to influence and drive the business opportunity of entrepreneurship, which is the buzzword that is gaining notable traction in South Africa in a bid to boost economic development and investment growth. Entrepreneurship is being supported as part of government’s National Development Plan in an effort to boost growth, foster innovation, and aid in the creation of employment opportunities. WIL provides learners with the opportunity and capability to demonstrate an innovative approach, creativity, and collaboration. Small, medium and micro enterprises (SMMEs) can spark new life into a currently fragile South African economy. SMMEs offer hope of creating employment opportunities, effecting change where it’s needed, for growing and cultivating an entrepreneurial spirit in South Africa. Innovative SMMEs in the science, engineering, and technology space can also enable South Africa’s productive participation in the 4IR.

Dhliwayo (2008) explains that experiential learning can translate work experience into entrepreneurial knowledge, and that entrepreneurs can be produced in the same way that nurses are, through well-designed WIL programmes. However, if entrepreneurial education and training is to develop productive entrepreneurs, a new strategy is required; one that should begin as early as possible to maximise the impact and effect.

Entrepreneurial learning is well established and recognised on the international stage, as a means of providing learners with opportunities of solving real-world problems. Entrepreneurial learning can be encouraged and promoted through WIL initiatives and structured programmes. Some scenarios can be simulated in a classroom; however, the more effective approach is to develop a learning ecosystem with all relevant stakeholders i.e. students, teachers, lecturers, learning facilitators, and employers. Students can acquire general life skills and work skills; academic staff can expand their industry networks; and employers can collaborate with HEIs to address workplace issues and to promote innovation and a culture of entrepreneurship.

Due to the high unemployment rates in South Africa, Dhliwayo (2008) suggested that WIL should focus on “job creators rather than job seekers” so that experiential learning can also promote entrepreneurial education. The author indicated that the foundation of learning should be an appropriate and well-structured WIL-based entrepreneurial programme which includes both classroom and field activities, and that current internship programmes should be specifically adapted to exhibit an entrepreneurship focus and embedded into existing entrepreneurship curriculum. Stakeholders should recognise that failure is an inevitable element of entrepreneurship, and students should be given the opportunity to 'attempt and fail' in order to experience 'intelligent failures' as part of their effective and constructive learning.

According to Lindner (2020),

> The International Centre for Technical and Vocational Education and Training of the United Nations Educational, Scientific and Cultural Organization (UNESCO-UNEVOC) believes that entrepreneurial learning offers a realistic and effective means to develop the transferable skills needed in this changing world. Technical and Vocational Education and Training (TVET) can take place

> at secondary, post-secondary and tertiary levels. It is integral to lifelong learning and includes work-based learning, continuing formal and informal training and professional development, which may lead to qualifications.

Lindner (2020), further explains that expanding youth populations, increasing unemployment rates in numerous countries, and changes in the labour market and economy as a result of technological advancements, are just a few of the reasons why future generations will require entrepreneurial skill sets and mindsets to cope with an evolving world. Entrepreneurial education is the foundation for the creative and innovative ideas that will enable us to succeed in the twenty-first century. It is also a technique to encourage the education and training of resilient lifelong learners who can adapt to social, economic, and environmental change. The international community's commitments highlight the importance and relevance of entrepreneurial skills in better equipping adolescents for employment.

> The sustainable development goal 4 on education, explicitly calls for the need to strengthen ‘skills for employment, decent jobs and entrepreneurship’. Further, sustainable development goal 8 to promote ‘full and productive employment and decent work for all’ emphasises support for productive activities, decent job creation, entrepreneurship, creativity, and innovation. (Lindner 2020)

According to Pretti *et al*. (2020), the Covid-19 pandemic presents increased opportunities for the development and application of entrepreneurial attributes. The global response to the pandemic has recognised the need for the development of these skills in students and recent graduates who need to navigate a rapidly changing world. Educational institutions must consider introducing or enhancing WIL programmes, since WIL experiences may assist in entrepreneurial skills development. Furthermore, entrepreneurial WIL programmes may be a viable alternative during periods of disruption and an uncertain labour market (Pretti *et al.* 2020).

WIL can provide students with an opportunity to improve their entrepreneurial orientation. Exposure to entrepreneurial business through employment history positively impacts attitudes towards entrepreneurship, and learners report an increase in developing initiative and enterprise which may be similar to the development of an entrepreneurial orientation. Hence, WIL programmes at post-secondary institutions may improve students' entrepreneurial orientation (Harris and Gibson 2008, and Jackson 2013, cited in Pretti *et al*. 2020).

The DUT ENVISION2030 strategic plan refers to four perspectives i.e. S*ociety, Sustainability, Systems & Processes,* and *Stewardship.* One of the four highlighted perspectives is *Society,* which is one of the ultimate aims on the strategic map. It speaks of, "a dynamic and innovative solutions-focused interaction with, and impact on, society at both local and global levels" and a "Society that leads to mutually beneficial collaborations, the practical application of knowledge and future-ready graduates". Furthermore, one of the key strategic objectives referred here is, *"Innovation and entrepreneurship"*, which aims to generate new, innovative and relevant knowledge systems and solutions for societal impact (DUT 2020b). This once more clarifies DUT's mandate as a UoT, to educate and train capable, proficient, and knowledgeable graduates with the necessary entrepreneurial attributes to succeed in an evolving labour market and competitive economic circumstances.

DUT has embraced the philosophy of entrepreneurship by establishing the DUT Centre for Entrepreneurship and Innovation in 2018. The development of entrepreneurs and innovators is a priority for South African HEIs, in alignment with the National Development Plan 2030 as well as the Entrepreneurial Development in Higher Education Programme which was initiated through DHET and hosted by Universities South Africa (USAf). This aligned well with DUT ENVISION2030 which consists of two DNA strands that will ensure people are 'innovative and entrepreneurial' as well as 'people-centred and engaged'. In terms of supporting innovation and entrepreneurship, the university formulated a strategy to initiate entrepreneurial support structures and infrastructure in 2018. As part of a university-wide incubation programme, the process entailed combining efforts to develop the foundational entrepreneurial programmes, support structures, and resources required to assist students. The belief is that it will contribute to social economic development and employment opportunities (DUT 2021b).

The concept of entrepreneurship is receiving growing interest from the DUT community. The DUT's Midlands Entrepreneurship Centre has launched an Adopt a School project with four schools from within neighbouring communities to expose primary and high school learners to the concept of entrepreneurship. This is aligned to ENVISION2030 which has refocused the university's character from being a 'student-focused' to a 'people-centred' and engaging university (Ngubane and Govender 2021). The Employability Improvement Project (EIP) is also an innovative programme for promoting entrepreneurial attributes. DUT's DVC of Research, Innovation and Engagement, Prof. Moyo, expressed her satisfaction with the programme, stating:

> For DUT, employability is a key issue and since technology, business, and lifestyles have been changing globally, employability has been increasing its value and recognition as never before. We at DUT want to make sure that our students are employable and are able to be innovative entrepreneurs. (DUT 2019).

According to advocate Rory Voller, a Commissioner at Companies and Intellectual Property Commission:

> South Africa must teach innovation and entrepreneurship to schoolchildren; in the new world of work, problem solvers, collaborators and flexible creative thinkers will be most in demand. The world of work is being re-imagined, and South Africa needs to teach its youth to be more innovative and more entrepreneurial to create a sustainable and growing economy. The world is moving; there is something called the fourth industrial revolution, which is about new technology and being a disruptor" (Brand South Africa 2017)

Voller firmly believes and advocates that learners should receive lessons in critical thinking, communication, and collaboration skills, and that they should be inspired to become entrepreneurial, financially responsible and understand the value of teamwork. A foundation established on an entrepreneurial education will be advantageous to students from all socioeconomic backgrounds. He further elaborated that entrepreneurship encourages students to think outside the box and for youth to take risks and make mistakes, adding that "these lessons are vital to breeding ingenuity". Such lessons will inspire them to become creative, inventive, and innovative (Brand South Africa 2017). Being an established professional and government representative, Voller has clarified the urgency for more entrepreneurial education in shaping young minds to become problem solvers, and critical thinkers and to be successful in growing the economy. Notably, WIL in its many diverse forms addresses most if not all of the above, as students/graduates undergo WPL which may be the appropriate platform to cultivate the seeds of entrepreneurship and innovation.

Prof. Moyo once again reiterated the importance and relevance of entrepreneurship at an online opportunity assessment workshop in February 2021, stating:

> As we go through COVID-19, we need to look at solutions in our community as skills are critical, so we are really privileged to work with experts who can share their knowledge with us. From the university side, the Envision2030 strategy is mainly focused on trying to make sure that our staff and students are entrepreneurial and our students, after they graduate, do not struggle to find jobs, and that they are able to become entrepreneurs, and employers instead of just job seekers (Peters 2021).

Most senior surveyors and geomatics practitioners are well established in the industry and are entrepreneurs themselves who have successfully set up business practices after acquiring the necessary qualifications, skills, mandatory work experience and expertise; as well as engaging in ongoing professional activities such as 'continuous professional development' (CPD). This wealth of expertise will serve to inspire, motivate, and mentor young students/graduates on key employability skills and entrepreneurial attributes, to further educate and enlighten students on the requirements of starting and managing a business practice which may be categorised as a SMME. SMMEs are referred to as small businesses and play an important role since they can be key drivers of economic growth, innovation, and job creation. According to Sullivan (2000), "mentorship in the context of the student entrepreneur is a protected relationship in which learning and experimentation can occur, potential skills be developed, and results be measured in terms of competencies gained rather than curricular territory covered".

The literature shows that entrepreneurial education has gained significant interest in the higher education sphere and in a slowing economy. WIL programmes may serve as an enabling mechanism for entrepreneurial skills development, which can provide learners with the ability to demonstrate a creative and innovative approach to problem solving through collaboration, and a means to promote the global culture of entrepreneurship. These attributes can make a huge difference and stimulate students to ‘think out of the box’, aim high and aspire to establish their own business practices and corporate ventures through professional networking, upon acquiring the prerequisite academic qualification, prescribed mandatory training, and mentoring by qualified professionals within the geomatics and associated industries. Students may also receive exposure in drafting business plans, preparation of proposals for the purposes of funding, and developing viable financial systems to sustain the business. Students will themselves in time, then become employers and contributors of productive employment and provide business opportunities for others, and so the trend will continue.

2.12 WIL and community engagement

According to Du Pré (2013), the aim of South African career-oriented universities is to provide relevant education for a developing state while also rectifying historical inequities. The government has prioritised career-oriented education, and universities are well-positioned to be directly engaged with communities, not just to provide the necessary education and training, but also to extend that commitment to specific community development and engagement. Because most programmes are undertaken in collaboration with business and industry, the requirements of individual communities are constantly fulfilled. As part of their experiential learning, many students engage in community initiatives. Additionally, projects and research initiatives are also focused on growth and community involvement, which include low-cost housing, educational outreach programmes, and health facilities. Upliftment and skills transfer to the community are of great importance in terms of the teaching, research, and development conducted. Due to the emphasis on relevant and transferable skills, many students are able to render a much-valued contribution towards community training and upliftment during the course of their studies. These universities play a key role in assisting the youth with career decisions and preparing them to execute a relevant and significant role for the future benefit of their communities (Du Pré 2013).

Winberg *et al.* (2011) state that innovative curricula, teaching, learning, and assessment techniques are required for programmes that enhance graduates' effective and successful integration into the WOW and enable them to deliver meaningful contributions in developmental contexts. The importance of WIL in curriculum design and development, as a process of reciprocal interaction that is beneficial to students, employers, professions, and communities, is further enhanced by SA universities' commitment to positive graduate outcomes, global citizenship, and community engagement (Winberg *et al.* 2011).

Increased community engagement can be effectively facilitated by ‘service learning’ which is one of the many forms of WIL. As explained by Bringle, Hatcher and McIntosh (2006),

> Service learning is a course-based, credit-bearing educational experience in which students (a) participate in an organised service activity that meets identified community needs and (b) reflect on the service activity in such a way as to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of personal values and civic responsibility.

Suffolk University (2021) further describes service learning as

> a method of teaching and learning that integrates community service activities into academic curricula. Within service learning, classroom studies complement service within the community and enable students to reflect upon and address local and national problems. A service learning curriculum enlarges the learning arena of students from the classroom to the community. Students are encouraged to reflect on issues in ways that allow them to apply their academic knowledge and skills to deliver effective community service through coordinated activities. This enables service learning to transform students from passive consumers of information into active and engaged learners, and community members whose responsible activities and service refresh and transform their

> communities' landscapes. Service learning affects not only how students learn, but also how society views education and service. Service learning is perceived as a philosophy of education and community service.

Reinhard *et al.* (2016) explain that the relevance of industry as a mutual partner in the decision-making and structure of degree programmes has been validated by the success of the Duale Hochschule Baden-Württemberg study model, assuring a learning outcome that is customised to the requirements of local industry. In South Africa, it is envisaged that the formation of community engagement partnerships will strengthen local industry's commitment to developing a customised model of WIL through a multi-stakeholder approach (Reinhard *et al.* 2016).

The need for increased community engagement at DUT was envisaged and recognised as far back as the year 2008, in a document titled "*100 years of Wisdom*", where it was stated:

> DUT recognizes the need for a UoT to be engaged with the community. DUT will have to strengthen its relationship with industry and the community to transfer technology and knowledge to help meet and solve the needs and problems of society (DUT 2008).

It was further elaborated that greater DUT community involvement would be achieved through the concept of co-operative education (i.e., WIL) which was a compulsory module at the time in most of its programmes, requiring students to do "on-the-job" training before they could graduate. However, the vision of encapsulating WIL into the academic programmes for increased community engagement did not materialise throughout the university, and after the curriculum renewal project, various elements of WIL have fallen by the wayside.

Fast-forward 13 years later and the current DUT ENVISION2030 strategic map once again highlights the need for providing innovative solutions to society's challenges. One of the four highlighted aspects is *Society,* which is one of the focal aims of the management strategy. It speaks of "a dynamic and innovative solutions-focused interaction with, and impact on, society at both local and global levels" and a "Society that leads to mutually beneficial collaborations, the practical application of knowledge and future-ready graduates”. The objective then is to be “An engaged university – be engaged and productive glocal citizens that establish mutually beneficial partnerships” (DUT 2020b).

DUT has since established an official community engagement office, which falls under the ambit of the DVC: Research Innovation and Engagement to gauge the level and type of work and engagements occurring in this domain, which are aligned to ENVISION2030 strategy and embedded within the research, innovation and teaching and learning core functions of the university. Furthermore, Prof. Marks, director at the DUT Urban Futures Centre (UFC) has been acknowledged for her efforts in establishing and organising mutually beneficial collaborations to service communities. The UFC which is housed in the FEBE serves as a hub for a network of projects, institutions, practitioners, and academics involved in the future of cities locally and internationally. Prof. Marks stated that “…we take community engagement seriously; as it’s all about the community engagement component which commonly describes ourselves as engaged scholars who are trying to engage in real world issues, and positive life changes”. She expressed her satisfaction, stating: “I am really grateful to DUT for recognising community engagement as significant as many universities don’t,” further adding that “DUT is one of few universities that are still engaged because there is that very strong focus on technical and practical skills which does not compromise the outcome from our students” (Peters and Zuma 2021).

The literature puts into perspective the role of a UoT in terms of its civic and social responsibility for increasing community engagement, in establishing mutually beneficial partnerships and collaborative initiatives with local and national communities, thus provide solutions for society and promoting socio economic growth in developing communities. Students should be able to apply knowledge, skills and expertise acquired in the WOW to make a meaningful contribution to these communities. If implemented strategically, WIL could be one such instrument that can facilitate this process, effect positive change, and improve livelihoods. Failure to actively embark on these types of strategic partnerships will be regarded as a missed opportunity and misalignment in terms of the university's Envision2030 strategy, obligation, and mandate as a UoT in the higher education landscape.

2.13 Challenges of WIL in higher education

The pressure and expectations exerted on HEIs from the public and private sectors is to produce a work-ready graduate with the necessary attributes, competencies and skills sets for the modern workforce. New qualifications and programme re-curriculation have led to a complex and challenging scenario for UoTs where institutions have to prioritise and aim to achieve a balanced and equitable approach to academic theory, practicals, laboratory work, WIL and research activities, while satisfying a growing and demanding industry network, who require productive outcomes from emerging graduates.

The lack of value and recognition for WIL as well as resistance to committing to WIL activities by the university hierarchy is another source of hindrance in the higher education sector. Significant cultural changes are required for WIL to permeate profoundly across some universities and disciplines. Edwards *et al*. (2015) explained that the reality for many academics and administrative staff involved with WIL is that their contributions are not necessarily valued by leadership and by peers across their disciplines in the same manner that their colleagues' research grant successes or traditional teaching and learning approaches are celebrated (Edwards *et al.* 2015).

Although there are advantages for participation in WIL for tertiary institutions, industry, students, and associated stakeholders, according to Jackson *et al*. (2017), some barriers exist that may prevent some companies and organisations from actively engaging or participating in WIL opportunities, or limit the extent to which they participate. As the WIL gains traction, a greater number of employers will be required to fulfil the demand for WIL placements. A major impediment is a lack of shared knowledge and awareness amongst employers of what WIL entails and how to participate. Some employers have difficulty in locating and sourcing an appropriately skilled student or one that can attend the workplace at the specific required time. Inadequate resources for coordinating WIL placements, including student monitoring and supervisor at the worksite, have also been identified as challenges Department of Industry 2014, cited in Jackson *et al*. 2017).

Further, Patrick *et al*. (2009, cited in Jackson *et al*. 2017) indicated that there are also misalignments between industry and university expectations on the purpose and nature of the WIL experience. Smith *et al*. (2006, cited in Jackson *et al*. 2017), identified three areas where HEIs WIL co-ordinators' and industry's expectations of the nature and objective of WIL varied significantly. These included:

> the level of commitment of host employers to WIL activities and their understanding of what WIL actually entails; the capacity of assigned mentors and supervisors to undertake their roles effectively; and what constitutes a quality placement and how this can be achieved.

Monitoring the quality and completion of the work, communication with university partners, and mentoring and supervising of the student, are all significant expenditures related to establishing effective WIL programmes. These costs are further compounded during periods of economic downturn where organisations are financially constrained. Furthermore, the challenges of hosting WIL students are difficult for smaller firms, because employees must fulfil various functions and perform multiple duties, with limited time and resources for teaching, mentoring and supervising students (Jackson *et al.* 2017). Structured monitoring of students at the workplace is a requirement for HEIs, in addition to risk management administration, which has implications on staffing resources. Smith *et al* (2014, cited in Jackson *et al*. 2017), recommended that "university and industry partnerships be structured, intentional and resourced".

According to Choy and Delahaye (2011), the development of a WIL curriculum depends on genuine partnerships between the universities and organisations, which require a comprehensive process of negotiating the curriculum and pedagogies to support WPL. These collaborations allow one to critically examine universities' traditional roles as transmitters of discipline-specific knowledge and the workplace as less active partners in educational learning processes and outcomes (Choy and Delahaye 2011).

Furthermore, Boud and Symes (2000, cited in Choy and Delahaye 2011) emphasise that, due to the lack of pre-existing maps that describe the territories of knowledge in academia and workplace practices, the alignment of academic content to industry activities is complex and challenging for academic staff. In general, HEIs pay more attention to content, types of learning activities, and outcomes that meet academic criteria. While this method serves the university's objectives well, it falls short of satisfying the requirements of the workplace and students. It is suggested that it is better for WIL to be designed collaboratively to meet the needs of all three parties.

Choy and Delahaye (2011) commented that innovative models of WIL necessitate collaboration between universities and industry to appropriately design and facilitate learning in the workplace. In fact, members of both organisations, have subject knowledge and experience that can contribute considerably to productive WIL programmes, and each possesses unique sets of skills and expertise that can be consolidated in order to enhance the design of the curriculum. These strategic partnerships "require new 'power – knowledge' relations, and the territories need to be negotiated and mediated" (Choy and Delahaye 2011).

There is a renewed call for strategic partnerships between education providers, employers, and stakeholders to be further explored, to clearly determine their definitive roles and responsibilities in terms of creating an enabling integrated environment that will promote and sustain WIL partnerships in the quest for the ideal 'work-ready' graduate that meets and perhaps exceeds the needs of academia and the workplace, thereby driving skills acquisition and economic recovery and growth.

At the third annual WIL Africa Conference in 2018, industry panel members expressed serious concerns about the lack of WIL or the reduction in WIL at UoTs. DUT Vice-Chancellor, Prof. Mthembu, responded to concerns and refuted the notion that DUT had abandoned WIL, instead stating that it was facing some teething problems in the transition from traditional forms of WIL e.g., a stand-alone third year of work-based learning, to a new, more integrated, approach. As he explained:

> The higher education sector now has CHE good practice guidelines on WIL, which universities are now using to develop their curricula. These guidelines are not one-size-fits-all, with several options universities could adopt. This caused great consternation by WIL enthusiasts whose conception of WIL is more traditional. DUT has not abandoned WIL. Instead, the new guidelines have provided other innovative ways or approaches to do WIL differently from how it had been done up to then. There are protagonists and antagonists alike to these WIL developments (Dell 2018).

Prof. Mthembu also elaborated on the issue of funding, stating that traditional WIL with a work placement approach is not funded as opposed to an integrated WIL which is funded. He believed that this has become a determining factor for some departments or faculties making decisions on which approach to adopt. He revealed that there was also a lack of funding for lecturing staff to be relieved while they monitor WIL in industry, as well as available fees paid to the co-op education unit for travel to work sites. He conceded that there were sometimes inordinate delays in the graduation of some students because of the lack of WIL placements, which had a significant impact on both the institution and the individual students. He further mentioned that "The requirement that universities have to take responsibility for placing students when placements fully depend on the availability of opportunities in industry, in a lacklustre economy where job opportunities are not being created, is a big challenge to universities" (Dell 2018).

Some of the glaring challenges identified include students' difficulty in securing placements, lack of funding, insufficient resources for coordinating WIL, delays in students' graduation, and the responsibility laid on HEIs to effectively place students. These have to some extent deterred some academic departments from pursing traditional WIL work placements in their programmes. Moreover, proposed plans and evidence on the structured integration and future implementation of WIL into the new qualifications by the university hierarchy at DUT is yet to be confirmed for engineering programmes including geomatics.

2.14 WIL simulation

WIL can include a range of workplace experiences and practices delivered in various forms such as co-operative education, experiential learning, internships, apprenticeships, PBL, PJBL, service learning, inquiry learning, practicum placements, scenario learning, virtual or simulated WIL learning, and WPL. It is assumed in most cases that these traditional experiences or work activities are located within an actual authentic professional practice or community setting, however changes within the higher education sector and programme offerings have required academics, learning facilitators, programme co-ordinators, as well as public and private sector industry practitioners to revisit this notion.

Oliver (2015, cited in Sachs, Rowe and Wilson 2016) suggests that learning can occur at different levels and across a series of tasks which can either be 'authentic' or 'proximal', and that WIL activities or experiences may be on a continuum contingent on how closely they mirror tasks required in real-world circumstances, and how well the surroundings resemble professional practice contexts (Sachs, Rowe and Wilson 2016).

Simulated learning, according to Winberg *et al*. (2011), is learning stimulated by a task or activity which entails the imitation of the real world in an academic setting. The process of simulation entails the reproduction of specific key elements or characteristics of a chosen workplace, and may include such effects as flight simulations, laboratories, patient models, mock meetings and so on.

According to HCA (2017), simulations mimic real-world circumstances, processes, and systems in the workplace, providing a risk-free environment in which students can experiment, make judgements, and, most crucially, commit mistakes without facing real-world consequences. The student can receive feedback as they progress through the simulation or upon conclusion of the simulation. A supervisor or manager can assess the individual's level of competency and provide necessary feedback or remedial action during the simulation phase, with students also given time for reflection. Simulation has been adopted as an effective learning approach in many companies, and if developed, and executed correctly, can provide a quicker path to achieving the desired skills and competence. Scenarios within the simulation can be created such that students interact with the content in different ways. These situations could evaluate their capabilities by challenging them to respond to a specific question, problem or situation; identifying and/or selecting items, tools or appropriate technologies to complete a task or time-based activities (HCA 2017).

Moyer *et al*. (2017) offer a concise explanation and describe simulated work-based learning (WBL) as:

> an immersive, career-themed experience, offered in a protected setting at an educational institution, that replicates workplace tools, processes, and/or environments to offer students realistic hands-on opportunities to practice, reinforce, and grow the technical skills, employability skills, and academic knowledge learned through classroom instruction.

Simulations may be considered for numerous reasons, including the challenges educators face in the placement of students with employers, logistical issues, scheduling challenges that restricts student’s ability to travel, and safety concerns that inhibit students’ access or engagement. Simulated WBL strives to mimic real-world work experiences by allowing students to participate in a realistic worksite activity on campus (Moyer *et al.* 2017).

A study by Iipinge, Batholmeus and Pop (2020) was conducted at a Namibian university to explore the use of simulations to better prepare students for WIL placements and to improve work readiness skills. According to the findings of the study, incorporating suitable simulation activities into the WIL readiness programme could form part of the university's initiative to develop WIL readiness programmes that are focused on developing and equipping learners with necessary competencies required for WIL placements. The study revealed a need for simulations to include more practical organisational scenario settings from industry to fit the student’s disciplinary profiles e.g. human resources, information technology, engineering, management etc.

According to the findings, simulations have an essential role in instructional pedagogy and can be applied to WIL preparation. Simulations for WIL readiness can be created with an employability focus in mind, with the goal of developing WIL readiness skills in order to prepare students to secure a work placement in industry and to benefit from their WIL experience. As a result, the onus lies with tertiary institutions, educators and learning facilitators to design educational technologies that drive knowledge and skills acquisition, as well as to develop a learning environment that enables learners to practice realistic scenarios related to their qualifications, and that is also adaptable to change as required by the fluctuating environment imposed by COVID-19 (Iipinge, Batholmeus and Pop 2020). These simulations were not conducted with the intention to replicate or replace WIL work placements altogether, but merely to enhance work readiness skills in preparation for industry WIL placement.

A study into the impact of an authentic, simulated learning activity on student readiness for WIL in an occupational therapy degree conducted at the Deakin University, revealed that students reported improved confidence levels and appreciated having opportunities to practice and obtain feedback on fundamental skills. The findings confirmed that participation in a simulated learning activity improves confidence and skills in a variety of areas that are relevant to WIL placement. A statistically significant improvement was found for all outcomes measured (Richmond, Richards and Britt 2015).

Smith, Ferns and Russell (2014) indicated that there is an increasing recognition that authentic simulations may deliver equivalent educational outcomes to WIL placements. Consequently, WIL has evolved into a holistic approach for a series of curriculum strategies that allow learners the opportunity to experience elements of real-world application of their disciplinary or generic abilities. Authentic simulations that represent the workplace, PBL, virtual simulations, industry-based project work, case studies, mentoring from industry employers, and work-related presentations are all examples of practice-based activities that do not directly relate to a placement in a work-based setting (Smith, Ferns and Russell 2014).

The US Department of Education in 2017 outlined a series of approaches to simulate work, resulting in three common models being used: 1) The application of simulation tools to impart occupational specific skills; 2) Simulated workplaces intended to replicate worksite settings; and 3) School-based initiatives, operated as student-run businesses that manufacture and sell products or services. Figure 2.7 illustrates the models of simulated work-based learning and their distinctive characteristics, which could possibly be adapted for institutions of higher learning and suited to the various faculties according to their programmes of study and discipline specific professions (Moyer *et al*. 2017).

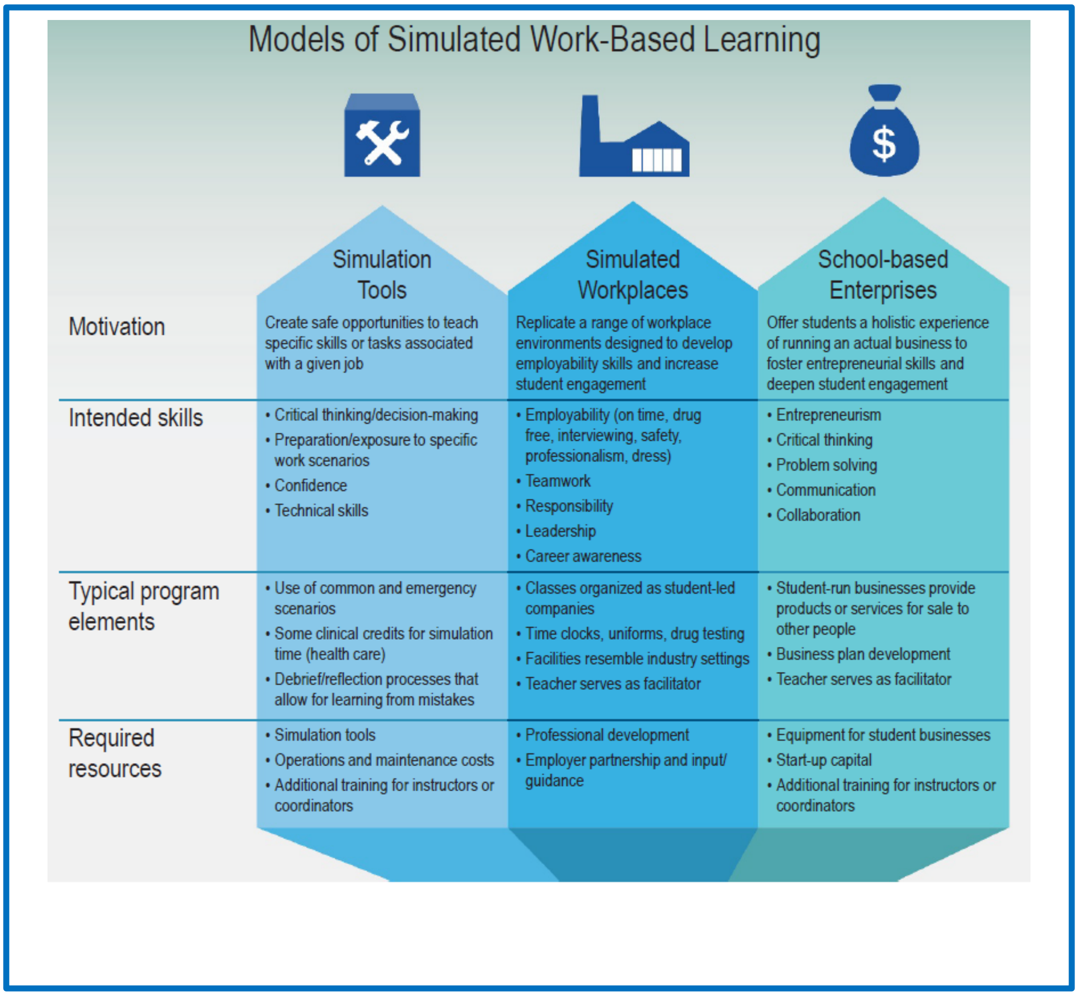

Figure 2.7: Models of Simulated Work-based learning
Source: Adopted from Moyer et al. (2017)

In South Africa, some HEIs are increasingly exploring creative ways of incorporating the trusted traditional WIL workplace practice into a more structured curriculum format, by investigating the option of WIL simulation to satisfy industry concerns about the lack of sufficient industry practice and work preparedness of the graduates. As a result, WIL is now being considered in a modern approach by incorporating elements of industrial work in a revised curriculum format. Some of the more inventive mediums of attempting to bring across the traditional elements of WIL into a modern education framework is by incorporating Work-directed theoretical learning (WDTL), PBL and PJBL amongst others.

Table 2.3 provides an overview of the most common types of WIL in curricular practice.

Table 2.3: WIL typology

Curricular modality	**WDTL**	**PBL**	**PJBL**	**WPL**
Terms and practices associated with the curricular modality	Classroom-based instruction, Lecture, tutorial peer learning groups	Sequenced real world problems, integrated learning, discovery learning, self-directed learning, peer learning groups	Industry project, 'real world' learning, guided practice, 'capstone' modules	'In-service' Work placements, co-operative education, practicum work-based learning, 'sandwich' courses, apprenticeships, Internships, Traineeships
Examples	Career-focused courses and curricula (e.g., Maths for Engineering, Communication for Business), Guest lecturers (e.g. from industry), Authentic examples, Workplace assessors	Work simulated problems, Case studies and scenarios, Team learning	Study visit, Site visit, Job shadowing, Authentic tasks & texts, Fieldwork, Interviews, Team work, Service Learning, Inter-disciplinary projects	Learning contracts, Work record books, Learning logs, Journals, Mentoring, Specific training, Learning portfolios
Sites of learning	Lecture theatre, Classroom,	Classroom, Laboratory,	Multiple sites: Classroom &	Workplace & Classroom (for

	Laboratory,	Group sessions,	Workplace,	preparation &
	Studio,	Library,	Laboratory &	reflection)
	Websites, Blogs	Electronic media	workplace, etc	Electronic media
			electronic media	

Source: Adapted from Winberg *et al.* (2011)

Work-directed theoretical learning (WDTL) refers to the acquisition of discipline-specific content knowledge. These are regarded as active mediums of learning, which include tutorials, practical work, demonstrations, group learning, and experiential learning opportunities. It may also include guest lectures and presentations by industry practitioners, experts, and representatives to increase mostly technical knowledge. This is a component of most UoT courses already.

Problem-based learning (PBL) is a student-centred approach and instructional method in which students acquire knowledge through structured facilitated problem solving. In PBL, student learning revolves around a simulated or intricate real-world problem that may not have one correct answer. Students engage and collaborate in groups to determine what they need to learn in order to solve a problem. They practice self-directed learning (SDL) and then apply their new knowledge to the problem at hand, thereafter, reflecting on what they've learned as well as the effectiveness and success of the strategies that were utilised. The lecturer fulfils the role of a facilitator to the learning process rather than providing facts and concepts about a specific subject. The goals include "helping students develop a) flexible knowledge, b) effective problem-solving skills, c) SDL skills, d) effective collaboration skills, and e) intrinsic motivation". Therefore, PBL not only reinforces students' teamwork, communication, and research capabilities, but it also improves their critical thinking and problem-solving abilities, which are important for lifelong learning (Hmelo-Silver 2004; Kurt 2020).

According to Winberg *et al*. (2011),

> PBL is an active form of learning, whereby interdisciplinary teams design and provide the problem simulations and problem experiences that challenge students to achieve curricular outcomes. Facilitators guide students as they develop problem-solving skills, identify what they need to learn and develop SDL skills. However, PBL is considered by some as ineffective when it is sporadic, added on to, or mixed in, with more traditional, didactic, teacher-directed, passive, memorisation and lecture based educational methods. Nevertheless, modifications of PBL have been successfully incorporated into more learning-centred WIL curricula.

Project-based learning (PJBL) is an instructional teaching methodology which encourages students to learn by actively engaging in real-world and personally meaningful projects, through the application of knowledge and skills. Students will generally work on a project over a long duration of time that requires them to solve a real-world problem or answer a complex question. They then showcase their accumulated knowledge by producing a final product or presentation for an authentic public audience, comprising industry experts, community leaders and scientists who provide constructive feedback to the students. The presentation stimulates feedback and provides students with an opportunity to respond to questions and react to constructive criticism, which then evaluates another real-world skill (PBLWorks 2021).

PJBL is often differentiated by the following characteristics:

a) Interdisciplinary

This is an inter-disciplinary approach since real-world challenges are seldom resolved utilising knowledge or skills from a single subject area. In PJBL, project work necessitates the need for students to integrate subject knowledge and abilities from many academic disciplines to engage in research, solution development, and product construction, to help address the issue.

b) Rigorous

PJBL often requires the application of knowledge and skills rather than merely recollection and recognition. The students' initial steps are usually to engage in an inquiry process, which allows them to think critically while applying their academic knowledge in real-world circumstances, leading to a phase of deeper learning. The process of inquiry leads to the formulation of solutions to address the identified problem, which culminates in the creation of products.

c) Student-centred

In PJBL, the responsibility of the lecturer shifts from content-deliverer to facilitator, or project manager. Students work more independently while the lecturer provides support only when required. Students are urged to make their own independent decisions about the best approach to undertake the work and demonstrate their understanding. PJBL promotes student autonomy, ownership of his or her work, and the development of 21st-century workplace skills (O'Brien 2021).

According to MagnifyLearning (2021):

> PJBL units include the following core components:
>
> - Content knowledge & skills
> - Authenticity & relevance: Addresses a real-world challenge, need, problem, or concern
> - Inquiry
> - Student voice & choice
> - Collaboration
> - Employability (21st Century) skills
> - Community partnerships
> - Feedback & revision
> - Publicly presentation of product
> - Reflection (MagnifyLearning 2021).

Jollands (2017) described non-placement WIL as an on-campus or online mode of delivery, designed to simulate an authentic work placement to assist students to integrate their learning across various contexts or settings. However, it was noted that there are few studies comparing the effectiveness of non-placement WIL to real-world experience (Jollands 2017). Smith, Ferns, and Russell (2014) suggested that future research on simulated work experience should focus on determining the characteristics of a high-quality simulated WIL experience that positively influences the work-preparedness of students.

There is growing recognition amongst HEIs that WIL simulation may provide students with the opportunity to acquire the necessary skill sets and competencies for gainful employment in the WOW, by creating an enabling learning environment that emulates the future workplace, however further studies are required to determine the overall impact and outcomes. Further, it may present some challenges for specific programmes of study where simulation may not have the desired impact. While higher education is seen as an enabler for predominately academic knowledge, it may be argued that the acquisition of knowledge and skills pertaining to the application of modern geomatics technology in addressing the needs of the built environment, may be perceived by some as most effective and beneficial in a professional practice context where students can observe, participate, learn, experience, reflect, and grow under the expert guidance of qualified and registered industry professionals engaged in real-world projects. This type of learning experience could prove challenging to replicate effectively in a university setting even through some form of simulation. Nevertheless, the incorporation of consolidated forms of WDTL, PBL, PJBL and Service learning will require well thought out educational strategies, project co-ordination and learning outcomes from HEIs and industry partners, to produce the desired graduate outcomes.

2.15 The fourth industrial revolution

According to Moore (2019):

> The Fourth industrial revolution (Industry 4.0 or 4IR) is the ongoing automation of traditional manufacturing and industrial practices, using modern smart technology. Large-scale machine-to-machine communication (M2M) and the Internet of things (IoT) are integrated for increased automation, improved

communication and self-monitoring, and production of smart machines that can analyze and diagnose issues without the need for human intervention.

The African Centre for Economic Transformation published a report in 2020 emphasising the critical impact of the 4IR on the African continent in terms of readiness of the workforce:

> As the world enters the Fourth industrial revolution of artificial intelligence, robotics, 3-D printing and the 'Internet-of-things' (IoT), the challenge for Africa, which has one-fifth of the world's population aged under 25, is providing its youth with the knowledge and skills needed for the emerging world of work. With the right education, training and job-creating policies, this fast-growing population could be a great asset for socio-economic transformation. Africa is far from being ready for the new challenge. This revolution will affect jobs in all sectors, but in phases and to different degrees. Africa is not going to become automated suddenly, but the coming global impact of 4IR makes more urgent the economic transformation Sub-Sahara Africa (SSA) already needs in order to maximise its advantages and realize its potential (Brown 2020).

According to Brown (2020), diversification, export competitiveness, increased productivity, and technological upgrading are some of the most important transformation policies. Progress will be determined by how rapidly Sub-Saharan Africa (SSA) can build a significantly more educated and competent workforce, as well as create decent employment that remains up to speed with workforce growth. Students are among the 10 to 12 million youth who enter the SSA workforce annually, yet only three million formal jobs are created. For those who are successful in securing employment, there is frequently a mismatch between their skillsets and the needs of the employer. It is anticipated that this mismatch will deteriorate in the future, with more job applicants being unprepared for positions that, as a result of technological progress, demand high levels of critical thinking, communication, writing, and other soft skills. The key to unlocking Africa's potential is a better educated and more highly-skilled workforce.

> The essential ingredients include amongst others: improved access to early childhood education; an emphasis on ICT skills and critical thinking; higher

> participation in science, technology, engineering, and mathematics (STEM); higher participation in upgraded technical and vocational education and training (TVET); and investing in well trained educators and facilitators to work with modified curricula to prepare students for the new world of work. (Brown 2020)

TVET reform is regarded as vitally important as part of a wider economic strategy. Participation of the private sector in the design and delivery of TVET is critical for quality and relevance. Students also require entrepreneurship training and business literacy in addition to industrial placements and internships. The objective is to produce better-educated youth for productive, formal and informal self-employment (Brown 2020).

A report published in 2016 by the World Economic Forum (WEF) stated that, as entire industries adjust, most professions will experience a major transformation. While certain jobs are threatened by redundancy and others are fast expanding, current jobs are also changing in terms of the skill sets required to perform them. The reality is highly specific to the industry, region, and profession in question as well as the ability of various stakeholders to manage change. Human resources will be tasked with determining the implications of present shifts in employment, skills, and recruitment across industries and geographical boundaries. It has become apparent that the need for greater talent in specific job categories is complemented by a high level of skill insecurity across the board. Technological transformation, talent shortages, increasing unemployment, and rising inequality requires the critical reskilling and upskilling of today’s workforce. Increased collaborative initiatives among stakeholders such as online talent platforms, employers, educational institutions, human resources consulting firms, policymakers, and labour unions may significantly influence the momentum and precision of future workforce planning and management of organisational change.

> Technological trends such as the Fourth industrial revolution will create many new cross-functional roles for which employees will need both technical and social, and analytical skills. Most existing education systems at all levels provide highly siloed training and continue a number of 20th century practices that are hindering progress on today’s talent and labour market issues. (WEF 2016)

The goal then is to effectively manage the disruptive transformational impact of the 4IR on employment, skills, and education by incentivising and enhancing collaborations between governments, employers, educators, training providers, employees, and businesses (WEF 2016).

Geomatics has been described as the science and technology of gathering, storing, processing, analysing and delivery of geographic or spatially referenced information. It incorporates the tools, technologies and techniques utilised in land and engineering surveying, geographic information systems (GIS), global navigation satellite systems (GPS, GLONASS, GALILEO, COMPASS), digital photogrammetry, cartography, remote sensing, geography, geodesy, and other disciplines that utilise earth- related spatial data. Industry 4.0 is set to dramatically change the world and the industry landscape forever and will influence how traditional surveyors, geomatics practitioners and associated built environment professionals function to map the world, assets, and infrastructure, and produce deliverables in a seamless integrated workflow from field to finish. According to UNCTAD (2021), the United Nations Conference on Trade and Development (UNCTAD) has highlighted in its 2021 technology and innovation report, that new emerging technologies may create a greater digital divide, alienating lower income countries, especially those in SSA, from wealthier nation states, if these countries do not invest in the new technologies that have shown potential for inclusive and sustainable global development. However, with new technologies comes a critical need for upskilling of the workforce to meet and exceed expectations resulting from the digital revolution, and to maximise financial profits from the current technological revolution.

Arising from the digital revolution, the geomatics profession will most likely benefit from a modern graduate that exhibits sound theoretical knowledge of the core concepts, which is further reinforced by specialised practical instruction, specific technological skill sets, and relevant expertise to effectively collect, process, analyse, manage, and present geospatial data for various engineering applications in the built environment. In fact, the emerging opportunities, tools, and technologies that Industry 4.0 presents, sees a growing interest and global trend in the establishment of ‘digital smart cities’ of which geomatics is considered as one of the key enablers and drivers in terms of providing precise geospatial positioning services for futuristic urban landscapes.

A smart city, according to Thales (2021), is a framework primarily made up of information and communication technologies (ICT), for developing, deploying, and promoting sustainable development strategies to solve growing urbanisation concerns. A key component of this ICT framework is effectively an intelligent network of connected items and devices that transmit data utilising wireless technology and cloud-based applications. Real-time data is received, analysed, and managed by cloud-based IoT applications to assist government and municipal organisations, businesses, and individuals to make better decisions that improve the quality of life. Individuals interact with smart city ecosystems in a variety of ways, including through smartphones, tablets, mobile devices, connected cars, and smart homes. When these devices and data are connected virtually with a city's physical infrastructure and services, this will result in reduced costs and improved sustainability, enabling communities to enhance energy distribution, reduce traffic congestion, and even improve the quality of air, with support from the IoT (Thales 2021).

Geomatics has a wide spectrum of applications in areas such as forestry, health, urban management, civil security, tourism, and so on. Private and governmental organisations frequently employ geographic information systems to display geospatial and location-based data and undertake spatial analysis. They usually depend on airborne and satellite remote sensing data to achieve a modern view of the physical world. Over the years, these related technologies have aided in the monitoring, gathering of information, and management of resources, as well as the mitigation of associated risks. Modern geomatics tools can offer innovative solutions for management, governance, and public participation practices that are compliant with smart city objectives, thanks to recent developments in GISs, GNSSs, remote sensing, and location-based services and technology. Mobile laser scanning to facilitate large area high-resolution 3-D data acquisition is also gaining traction, as one of the fastest growing market segments, which is 3-D city modelling. It is further expected that unmanned airborne vehicles (UAVs) will have a positive impact on smaller scale projects with more frequent and economic data collections being possible.

Furthermore, these integrated technologies provide substantial added value by transforming collected 3-D georeferenced point clouds into intelligent 3-D models of urban infrastructure and surrounding environments to aid in planning and decision-making processes (Daniel and Doran 2013).

According to Toschi, Nocerino and Remondino (2017), the creation of 3-D building models utilising geomatics tools and technologies have significant potential for advancing the smart city concept. Enhanced 3-D building models could aid with disaster management, 3-D cadastres, energy assessment, noise and pollution monitoring, and visibility analysis, since the technology for capturing and processing 3-D geodata continues to advance rapidly. Digital photogrammetry and light detection and ranging (LiDAR) systems integrated with 3-D city modelling software form the crucial foundation for developing 3-D textured building models. Geomatics professionals strive for optimal utilisation of geodata and automated 3-D city modelling technologies in order to improve our understanding of urban ecosystems and, as a result, the liveability and safety of ever-growing cities (Toschi, Nocerino and Remondino 2017).

Geomatics has always played a fundamental role related to reality-based data acquisition and processing. Actual, exact, and integral data are critical for smart city design, modelling, and planning. Knowledge of the underlying terrain is essential for a range of smart city applications, such as the simulation of urban floods, which necessitate high precision, and high resolution GIS. Those cities that do not adapt and progress using innovative urban planning, modern design, technological models, and intelligent resource management may be left behind, with negative implications for their population. However, in forward-thinking cities, geomatics will continue to play a significant function in this domain (Mahieux 2017). Geomatics professionals through engagement and collaboration with associated built environment practitioners, can deliver the tools and technologies, technical expertise, and support mechanisms to achieve these futuristic urban goals.

The literature emphasises the growing call that governments, businesses, economies, and societies at large can only fully thrive if the workforce has the essential individual and collective skills sets, professional attributes and core competencies to promote technology transfer, research, and innovation, as it enters this new age of digitalisation. New advanced technology and innovations driven by 4IR can propel these futuristic type smart city urban concepts into a South African reality. It will, of course, require emerging graduates from the HEIs to be adequately equipped with the relevant academic, technical, and technological skill sets to thrive in this vibrant evolving industry and aim to be at least on par with other developing nations. The lack of essential skills and competencies may delay or compromise efforts for a smooth transition in the 4IR. A further expectation of graduates will be to embrace and utilise technology intelligently while engaging in research activities, to address problems connected to the engineering and the built environment, for the advancement of society.

This chapter has shown that there is a substantial amount of relevant literature that reveals the significance of WIL in a modern education system. There are some challenges as one would expect, as HEIs transition to new programme offerings and revised curricula. This then requires renewed conversations and fresh perspectives amongst policymakers, academic structures, professional bodies, and quality assurance bodies, to establish a balanced approach in creating an invigorating and holistic educational experience for the student, and a product that is well received by the relevant stakeholders to affect the desired economic and societal impact.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Research methodology

The study was conducted by employing a mixed-method approach incorporating quantitative and qualitative methods. The combination of both research techniques provided a holistic and rigorous research approach to achieving the aims/objectives of the study and added credibility to the findings. However, emphasis was primarily on quantitative research techniques, data collection methods, and appropriate statistical techniques, which involved the organisation, analysis, interpretation, and presentation of the numerical data with the utilisation of *SPSS* data analysis software.

The research embraced a philosophy of positivism in the creation of knowledge as it was highly structured and employed quantitative methods as the primary data collection method and analysis. The research approach was deductive and objective in nature and endeavoured to make a positive and meaningful contribution to the higher education and training sectors, to assist in terms of informed decision making and best practices pertaining to WIL practices.

3.1.1 Quantitative method

The quantitative method was the predominant technique since it constituted a significant part of the study, which involved the administration of a structured closed-ended questionnaire to the sample (Table 3.1). This method is based on numerical and mathematical data and is considered objective and scientific in nature as it produces results that are accepted as accurate, reliable and reduces bias. The method also facilitates a quicker data collection process which is a cost-effective option when faced with limited resources.

This method was utilised to quantify respondent's perspectives, opinions, attitudes, impressions, and beliefs etc. and to generalise results and findings from the sample population. A combination of the nominal, ratio, Likert, and semantic differential rating scale types were used to obtain a series of scaled responses, as well as to measure and analyse the varying degrees of opinion and attitudes of the respondents towards the concepts being measured. These scales are common and well-validated methods of collecting the required data and have been used extensively in quantitative research studies. The measurable data was used to fulfil the aims/objectives, evaluate the objective data, determine patterns in the research which was subsequently presented in both tabular and graphical formats; as well as formulate facts and make recommendations based on the findings. Both questionnaires concluded with an open-ended question to invite respondents to express their views on WIL.

3.1.2 Qualitative method

The qualitative method was the secondary technique adopted since it constituted a smaller component of the study. This involved analysis of the employer comments/perspectives from the experiential training report data set. Additionally, the one open-ended question appearing on both the employer and student questionnaires provided respective respondents with an opportunity to express their views, opinions, and experiences, and to further elaborate on any aspect pertaining to WIL. The qualitative data was collected to complement and support the findings in the quantitative study where applicable. Since qualitative research methods are primarily exploratory research, unstructured, subjective and focus largely on open-ended questions, this method was not extensively used in the study, as it would have involved time-intensive activities and required additional resources resulting in increased costs, which would have not been deemed feasible for a study of this nature.

3.2 Population and sample selection

Table 3.1: Population, sample and data set

Data Sample	*Description*	*Approx. Target Population size*	*Sample Size*	*Sampling method*	*Remarks*
Sample 1	Industry partners, employers	*n= 185*	*n= 150*	Simple	45 questions
	and stakeholders			random	(Part A – D)
				sampling	
Sample 2	Geomatics students and	*n= 100*	*n= 90*	Simple	28 questions
	graduates			random	(Part A – C)

				sampling	
Data Set	Experiential training record		*n= 100*	Data set	for the period
Sample	data set (ET4 & ET5 reports)				2010 – 2020

3.2.1 Population Sample 1

The target population for Sample 1 was the various key industry partners, employers and stakeholders from the public and private sectors which included surveying/geomatics practitioners, local municipalities, Eskom, DRDLR, KwaZulu-Natal Department of Transport and the civil engineering and construction industry within the KwaZulu-Natal region. Database records indicated that there were approximately 140 eligible industry members affiliated to the South African Geomatics Institute (SAGI) KwaZulu-Natal region. It was also determined from the Departmental experiential records, that there were a further 45 industry members who provided students with experiential learning (EL) opportunities, which resulted in a total target population size of 185 members.

The sample comprised a random selection of members from the various industries described above using the simple random sampling method. The projected sample figure for 150 members equated to 81%, which was a good representative sample to make statistical inferences and draw conclusions about the entire population in terms of generalisability of the findings.

a) Inclusion and exclusion criteria

The target population included surveying/geomatics practitioners and companies/organisations in the public and private sectors who employed surveying/geomatics students/graduates in the KZN region only. Practitioners and companies/organisations outside the KZN region were excluded from the study. The survey pertained to the National Diploma: Surveying and the BBE: Geomatics programmes at the Durban University of Technology, Durban campus. Other HEIs and programme offerings were excluded from the study.

3.2.2 Population Sample 2

The target population for Sample 2 was the first cohort of geomatics graduates in the year 2020, as well as the second and third year geomatics students registered in 2021. These students/graduates have not previously engaged in WIL. The first cohort of graduates was a low figure of four students, as this was a first-time programme offering. This is attributed to the fact that a significant number of students in FEBE programmes take longer than the minimum prescribed period to complete their qualifications on the first attempt, with many repeating modules en route to graduation. Furthermore, the Covid-19 pandemic also created many challenges for students, including the lack of PCs, location of learners in remote areas with poor or no network coverage, inaccessibility to online learning platforms and resources, non-availability of data or internet facilities, lack of online computer skills, lack of e-learning training etc. This may have adversely affected their academic performance in transitioning from contact classes to online virtual teaching and learning platforms. Additionally, this coupled with the added fear, stress, uncertainty, and anxiety of coping with the ‘new normal’ under the current global crisis, may have all contributed detrimentally to the small size of the first cohort number of graduates.

The typical registered intake of students for each level of study in the degree is approximately 50 students starting from Year 1. The total target population size was achieved by combining the total number of Year 2 and Year 3 students, and the first cohort of graduates, which resulted in a total population size of approximately 100 participants. The sample comprised a random selection of students using the simple random sampling method. The projected sample figure of 90 students equated to 90%, which was a good representative sample to make statistical inferences and draw conclusions about the entire population in terms of generalisability of the findings.

Since WIL was a relatively new concept to the geomatics students, they were provided with an electronic copy of the official CHE document titled: *WIL Good Practice Guide*, a copy of the ND: Surveying experiential training logbook, and a link to the official DUT co-operative education website to enlighten them on the concepts of EL and WIL. The researcher also conducted a brief Microsoft (MS) Teams session with the respective students, to highlight the aims/objectives of the study and explain the participant letter of information/consent form. The session was conducted in a fair and transparent manner to avoid introducing bias, and to maintain professional and ethical standards in the study. Students were also encouraged to complete the survey in a fair, honest, and objective manner. The Google forms survey link was made available to the students two weeks after the briefing session to allow them time to peruse the respective documents.

a) Inclusion and exclusion criteria

The target population included only geomatics students in Year 2 and Year 3 of their academic studies as well as the first cohort of BBE: Geomatics graduates at the DUT. Geomatics students from Year 1 and civil engineering students were excluded from the study. Surveying and geomatics students from other HEIs were also excluded from the study.

b) Pilot study

A small pilot study comprising 10 students was conducted to test the survey instrument (questionnaire). The students were invited in a separate email to participate in the electronic survey. Based on the results of the pilot study, some minor adjustments were made to the main questionnaire, in terms of similar, repetitive, and ambiguous questions. The pilot study participants were not included in the main study.

3.2.3 Data set sample: Experiential training records

A sample of 104 completed experiential training reports (ET4 and ET5) were extracted from department file archives of students who engaged in WIL for the period 2010 to 2020, which covered at least two SAGC accreditation visits for the National Diploma programme. A sample of a set of blank ET4 and ET5 report forms is attached as Appendix E. The numerical data extracted from the ET4 and ET5 reports were then tabulated in a spreadsheet. A sample of the blank template used for capturing the experiential training spreadsheet data is attached as Appendix F. The data set further consisted of a small component of qualitative research which focused on a brief analysis of the employer and student comments/perspectives from the reports.

3.3 Data collection and processing

The survey instrument employed for Samples 1 and 2 was an online electronic survey questionnaire. The instrument focused on perceptions rather than actual performance. Data collection and research statistics were determined from three sources as laid out below.

3.3.1 Sample 1: WIL industry employer questionnaire

This focal aspect of the study was conducted primarily by means of quantitative research methods, where feedback was elicited through a closed-ended questionnaire which consisted of four parts (A – D). The questionnaire comprised 45 structured questions and utilised predominately the Likert and semantic differential scales. Question 45, however, was qualitative in nature, as it was an open-ended question to provide respondents with an opportunity to express their views and opinions, and to elaborate further on any aspect pertaining to WIL. A sample of the WIL Industry employer questionnaire is attached as Appendix C**.**

The questionnaire specifically sought to obtain feedback on the impact of experiential learning/WIL as conducted in the National Diploma: Surveying programme, and evaluate the perceptions of the geomatics profession pertaining to exclusion of WIL in the BBE: Geomatics programme at the DUT. The questionnaire survey was administered via online web-based means to various industry partners and stakeholders within the KwaZulu-Natal region. This procedure was facilitated through the use and application of Google forms, which is an electronic survey administration software tool that allows users to create, edit and administer online surveys. Data collection was therefore simplified, and any information gathered was typically stored via the automated system, in a spreadsheet format for further evaluation and analysis. Constructive industry feedback assisted with informed decision-making and was used as a tool to better understand the deficiencies and to implement best practices.

a) Recruitment process and Informed consent

Prospective participants were invited to participate in the study through a formal invitation email, attached as Appendix K, which provided a brief overview and outlined the aims/objectives of the study. Permission to conduct the study and disseminate the survey to the industry members was firstly obtained from the SAGI administration. A letter addressed to the SAGI president, and the subsequent letter of approval is attached as Appendix G and Appendix I respectively. The invitation email containing the web link to the actual electronic survey was then distributed by the SAGI office to its KZN affiliated membership base. The researcher also distributed separate invitation emails to the industry employers listed in the department experiential records database.

Participants each received an electronic information pack via email containing the Letter of Information and Informed Consent, attached as Appendix A. The actual informed consent was also embedded in the electronic survey questionnaire for convenience, where participants were prompted to grant consent before proceeding with the online survey. No email addresses were collected during the survey. All electronic information will be stored securely on a computer with password-restricted access to enhance the security of data. The identity of the respondent will remain anonymous.

b) Retrieval of questionnaires

The *URL* web link to the Google form survey questionnaire was embedded in the contents of the invitation email and the participant letter of information for convenience. After clicking on the link, participants were required to complete the electronic questionnaire survey by responding to a list of structured questions in a fair and objective manner to ensure ethical standards and credibility in the study. The expected time required to complete the questionnaire was in the range of 10 to 15 minutes. The data collection procedure was automated and upon completion, the data was processed and analysed.

c) Confidentiality and storage of data

Participation in the study was completely voluntary and anonymous. Personal information was not required. Information gathered during the research was used solely for the purpose of the study and all efforts were made to ensure the utmost confidentiality of participant's personal information. No form of identification was included in this report. As per the DUT ethics policy, hard copies of the answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet and all identifiable electronic data will be stored securely on a computer with password-restricted access and only the researcher, supervisor, and ethics committee members may have access to it. All identifiable information will be destroyed at the end of the study or after five years, whichever comes first. Computerised electronic data will be permanently deleted/erased off computer hard drives, external discs, and data storage devices. Hardcopies of data will be shredded in a paper shredder machine.

d) Data collection

The data collection process was conducted over a period of five weeks and resulted with 124 respondents out of a sample size of 150, resulting in an 83% response rate. The numerical data from the questionnaires were coded, processed, and analysed in *SPSS* software. The results are discussed in Chapter 4.

3.3.2 Sample 2: WIL student questionnaire

This aspect of the study was conducted primarily by means of quantitative research methods where feedback was elicited through a closed-ended questionnaire which consisted of three parts (A – C). This questionnaire comprised 28 structured questions and utilised predominately the Likert and semantic differential scales. Question 28 however, was qualitative in nature, as it was an open-ended question to provide student respondents with an opportunity to express their views and opinions, and to elaborate further on any aspect pertaining to WIL. The WIL student questionnaire is attached as Appendix D**.**

The questionnaire specifically sought to evaluate the perceptions of geomatics students and graduates pertaining to exclusion of WIL in the BBE: Geomatics programme at the DUT. The questionnaire survey was administered via online web-based means using Google forms. Data collection was therefore simplified, and any information gathered was typically stored via the automated system, in a spreadsheet format for further evaluation and analysis. Student feedback assisted with informed decision-making and was used as a tool to better understand the deficiencies and to implement best practices.

a) Recruitment process and informed consent

Prospective student participants were invited to participate in the study through a formal invitation email, attached as Appendix L, which provided a brief overview and outlined the aims/objectives of the study. Permission to conduct the study and disseminate the survey to the students/graduates were firstly obtained from the DUT, Department of Research and Postgraduate Support office. A letter addressed to the Director: Research and Postgraduate Support, and the subsequent letter of approval are attached as Appendix H and Appendix J respectively. The invitation email containing the web link to the actual electronic survey was then distributed to the student participants.

Participants each received an electronic information pack via email containing the Letter of Information and Informed Consent, attached as Appendix B. The actual informed consent was also embedded in the electronic survey questionnaire for convenience, where participants were prompted to grant consent before proceeding with the online survey. No email addresses were collected during the survey. All electronic information will be stored securely on a computer with password-restricted access to enhance the security of data. The identity of the respondent will remain anonymous.

b) Retrieval of questionnaires

The *URL* web link to the Google form survey questionnaire was embedded in the contents of the invitation email and the participant letter of information for convenience. After clicking on the link, participants were required to complete the electronic questionnaire survey by responding to a list of structured questions in a fair and objective manner to ensure ethical standards and credibility in the study. The expected time required to complete the questionnaire was in the range of 8 to 10 minutes. The data collection procedure was automated and upon completion, the data was processed and analysed.

c) Confidentiality and storage of data

Participation in the study was completely voluntary and anonymous. Personal information was not required. Information gathered during the research was used solely for the purpose of the study and all efforts were made to ensure the utmost confidentiality of participant's personal information. No form of identification was included in this report. As per the DUT ethics policy, hard copies of the answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet and all identifiable electronic data will be stored securely on a computer with password-restricted access and only the researcher, supervisor, and ethics committee members may have access to it. All identifiable information will be destroyed at the end of the study or after five years, whichever comes first. Computerised electronic data will be permanently deleted/erased off computer hard drives, external discs, and data storage devices. Hardcopies of data will be shredded in a paper shredder machine.

d) Data collection

The data collection process was conducted over a period of five weeks and culminated with 83 respondents out of a sample size of 90, resulting in a 92% response rate. The numerical data from the questionnaires were coded, processed, and analysed in *SPSS* software. The results are discussed in Chapter 4.

3.3.3 Data set sample: Experiential training records

A sample of 104 completed experiential training reports (ET4 and ET5) were extracted from department file archives of students who engaged in WIL for the period 2010 to 2020. The period covered two SAGC accreditation visits for the National Diploma programme. The data consisted of 'personal skills' and 'performance appraisal' scores for the first six-month (Time 1) and second six-month (Time 2) periods of WIL. The quantitative (numerical) data from the actual reports were captured and organised in a methodical order utilising MS excel spreadsheets to facilitate the data analysis in *SPSS* software. The numerical data were then analysed in *SPSS* software, producing appropriate descriptive tabular data, and supporting graphical illustrations per appraisal category.

This data set also contained a small component of qualitative research which involved analysis of the employer and student comments/perspectives from the individual experiential training reports. This was a source of valuable employer and student feedback pertaining to the quality of training, work experiences, work ethics and offered some insight into the historical impact of WIL over the past decade in the Diploma programme. The textual data was classified, analysed, summarised, and appropriately presented. The results are discussed in Chapter 4.

3.4 Limitations

This study was limited to the KwaZulu-Natal region and only considered the National Diploma: Surveying and the BBE: Geomatics programmes at the Durban University of Technology, Durban campus. Other HEIs and programme offerings were not considered in this study, and therefore no comparative studies will be reported on.

3.5 Ethical considerations

Ethical conduct is important in research as in any other field of human activity. When conducting research and collecting data, one has to be mindful of all guidelines and protocols and should endeavour to comply with the necessary ethical procedures and standards. The principles underlying research ethics involve aspects such as plagiarism, honesty and integrity, objectivity, confidentiality, and respect of privacy of individuals. Most universities have codes of ethics enforced by ethics committees which must approve all research projects involving humans and animals. The general principles in codes of research ethics are firstly that, no harm should come to the research subjects and secondly that subjects should take part freely based on informed consent.

> The DUT Institutional Research Ethics Committee (IREC) has the responsibility of evaluating, approving, and monitoring research involving humans, animals, and the environment. It does so by following ethical guidelines for research as stated by the Department of Health of South Africa and the Declaration of Helsinki, and other relevant declarations and statements in research ethics. It aims to protect the rights and welfare of research participants by adhering to the principles of beneficence, justice, and respect for people, especially vulnerable populations. In so doing, it assesses the ethical implications of the study design and research methodology (DUT 2018a).

According to the DUT guidelines for classification of prospective research with respect to research ethics (DUT 2018b), there are three categories of ethics that need to be considered for research at the DUT:

1. Straight forward research without ethical problems (exempt from ethics and biosafety Research committee review)
2. Minimal risk to humans, animals or the environment (expedited review – 2 reviewers)
3. Possible risk to humans, animals, environment, or sensitive research area – reviewed by the full committee with possible external expertise (DUT 2018b).

This research study is in Category 2. It involved the dissemination of questionnaires that had minimal ethical implications and risks to participants. The researcher endeavoured to strictly follow all necessary ethical protocol and procedures. The necessary gatekeeper letters of permission and informed consent for the study were obtained in terms of ethical requirements. The identity of the respondents will remain anonymous and protected throughout the study. Hard copies of the answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet and all identifiable electronic data will be stored securely on a computer with password-restricted access and only the researcher, supervisor, and ethics committee members may have access to it. All identifiable information will be destroyed at the end of the study or after five years, whichever comes first.

The study received the full Institutional Research Ethics Committee (IREC) approval. The IREC approval certificate is attached as Appendix M. The research ethics online training certificate is attached as Appendix N.

3.6 Validity and reliability

In this quantitative research study, both validity and reliability are important factors to evaluate the quality and credibility of the research study.

Validity is concerned with whether the right concept is being measured and tests the extent to which the instrument developed measures the concept it is intended to measure. Reliability refers to the stability and consistency in the measurement of the phenomenon being studied, in terms of how consistently the instrument/method measures the particular concept/s it is supposed to measure. The following measures were adopted to enhance the validity and reliability of the study.

- The aim and the key objectives of the study were clearly defined, and an appropriate research design formulated.
- The survey instrument developed specifically for the study included a structured electronic questionnaire survey containing relevant items, to ensure the right concepts were accurately measured.
- The employer and student questionnaires were structured to ensure that the right target populations were surveyed i.e. industry employers and geomatics students/graduates.
- An appropriate sampling design with good sample sizes were selected to ensure a strong representative sample.
- The overall appearance and structure of the electronic questionnaires ensured stable and consistent measurement as all eligible respondents participated in the same closed-ended questionnaire surveys using the official weblinks provided.
- Feedback from the open-ended question in both questionnaire surveys validated some of the responses.

- The requisite permission to conduct the study and collect the data was obtained as evidenced by the gatekeeper letters of approval from SAGI (Appendix I) and DUT (Appendix J).
- The study received full IREC approval as evidenced by Appendix M.
- A research ethics online training course was completed, as evidenced by the training certificate attached as Appendix N.
- An independent statistician was appointed for the statistical data analysis as evidenced by Appendix O.
- Cronbach's alpha which is a measure of reliability or internal consistency revealed that scores were > 0.7 which confirms reliability.

Based on the above measures, to ensure quality and credibility in the study, it is therefore possible to apply the scope of generalisability of the findings to the target population at large.

CHAPTER 4: DATA ANALYSIS AND DISCUSSION OF RESULTS

4.1 Statistical analysis and techniques

Statistics plays a significant role in the field of research, economics, science, and technology. Statistical analysis has been described by experts as the collection, exploration, interpretation, analysis and presentation of quantitative data to determine underlying patterns and trends, as applied in spheres of research, industry, education and government, for scientific decision making (SAS 2021).

4.1.1 Descriptive statistics

Descriptive statistics describes the important characteristics or properties of the data set using measures of central tendency (mean, median, mode) and the measures of dispersion (range, standard deviation, variance etc.). Data can be effectively summarised and represented in an accurate way utilising graphs, charts, and tables.

4.1.2 Inferential statistics

Inferential statistics involves using data from a sample and then making inferences about the larger population from which the sample is drawn. The aim here is to draw conclusions from a sample and generalise them to the population. It determines the probability of the characteristics of the sample using probability theory (Singh 2018).

4.2 Data analysis and interpretation: introduction

The Data analysis was accomplished utilising a combination of descriptive and inferential statistics. This entailed the collection, organisation, summarisation, processing, interpretation, analysis, and presentation of the numerical data derived from the quantitative electronic survey questionnaires. Information was extracted and populated from the available data and application of the appropriate statistical techniques in SPSS software which generated the required tabular reports and supporting graphical illustrations.

The data analyses of the Employer and Student surveys are reported separately in a sequential manner. This was achieved by grouping similar questions into separate categories/themes where applicable, to facilitate clear explanations, make better sense of the data in terms of the summary tables and graphical charts, and fulfil the aims/objectives of the study. The experiential training (ET) data analysis has been included in Theme 1 of the Employer survey, as it specifically relates to this aspect of the study.

The open-ended question in the Employer survey (D45) and Student survey (C28) sought to provide respondents with an opportunity to express their opinions, perspectives, and experiences, and further elaborate on any aspect relating to WIL. Direct noteworthy quotes and comments from employers and students have been included to substantiate and enhance the findings of the quantitative data where applicable. The overall results were used to draw inferences about the entire population.

To reiterate, the key objectives of the research were as follows:-

Objective 1: To determine whether the experiential training (workplace learning) conducted in the National Diploma: Surveying, had a meaningful and positive impact in terms of the student’s personal and professional development, and work placement.

Objective 2: To determine whether the absence of WIL will influence the type and quality of graduate entering the industry sector and if they will be perceived to be lacking substantive practical knowledge, skills, and technical expertise to cope with the industry demands and expectations.

Objective 3: To establish whether the absence of WIL will create a vacuum of knowledgeable, technically skilled, and competent technicians/technologists in industry thereby affecting industry productivity, workflow, output, and economic growth.

Objective 4: To determine whether the absence of WIL is perceived as an inhibitor to student's personal growth and professional development; and if this absence will affect the employability skills, graduate attributes, employment opportunities and job prospects of the graduates.

The themes which emerged from the questions are shown in Table 4.1 below in relation to the specific aims/objectives. Where the objective/s have been met, it is clearly stated at the end of respective theme/s.

Table 4.1: Table of themes

Theme / category	**Questions / Items included**			
	Employer survey	**Student survey**	**ET Data**	**Remarks**
Impact of ET in the Diploma	C9 – C13		ET Data set	Obj 1 fulfilled
Impact of excluding WIL	D18 – D22; D25; D27;	C7; C10; C11; C12;		Obj 2, 3, 4
	D30; D45	C14; C28		fulfilled
Importance and relevance of WIL	D24; D26; D28; D29;	C9; C13; C17; C18;		Overall aim
	D45	C28		fulfilled
Alternate forms of WIL	D32 – D35; D45	C20 – C23; C28		
WIL industry support & Collaboration	D38 – D40; D43; D45			
Industry challenges/concerns about WIL	D45			
Other proposals on WIL	D45			

Note: The codes appearing in Table 4.1 are the actual question numbers which have been numbered sequentially according to the various sections of the respective questionnaires followed by the specific question number e.g. C9, C28, D24, D40 etc.

The following tests were conducted in the analysis:

a) Measures of central tendency and measures of variability including the mean, median and standard deviation where applicable. Data is summarised and represented utilising graphs, charts, and tables. Frequencies are represented in tables or graphs.

b) Chi-square goodness-of-fit-test: This is a univariate test, used on a categorical variable to test whether any of the response options are selected significantly more/less often that the others. Under the null hypothesis, it is assumed that all responses are equally selected.

c) Binomial test: Tests whether a significant proportion of respondents select one of a possible two responses. This can be extended when data with more than 2 response options is split into two distinct groups

d) One sample t-test: Tests whether a mean score is significantly different from a scalar value. It compares the mean of the sample data to a predetermined value to establish if the sample mean is significantly greater or less than that value.

e) Paired samples t-test: A test that compares the means of two variables for a single group. It is utilised to determine if the mean difference between two sets of observations is zero.

f) Factor analysis: A statistical technique to reduce the number of items or variables through a search for underlying latent factors. It is a useful tool for investigating variable relationships for complex sets of data. The Promax rotation utilised is an oblique rotation which allows factors to be correlated, and hence appropriate for the factor analysis to be calculated more quickly to derive the required results.

4.3 Data analysis and interpretation: Employer survey

Part A – Informed consent:

Question A1: All respondents consented to participate in the study (100%).

Part B – General:

Questions B2 to B5: These questions utilised the nominal scale to determine the employment sector and registration categories of the members. They have been grouped and presented in Table 4.2, which displays the frequency and corresponding percentage figures.

Table 4.2: Employment sector and member registration categories

Item	*Categories*	*Frequency N (%)*
	Private practitioner e.g. (Land Surveyor / Engineering Surveyor /	55 (44.4%)

	Mine Surveyor / Geomatics practitioner)	
	Land Surveying company	12 (9.7%)
	Engineering Surveying company	16 (12.9%)
	Geomatics / Geoinformatics / Geospatial company	2 (1.6%)
	Civil Engineering / Construction / Built environment company	10 (8.1%)
	KwaZulu-Natal Municipality (e.g. Ethekweni / Msunduzi / other)	10 (8.1%)
B2: *Employment sector*	*Eskom land development (KwaZulu-Natal)*	3 (2.4%)
	Department of Rural development & Land Reform (DRDLR) /	
	National Geo-spatial Information	3 (2.4%)
	KwaZulu-Natal Department of Transport	2 (1.6%)
	Other Government agency or organisation	2 (1.6%)
	Retired practitioner	6 (4.8%)
	Other	3 (2.4%)
B3: *Member of SAGI*	*Yes*	86 (69.4%)
	No	38 (30.6%)
B4: *Member of SAGC*	*Yes*	105 (84.7%)
	No	19 (15.3%)
B5: *Member Registration Status*	*Professional Land Surveyor / Geomatics Professional*	47 (37.9%)
	Professional Engineering Surveyor / Geomatics Professional	11 (8.9%)
	Engineering Surveyor / Geomatics Technologist	31 (25.0%)
	Engineering Survey Technician / Geomatics Technician	16 (12.9%)
	Not applicable	14 (11.3%)
	Other	5 (4.0%)

Questions B3 and B4 was further analysed using the binomial test to determine if a significant proportion responded with either *Yes* or *No*. This is indicated in Table 4.3 which reflected that 69% and 85% are members of SAGI and SAGC respectively. This is important as it demonstrates that the majority of employers who provided WIL opportunities were registered with the necessary professional bodies which added credibility to the quality and monitoring of training.

Table 4.3: Number of registered members

Item	***Frequency (%)***		***N***	***P-value***
	Yes	***No***		
B3: *Member of the South African Geomatics Institute (SAGI)*	**86 (69%)**	38 (31%)	124	<.001*
B4: *Member of the South African Geomatics Council (SAGC)*	**105 (85%)**	19 (15%)	124	<.001*

* indicates significance at the 95% level

Part C – Experiential training (National Diploma: Surveying)

Question C6: All respondents (100%) confirmed that they have previously employed, supervised, or mentored National Diploma: Surveying students for experiential training.

Question C7: This question utilised a ratio scale to determine the number of students that were employed in a specific numerical range category. The data was analysed using the chi-square goodness of fit test to determine if any response options were selected significantly more than others. The results are reflected in Table 4.4 below.

Table 4.4: Number of students employed (2010 – 2020)

Item	***Responses as Frequency (%)***								X^2	***df***	***P-value***
C7: *Number of students employed, supervised or mentored (2010 - 2020)*	**0**	**1 - 5**	**5 - 10**	**10 - 15**	**15 - 20**	**20 - 25**	**26 - 30**	**> 30**			
	8 (6.5%)	**54 (43.5%)**	**31 (25.0%)**	14 (11.3%)	4 (3.2%)	4 (3.2%)	1 (0.8%)	7 (5.7%)	151.407	7	<.001*

* indicates significance at the 95% level

A significant majority of practitioners employed between 1 – 5 students (43.5%) and 10 – 15 students (25.0%). This means that a total of 68.5% employed up to a total of 10 students during the period 2010 to 2020. This could have been a contributing factor that facilitated the completion of the Diploma qualification for many students.

Question C8: The nominal scale was used to establish which categories of training was provided to students. The bar graph below (Figure 4.1) indicates that the vast majority of students were provided with training in *Topographical/Tache surveys* (91%); *Engineering/Construction surveys* (88%); *GPS surveys* (82%) and *Control surveys* (75%). Other important aspects of workplace training that are considered as essential experience for the modern-day geomatics technologist which appears to be lacking is: *Precise engineering surveys* (32%); *UAV's & Mobile mapping/Drone applications* (15%); *Geospatial/Geographical information science (GISc)* (19%) and *Reality capture/3-D scanning* (10%). This may require some attention to ensure that students/graduates receive the necessary experience and expertise from qualified industry professionals to enhance their knowledge and capabilities to fulfil the needs of the engineering and built environment sectors, and further complement the introduction of the 4IR and emerging digitalisation trends.

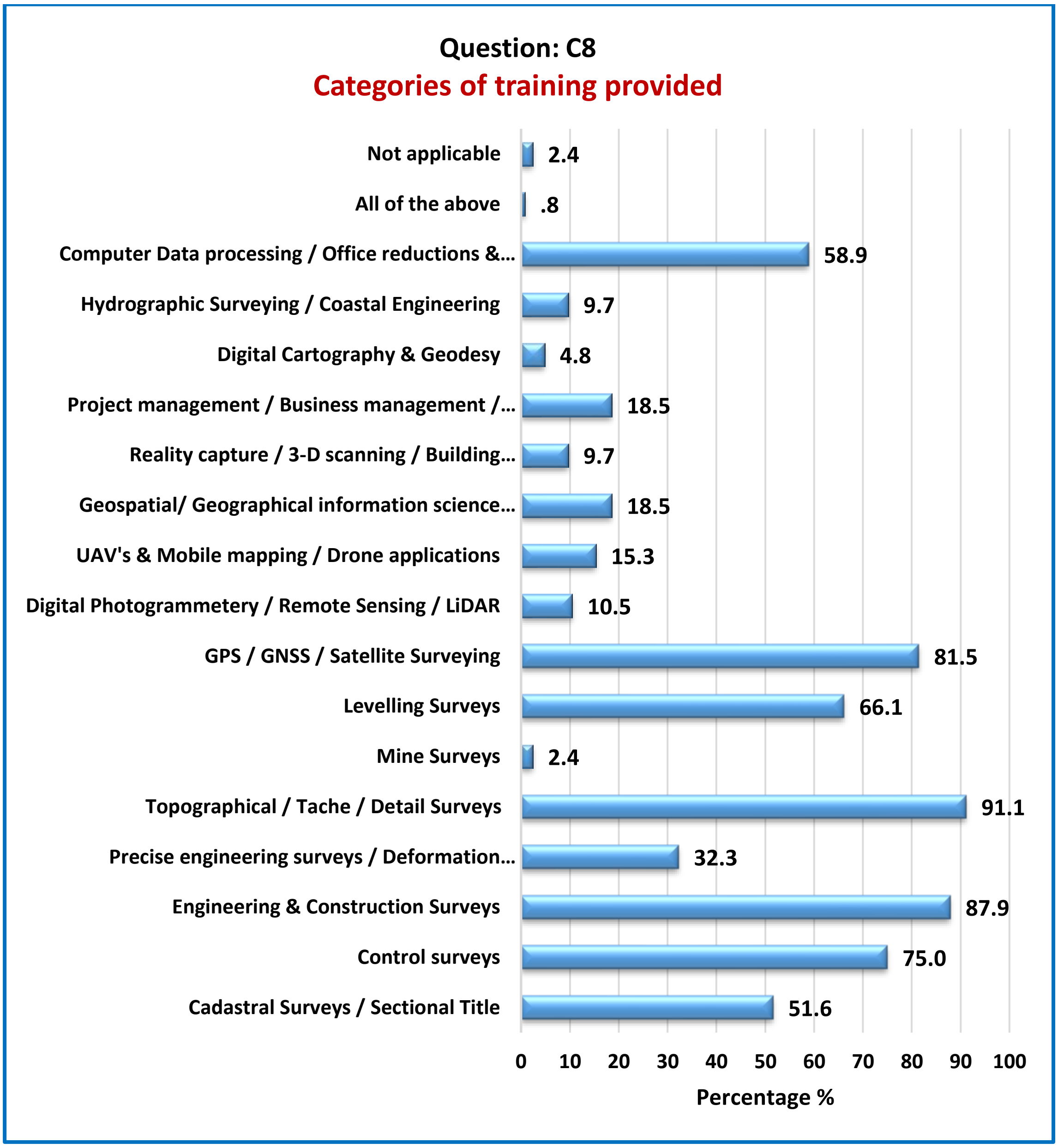

Figure 4.1: Categories of training provided

4.3.1 Theme 1: Impact of ET in the Diploma

This theme consists of two sections (Employer survey & ET data set) which contain separate data that contribute to this theme, and subsequently to the fulfilment of Objective 1.

Section 1: Employer questionnaire survey

Question C9 to C13: These five questions have been grouped into Theme 1 as it specifically addresses Objective 1 of the study from an industry perspective. The questions seek to evaluate the historical impact of WIL in the National Diploma. However, the overall results are represented in separate tables and figures since two different rating scale type questions were employed i.e., Likert scale and semantic differential scale.

Likert scale: All Likert rating scale type questions were analysed using the one-sample t-test to determine if there is a significant agreement or disagreement with the statement. The questions are coded as: *1 = Strongly disagree to 5 = Strongly agree*. Therefore, a higher value indicates more agreement. The central test value = 3. A significant agreement has been interpreted with a mean score > 3 and a significant disagreement with a mean score < 3.

Semantic differential scale: All semantic rating scale questions indicate the aspect of importance/relevance and are coded as: *1 = Not important at all to 7 = Very important*, relating to each statement. Therefore, a higher value indicates more importance. The central test score = 4. The analysis was conducted on the mean scores utilising the one-sample t-test to test the average score against the central test score and determine if there is significant importance or lack of importance.

Questions C9 and C10 utilised the Likert scale and the results reflecting the frequency, percentages and means are illustrated in Table 4.5 and Figure 4.2 below.

Table 4.5: Impact of ET on diploma graduates

Item	*Responses as Frequency (%)*					*n*	*Mean (SD)*	*t*	*df*	*P-value*
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
C9: *The Diploma graduate was adequately prepared for the World of work*	1 (0.8%)	21 (16.9%)	26 (21.0%)	**52 (41.9%)**	**24 (19.4%)**	124	**3.62** (1.009)	6.854	123	<.001*

***C10:** The Diploma graduate was adequately equipped with an appropriate level of academic knowledge & practical skill*		11 (8.9%)	21 (16.9%)	**71 (57.3%)**	**21 (16.9%)**	124	**3.82** (0.817)	11.212	123	<.001*

* indicates significance at the 95% level

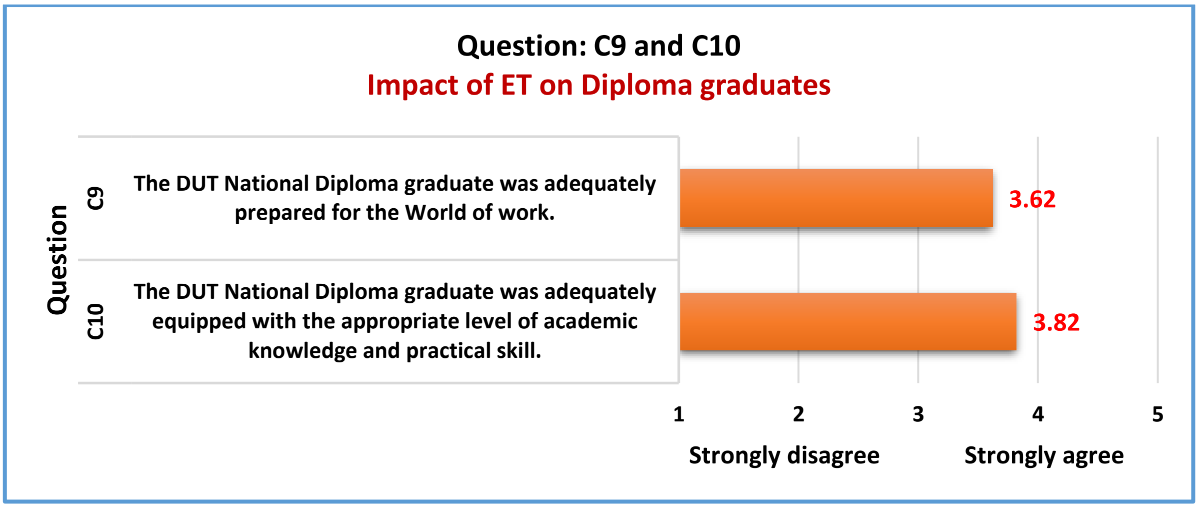

Figure 4.2: Impact of ET on Diploma graduates

Table 4.5 shows that a total of 61.3% of respondents agreed that Diploma graduates were adequately prepared for the WOW while a total of 74.2% was in agreement that graduates were adequately equipped to perform within a reasonable level of expectation in an industry-controlled setting. Figure 4.2 illustrates that both mean values are > 3.

Question C11, C12 and C13 utilised the semantic differential 7-point rating scale and the results are illustrated in Table 4.6 and Figure 4.3.

Table 4.6: Impact and importance of ET in the diploma

Item	*n*	*Mean (SD)*	*t*	*df*	*P-value*
***C11:** Rate the level of importance and impact that experiential training had on holistic student development and work placement in terms of: Work readiness; Work experience; Professionalism; Work ethic; Productivity and efficiency; Motivation & confidence; Teamwork and collaboration; Leadership; Time management; Life skills and Character building.*	124	**6.36** (1.031)	25.528	123	<.001*

C12: *Rate the level of importance and relevance that experiential training had on student progression and development in terms of: Responsibility and reliability; Initiative & problem-solving ability; Human relations; Written communication skills; Oral communication skills and Occupational safety.*	124	**6.27** (0.982)	25.781	123	<.001*
C13: *Rate the level of importance and relevance that experiential training had on professional student development related to key work competencies and skills acquisition in terms of: Theoretical knowledge; Practical/Technical skills; Technological knowledge and skills; Quality of work; Communication skills; Organisational skills; Interpersonal skills; IT Skills; Literacy skills, Report writing skills etc.*	124	**6.31** (0.947)	27.115	123	<.001*

* indicates significance at the 95% level

Table 4.6 shows that all mean values are > 6, while the bar graph in Figure 4.3 below also confirms that the majority of respondents indicated a score of 6 and 7 on the semantic scale. The above analysis confirms the positive impact and relevance of ET on the holistic development of the Diploma graduate in terms of key attributes, employability skills and competencies required for work readiness and entry into the labour sector.

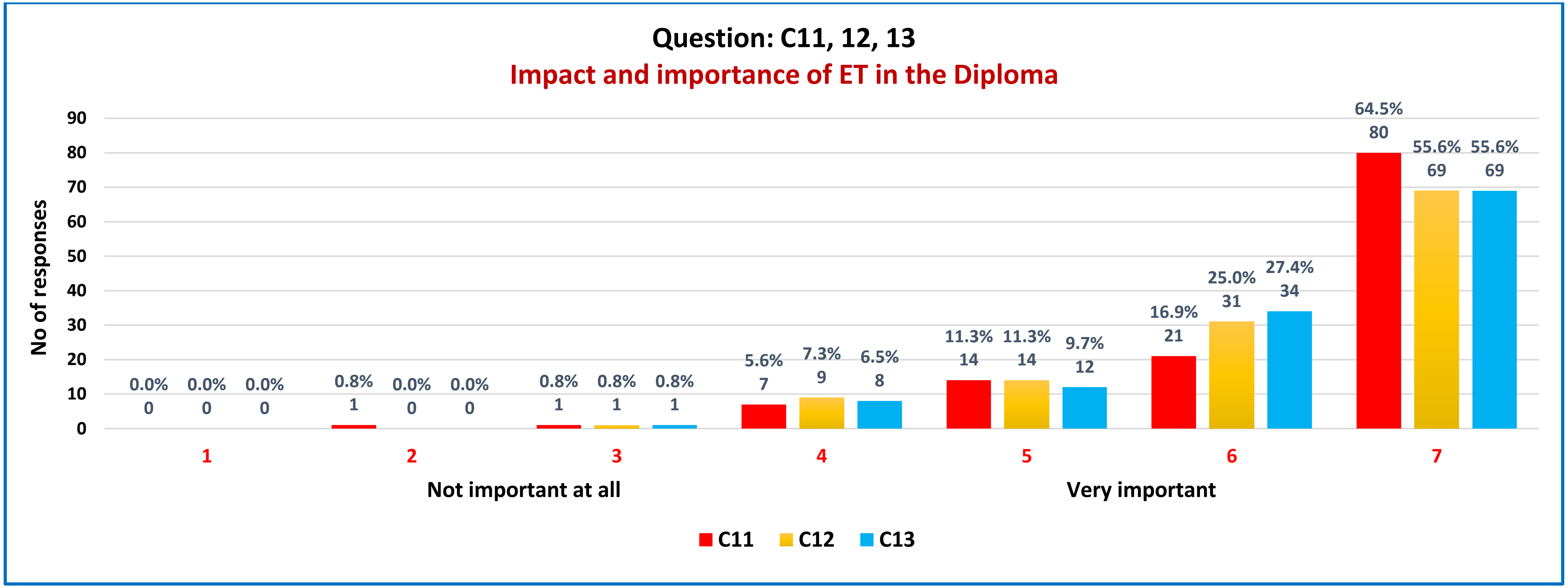

Figure 4.3: Impact and importance of ET in the Diploma

Section 2: ET data analysis

The ET data set which forms part of the EL component of the National Diploma: Surveying programme is also incorporated under Theme 1 as it relates to this aspect of the study and is presented accordingly below.

The first part of the analysis involves a comparison of ET4 and ET5 report data using actual scores for the first and second six months of EL. The ET4 data was measured out of 3 and the ET5 data out of 10 as described in the performance key below. Time 1 (T1) and Time 2 (T2) refers to the first six months and second six months of experiential training respectively.

ET4 report key:	
1	Poor (Below 60%)
2	Satisfactory (60% - 79%)
3	Excellent (80% - 100%)

ET5 report key:	
1 – 4:	Poor
5 – 6:	Average
7 – 8:	Good
9 – 10:	Excellent

A paired sample t-test was applied, and the results are summarised in Table 4.7 below.

Table 4.7: Comparison of experiential training (ET4 and ET5) data

	Item	*Mean (SD)*		*t*	*df*	*P-value*
		Time 1	*Time 2*			
ET4 Personal skills	Responsibility & Reliability	2.54 (0.538)	2.60 (0.531)	-1.000	103	0.320
	Initiative & Problem-solving ability	2.37 (0.504)	2.42 (0.552)	-1.000	103	0.320
	Human Relations	2.67 (0.492)	2.62 (0.527)	0.973	103	0.333
	Written Communication Skills	2.34 (0.499)	2.40 (0.492)	-1.043	95	0.300
	Oral Communication Skills	2.47 (0.557)	2.52 (0.521)	-0.713	103	0.478
	Occupational Safety	2.52 (0.521)	2.48 (0.557)	0.698	102	0.487
ET5 Performance measures	Quality of work	7.51 (1.487)	7.87 (1.229)	-2.700	103	0.008*
	Productivity	7.39 (1.502)	8.01 (1.289)	-4.348	103	<.001*
	Responsibility & Reliability	7.78 (1.433)	8.13 (1.402)	-2.549	103	0.012*
	Theoretical knowledge	7.26 (1.419)	7.74 (1.182)	-3.669	103	<.001*
	Practical skills	7.45 (1.473)	7.92 (1.221)	-3.576	103	0.001*
	Motivation	7.90 (1.341)	8.23 (1.265)	-2.668	103	0.009*
	Communication Skills	7.77 (1.358)	8.06 (1.202)	-2.217	103	0.029*
	Human Relations	8.05 (1.344)	8.32 (1.205)	-1.978	103	0.051
	Punctuality	8.44 (1.409)	8.52 (1.190)	-0.576	103	0.566
	Initiative & Problem solving	7.35 (1.440)	7.82 (1.229)	-3.869	103	<.001*
	Report Writing	7.00 (1.411)	7.36 (1.286)	-2.620	93	0.010*

* indicates significance at 95% level

ET4 – Personal skills: The results above indicate that there are no significant differences from Time 1 to Time 2. Furthermore, the scores reflected are well above 2 which indicates satisfactory to good performance appraisals as well as consistency for both periods.

ET5 – Performance measures: The results above indicate that there is a significant increase in all performance measures from Time 1 to Time 2, except for Human Relations and Punctuality. Furthermore, the scores are well above 7 for both periods, which reflects consistency across the good performance measures.

The subsequent bar graphs for the comparison of ET4 and ET5 data are shown in Figures 4.4 and 4.5 respectively.

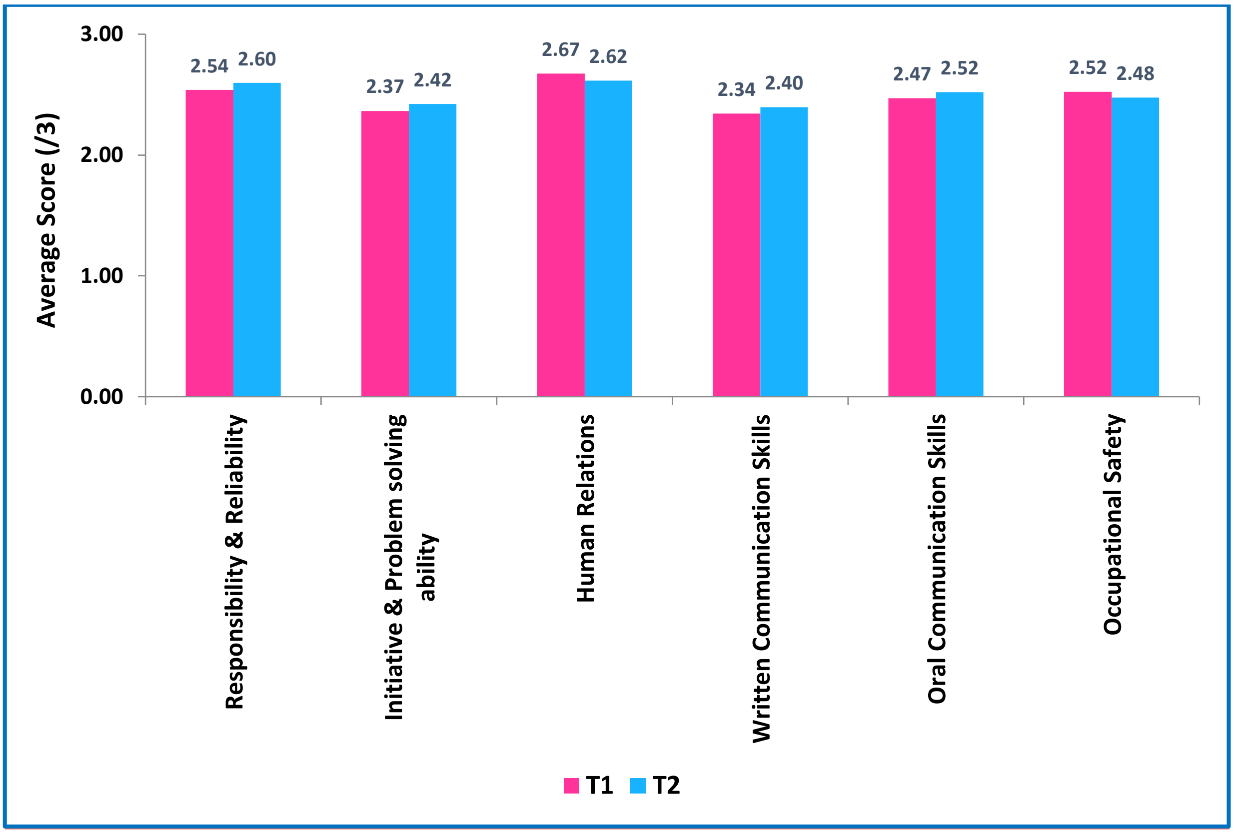

Figure 4.4: Comparison of ET4 data

The second part of the analysis was conducted on each category and reflects the respective performance scores as percentages. The ET4 data was measured out of 3 and the ET5 data out of 10. The percentage scores for the ET4 and ET5 data are illustrated in the corresponding bar graphs shown in Figures 4.6 and 4.7 respectively.

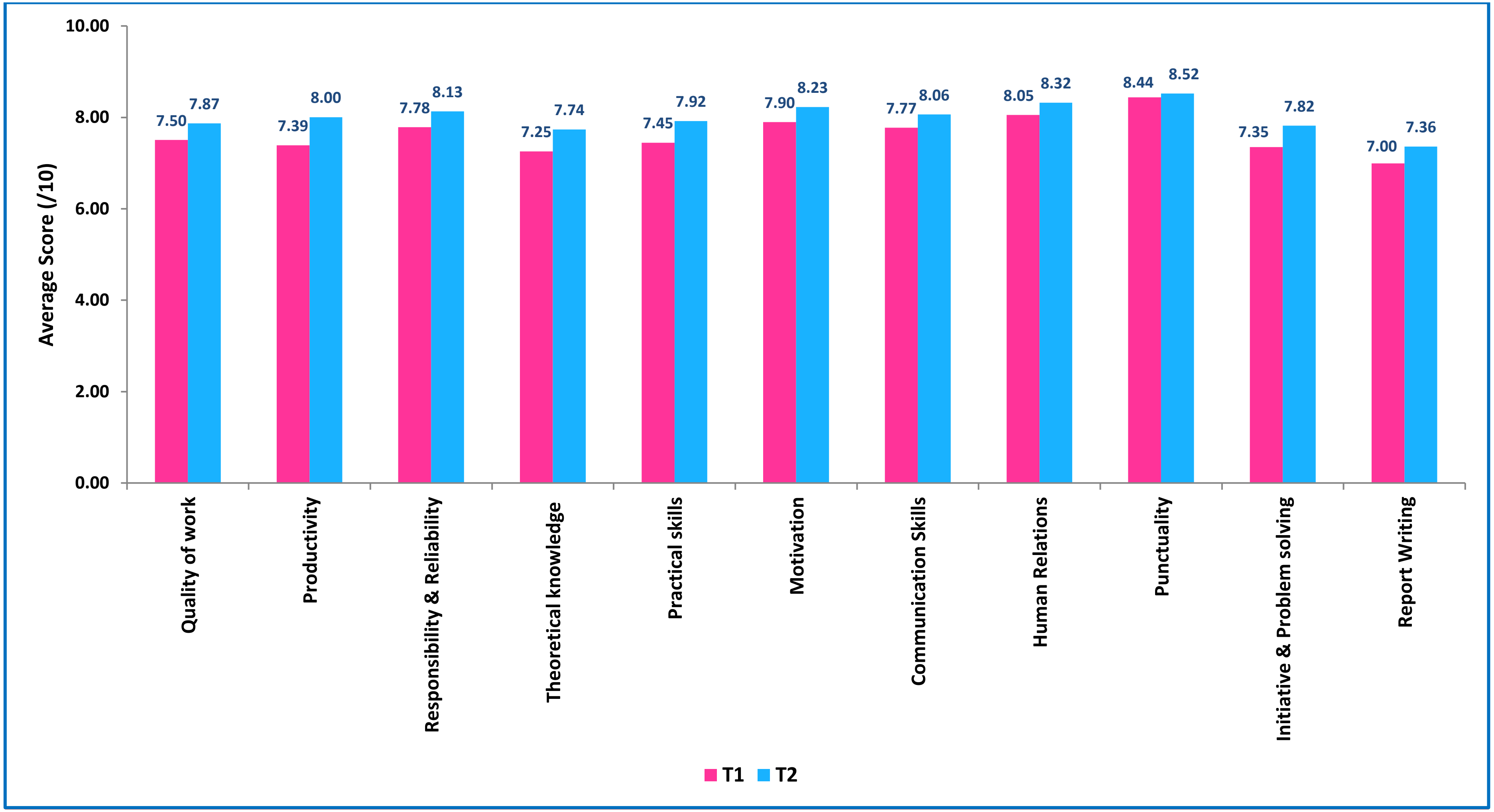

Figure 4.5: Comparison of ET5 data

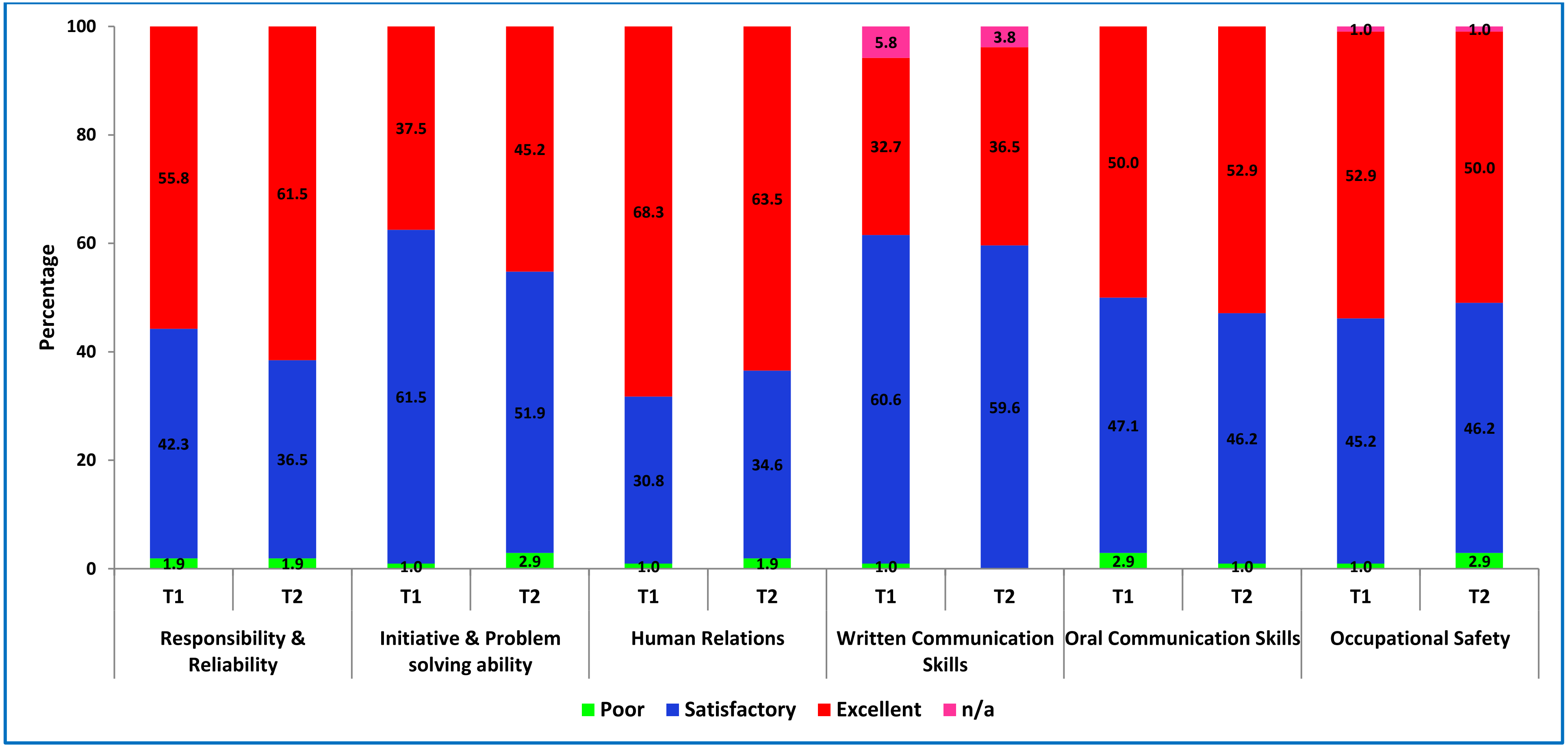

Figure 4.6: ET4 appraisal data

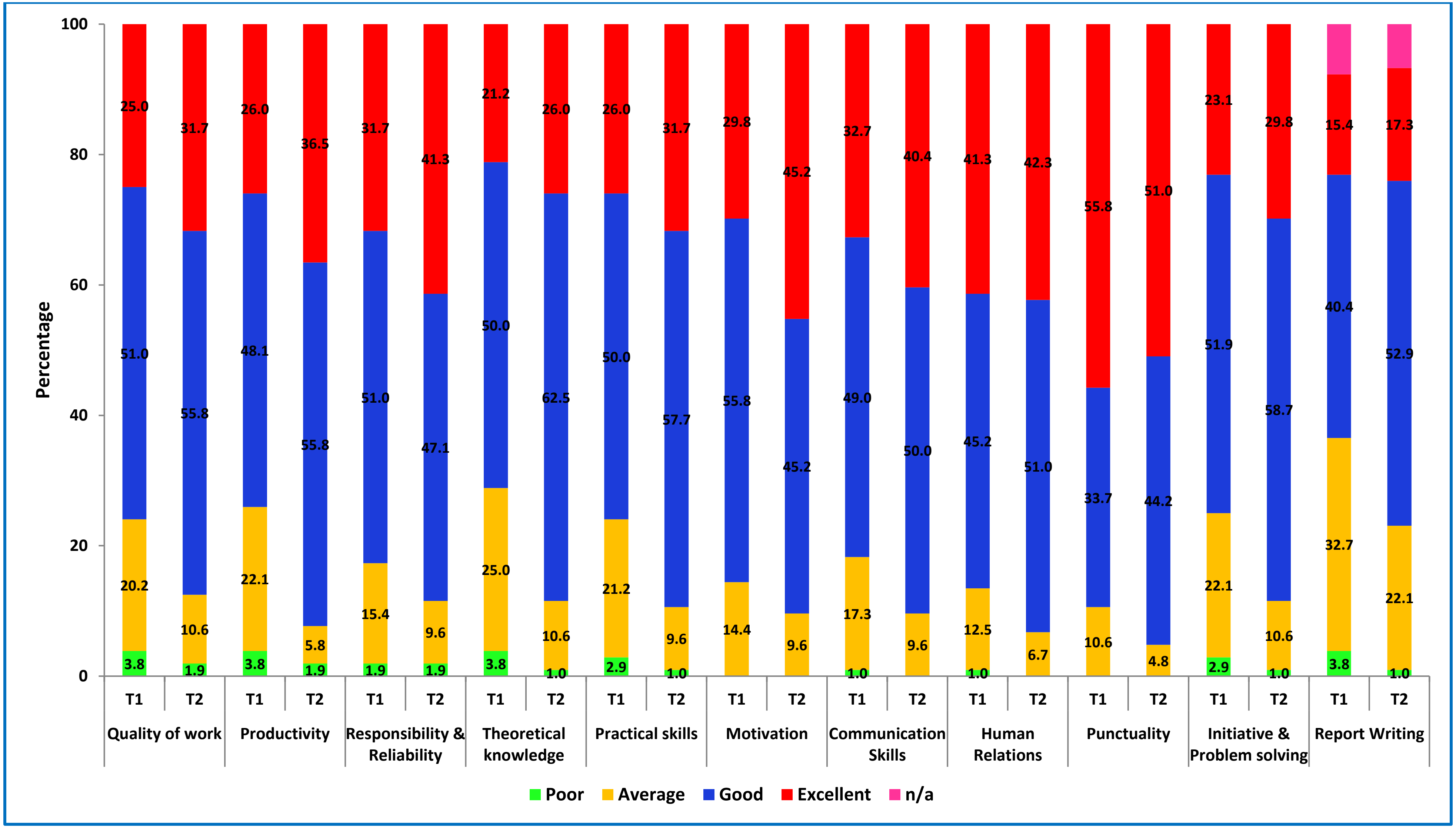

Figure 4.7: ET5 appraisal data

It is evident from the quantitative data that there was no notable decline in performance scores across both time periods, for the ET4 and ET5 data. The scores verify that the students performed relatively well in almost all aspects of their training. This may have certainly improved their work readiness skills, and the early industry exposure would have increased their prospects of employment upon graduation, as practitioners are more likely to recruit graduates with some prior work experience.

The quantitative data is further validated by some of the employer's comments (qualitative) included in the form of quotes below, which reflect the significant value and historical impact that the mandatory period of EL had on the professional development of the Diploma student in terms of key attributes, discipline knowledge, employability skills, and competencies valued by the work sector.

The employer comments below refer to the individual student's performances and cover appraisal aspects such as: *Experience; Quality of work; Productivity; Responsibility & Reliability; Theoretical knowledge; Practical skills; Motivation and confidence; Communication Skills; Human Relations; Initiative and Problem solving etc.*

> Pleasant hardworking individual. Understands instructions and works diligently. Student shows initiative in all aspects of work environment. Excellent teamwork. Productive in the workplace, keeps to time allocation. Student is competent while working. Eager to assist and learn. Gets on well with others.

> Improvement in knowledge, skills & abilities. Enthusiastic and shows initiative and willingness to learn. Will benefit from continuous fieldwork and learning to improvise. Can improve on innovation in the field.

> Student showing continued good work ethic, improvement and interest in problem solving. Student proved willing to work and able to learn and adapt to work environment. Will be asset to any employer. Regret cannot give student more Engineering Survey and levelling.

> Satisfactory student and cooperative. Keen and fast learner, very committed and willing to get the job done.

> Computer skills are good and has picked up Modelmaker very easily. Have no doubt that his human relation skills will make him a great surveyor one day. Great attitude towards his work. Keep up the good work, don't drop the pace.

He is a very bright student who is willing to learn and is very dedicated to his work. A little more practice and he will be excellent. More exposure to report writing and he will be fine.

Hard worker, always on time for work. Needs to learn to be more patient. Very eager and motivated to learn and very involved with projects. Works well with other employees. Love the determination and outlook on Surveying.

He has shown great progress in his ability to perform tasks and the understanding of his work. He has learnt to work independently and is able to run a small construction site. He is punctual, dedicated and responsible employee. He is reliable and committed to his work.

She has a positive attitude towards her job. Got initiative to solve problems. Will do well when she finishes her studies. She is a hard worker and eager to learn. Has shown a keen interest in her work. She has a pleasant attitude and has been a pleasure to have as a student. With experience she will develop into a good Surveyor.

Very well motivated individual and great with workers. Can clearly express herself. Excellent personal skills at this level. Productive individual. She has learnt and could implement what she has learnt. Excellent overall.

Great progress so far. In the last six months, student has improved a lot in his field of work. I'm very impressed with what he has learnt. Excellent on fixing control points. Has done a lot of construction work, roads & pipe setting out and was very good. He was responsible for a site where he was to beacon relocate 2000 sites.

The student is an asset to the company and with more training will be a great addition to the profession. The student is performing well, grasps the work well and is showing growth. The student has all the tools to be a great surveyor.

She is a quick learner and shows a lot of interest in this field. A punctual person and hardworking student. With time and experience, she will be a good survey technician. She has room for improvement, and has shown signs of being a good Surveyor, provided she applied herself more to her work. She has shown capability to do her work diligently. There has been major improvement e.g. with GPS and Total station. She can now be left on site and productivity is no longer an issue as she has gained her confidence.

Student is a pleasure to work with. He has shown keen interest in the work environment. He is keen to learn and has an excellent attitude. He communicates when he has difficulties. With experience he will become a good surveyor. I would not hesitate in employing him once he had completed his studies.

He has learned quickly to apply his theoretical knowledge to his onsite experience. He has enormous potential as a Surveyor but needs to work on his punctuality. Has showed a keen interest in applying his theoretical knowledge to the practical application on site. He has grown steadily in his knowledge, skill and understanding of site survey work. He has shown that he is well able to carry out site work with a very good ability to problem solve along the way. If he continues to apply himself with vigour and single mindedness, I have no doubt that he can become a highly competent Surveyor. He has become confident in his ability to carry out survey tasks with little supervision. He has shown very great understanding of all that was taught to him. With time, he will make a great surveyor. He is a quick learner and has the ability to do very well in the survey industry.

Excellent, honest, hardworking. A pleasure to teach and an asset to us. Student is growing in experience and confidence. Pleasant hard working young man. Is good at grasping techniques. Has a good attitude in both professional and personal capacity.

Student has shown himself as a very keen learner. He has a very good attitude and has always been prepared to go the extra mile. I have no doubt that with experience he will develop into a very good surveyor. He has become an excellent student and has been a pleasure to have on site. He takes care and pride in his work, and has shown a great sense of responsibility. His time keeping is excellent, also his communication is very good. His work ethic is excellent.

Student shows interest in his work and is very diligent. At first he was a bit nervous and battled to grasp what was being done but slowly coming to terms. He is gaining confidence by day in his work and is improving a great deal. He’s doing very well and can be left alone on site and he does the work satisfactory. He is a good student, hardworking, he must keep doing so.

She is a hard working student, a responsible individual but she lacks some confidence in our work. Good work progress, just a little improvement on the working pace would improve her practical skills. Excellent in comprehending the task in hand and there is still room for improvement.

The student is very quiet spoken, but accepts the tasks entrusted to him and is able to solve problems if given guidance along the way. We are generally very happy that he has settled down and is able to tackle survey assignments on his own with our guidance. He is making very good progress and is grasping the various survey techniques. The student was found to be hard working and reliable and approached all tasks with enthusiasm and dedication. He was introduced to the basics of Cadastral, engineering and sectional title surveys. Field and office duties included. The student continued to improve in his work and has shown good progress since starting with the firm. He continued to show dedication to his work and was eager to learn and improve his skills.

He is an above average student who has a very good methodical and systematic approach to his work. His work is always very well presented. I have no doubt that he will do the survey industry proud as he becomes a fully-fledged survey technician. He has listened carefully to instructions and has executed the survey tasks very well. He asks good questions and is a keen learner.

The student is quite sharp in learning and understanding survey principles and can work under pressure as is the case in big construction projects, he proved himself on a R500m worth project. He has learnt a lot within a short space of time and improved greatly as there is not much time to spend in showing him the work. He has also started to work independently. He respects time which is very critical in this field. A variety of projects we are doing has helped him to gain a lot of experience and currently, he has become an asset to the company. He has gained substantial experience and at the current stage he can conduct a survey project independently.

She is always willing to learn, grasps tasks quickly and easily and associates well with other workers. With more training she promises to be an asset to any institution. She is a dedicated and hardworking student and has shown a great initiative towards learning the survey profession during the period she was with us. She is focused and attentive and has showed great competence in grasping the duties. She is also very productive in her work, with such a positive attitude. Honest worker who showed great enthusiasm in her duties. She settled in very well with co-workers.

He has shown much potential in learning and I'm happy with his progress. He is a hard worker and is very capable with problem solving skills. He is reliable in his work and can solve most problems on site. He has learned more about communication skills and safety. I am pleased to have worked with him. His problem solving skills have improved and he is very reliable. After a thorough training I have given him, he can now work independently and resolve any obstacles he come across with onsite and also at the office.

She is a good communicator and she is very active when it comes to her work. She relates well with young and old company employees. She is very responsible and always at work. Her work is good and she takes initiative to solve problems. She presents the company professionally. She adheres to the teachings of our safety reps well. She has mastered the act of communicating with clients on site, and where she doesn't understand she will always consult her supervisor. Her progress is good and she's ready to work independently which is very good considering the short time she has joined us. She is learning new things and adapting well with new information. Understanding of practical work is improving a lot.

She is keen to learn and progress in her chosen career. She has shown keen intuition in solving survey challenges, sticks to her task at hand and complies to the initial instruction. Has done well in the execution of the tasks at hand. She has learned to listen and interpret instructions well. She is maturing every day in her attitude and approach to her work. She has surprised me with her ability to learn and master new technology and systems. She has been exposed to a large cross section of different type surveys, and onsite Health and safety procedures which she had to observe in her work. Has certainly developed in the latter part of the year into a confident Surveyor both in the field and office. She is ready for her next phase of University and believe that she will achieve high grades as a worthy Surveyor.

A very hardworking and intelligent young man. Always willing to learn more every day. Hope he continues to do that in the future. We need more people like him in the industry. The student has been exposed to Engineering surveying where he did a lot of setting out for most of the time e.g. roads, bridges, sports grounds etc.

> Hardworking, participated in every survey work done on site and prepared to learn more. Has made excellent progress and has shown that she has the ability to do fieldwork and calculation with ease. Continues to make progress in her practical skills and calculations. She picks up new tasks easily.

> She is a pleasure to work with and has shown a keenness to learn in all aspects of survey work. As she gains experience, I have no doubt that she will become an excellent Surveyor. Her time keeping is excellent and has showed a great sense of responsibility and work ethic. She also gets on well with her peers. I would not hesitate to recommend this student as a future employee for any other company.

> The trainee is responsible. He is able to apply theoretical knowledge gained at the University to his practical training. The trainee now understands the functions of the SG's office and the survey background involved. Keep up the good work.

> With time her problem solving ability will improve as she finds herself more on site. She is a dedicated student and will one day become a good Surveyor. She has learnt a lot. Her skills in Model maker have improved as she is now able to calculate quantities with ease. She has shown great improvement in all spheres.

These comments further solidify industry's strong view on the impact of ET on the Diploma student. It is clearly evident that the period of ET has contributed significantly to the student's holistic development in preparation for the real working world.

Thus, Theme 1 fulfils Objective 1 of the study.

Part D – Work integrated learning (BBE: Geomatics)

Question D14 and D15: These two questions utilised the nominal scale and was analysed using the binomial test to determine if a significant proportion responded with either *Yes* or *No* to the respective questions pertaining to industry's awareness about the exclusion of WIL and their agreement/disagreement thereof. The results are displayed in Table 4.8 and Figure 4.8.

Table 4.8: Industry's awareness on the exclusion of WIL

Item	*Frequency (%)*		*N*	*P-value*
	Yes	*No*		
D14: *Were you aware that the BBE: Geomatics qualification did not include a WIL/ Workplace learning component?*	27 (21.8%)	**97 (78.2%)**	124	<.001*

D15: *Do you agree with the exclusion of WIL/ Workplace learning in the BBE: Geomatics qualification?*	17 (13.7%)	**107 (86.3%)**	124	<.001*

* indicates significance at the 95% level

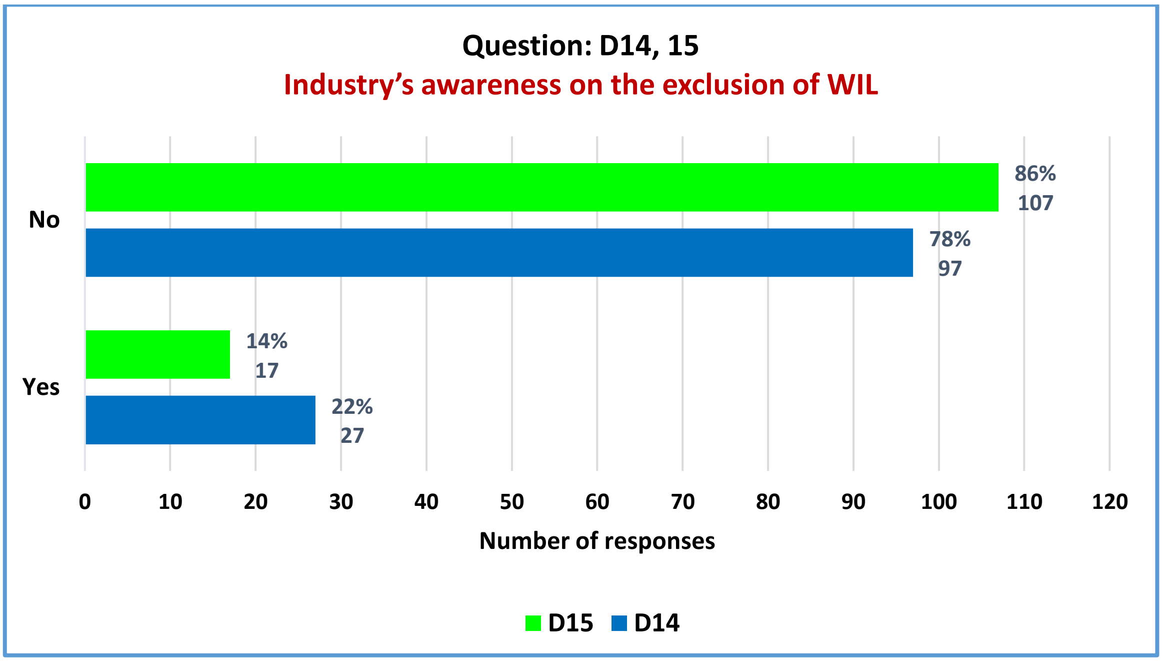

Figure 4.8: **Industry's awareness on the exclusion of WIL**

It is evident that the majority of industry employers (78%) were not aware of the exclusion of WIL in the geomatics qualification. Further, when asked whether they agreed with the exclusion of WIL in the degree, a large majority (86%) responded 'No'. This indirectly suggests that there may be support for the retention of WIL, or possible introduction of WIL in the new qualification.

Question D16 and D17: These two questions aimed to establish whether the exclusion of WIL in the degree is of negligible concern to practitioners in terms of the potential impact on the industry sector. It utilised the Likert scale and the results reflecting the frequency, percentages and means are illustrated in Table 4.9 and Figure 4.9 below.

Table 4.9: Negligible concern about WIL (industry)

Item	*Responses as Frequency (%)*					*n*	*Mean (SD)*	*t*	*df*	*P-value*
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
D16: *The lack of WIL/Workplace learning in the Geomatics degree will have a negligible or minimal impact on the industry sector, workforce and economy.*	**29 (23.4%)**	**46 (37.1%)**	15 (12.1%)	22 (17.7%)	12 (9.7%)	124	**2.53** (1.291)	-4.036	123	<.001*
D17 *The exclusion of WIL/ Workplace learning in the Geomatics degree is not a major concern and may not affect the student's employability as graduates will have to obtain post qualification work experience.*	**39 (31.5%)**	**54 (43.5%)**	11 (8.9%)	16 (12.9%)	4 (3.2%)	124	**2.13** (1.097)	-8.844	123	<.001*

* indicates significance at the 95% level

As can be seen in Table 4.9, both mean values are < 3. The bar graph in Figure 4.9 further illustrates that there is a significant disagreement with both statements. A total of 60.5% of respondents disagreed regarding the notion that the exclusion of WIL may have a negligible/minimal impact on industry, and a total of 75% disagreed that the exclusion of WIL was not considered as a major concern by practitioners. On the contrary, this could be an indication that there is a legitimate concern regarding the absence of WIL in the new degree, which concerns employers/practitioners.

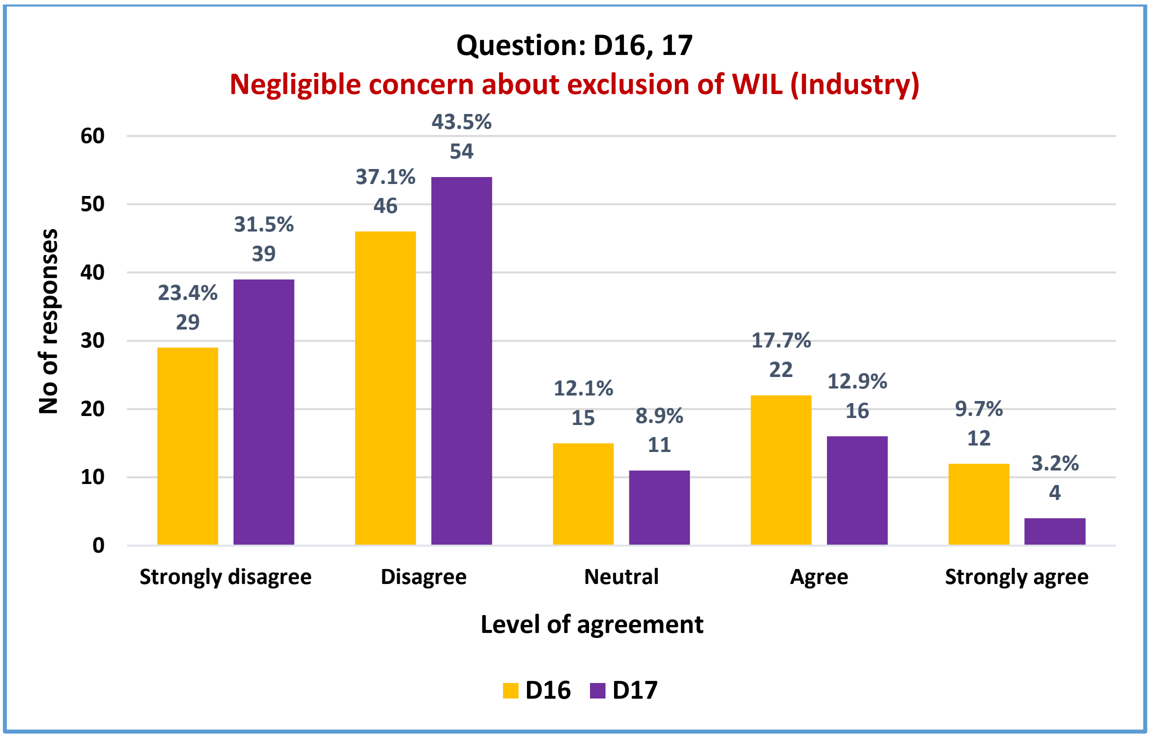

Figure 4.9: Negligible concern about exclusion of WIL (Industry)

4.3.2 Theme 2: Impact of excluding WIL

Question D18 to D22, D25, D27 and D30: These eight questions have been grouped into Theme 2 as it explicitly addresses Objectives 2, 3 and 4 of the study from an industry perspective. These questions assess the impact of excluding WIL in the degree, and how this is perceived by the work sector in terms of the possible negative implications for the student/graduate and the industry sector. All questions here utilised the Likert scale and the results reflecting the frequency, percentages and means are illustrated in Table 4.10 and Figure 4.10 below.

Table 4.10: Impact of excluding WIL (industry)

Item	***Responses as Frequency (%)***					***n***	***Mean (SD)***	***t***	***df***	***P-value***
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
D18: *The absence of WIL in the geomatics degree, may have a significant impact on the type and quality of graduate entering the work sector.*	2 (1.6%)	5 (4.0%)	7 (5.6%)	**64 (51.6%)**	**46 (37.1%)**	124	4.19 (0.840)	15.720	123	<.001*

D19: *The new geomatics graduate may be perceived as one with possibly diminished practical skills/technical expertise and lacking essential knowledge and capability necessary for the execution of Surveying/Geomatics field operations.*		7 (5.6%)	7 (5.6%)	**67** **(54.0%)**	**43** **(34.7%)**	124	**4.18** (0.776)	16.893	123	<.001*
D20: *The absence of WIL/ workplace learning in the Geomatics degree may in time create a vacuum of knowledgeable, skilled, experienced, competent and accountable technicians and technologists in industry.*	2 (1.6%)	14 (11.3%)	14 (11.3%)	**61** **(49.2%)**	**33** **(26.6%)**	124	**3.88** (0.984)	9.944	123	<.001*
D21: *The exclusion of WIL/workplace learning in the Geomatics degree, may disadvantage students in terms of their personal growth & professional development; and may negatively impact on the employability skills, graduate attributes, job prospects and career opportunities of the graduates.*	4 (3.2%)	8 (6.5%)	5 (4.0%)	**69** **(55.6%)**	**38** **(30.6%)**	124	**4.04** (0.949)	12.206	123	<.001*
D22: *The exclusion of WIL in the Geomatics degree may disrupt the student's ability to link and integrate theoretical (classroom-based) knowledge with professional practice-based knowledge gained through workplace learning.*	1 (0.8%)	5 (4.0%)	8 (6.5%)	**63** **(50.8%)**	**47** **(37.9%)**	124	**4.21** (0.799)	16.856	123	<.001*
D25: *The exclusion of WIL/ workplace learning in the Geomatics degree will impact on the student's employability and entrepreneurial & innovative attributes, which may negatively influence the production of entrepreneurs and SMMEs.*	4 (3.2%)	6 (4.8%)	16 (12.9%)	**67** **(54.0%)**	**31** **(25.0%)**	124	**3.93** (0.930)	11.107	123	<.001*

D27: *The exclusion of WIL/workplace learning in the Geomatics degree may possibly contribute to an unexpected and indirect increase in the unemployment rate amongst university graduates.*	5 (4.0%)	10 (8.1%)	15 (12.1%)	**60** **(48.4%)**	**34** **(27.4%)**	124	**3.87** (1.036)	9.365	123	<.001*
D30 *The absence of WIL/workplace learning may have a possible indirect impact on the workflow and productivity levels of professional practitioners and organisations that appoint technicians/technologists for support in the execution of field operations and facilitating deliverables.*	2 (1.6%)	8 (6.5%)	16 (12.9%)	**71** **(57.3%)**	**27** **(21.8%)**	124	**3.91** (0.865)	11.732	123	<.001*

* indicates significance at the 95% level

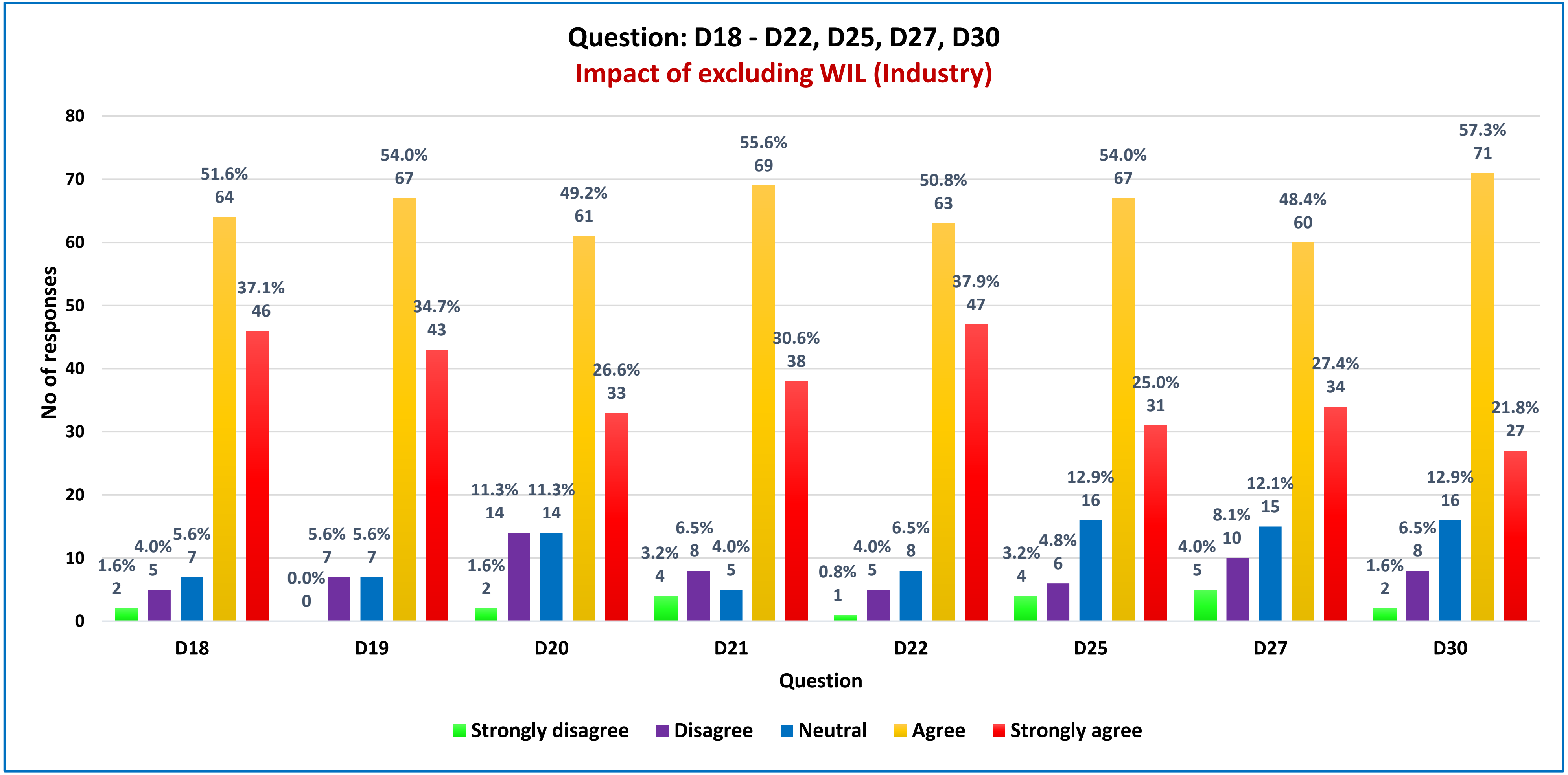

Figure 4.10: Impact of excluding WIL (Industry)

Table 4.10 shows that all mean values are > 3. The bar graph in Figure 4.10 further illustrates that there is a substantial agreement that the exclusion of WIL from the degree may have a detrimental impact for the student/graduate as well as the industry sector.

- A total of 88.7% of respondents agreed that the absence of WIL may have a significant impact on the type and quality of graduate entering the work sector.
- A total of 88.7% agreed that the geomatics graduate may be perceived as one with possibly diminished practical skills/technical expertise and lacking essential knowledge and capability to cope with industry expectations.
- A total of 75.8% agreed that the absence of WIL may create a vacuum of knowledgeable, skilled, competent, and accountable technicians/technologists in industry which may affect productivity, workflow, and economic growth.
- A total of 86.2% agreed that the exclusion of WIL may disadvantage students in terms of their personal growth and professional development; and may negatively impact their employability skills, graduate attributes, job prospects and career opportunities.
- A total of 88.7% agreed that the exclusion of WIL may disrupt the student's ability to link and integrate theoretical knowledge with professional practice-based knowledge gained through WPL.
- A total of 79% agreed that the exclusion of WIL may impact the student's employability and entrepreneurial & innovative attributes, which may negatively influence the production of entrepreneurs and SMMEs.
- A total of 75.8% agreed that the exclusion of WIL may contribute to an unexpected and indirect increase in the unemployment rate amongst university graduates.
- A total of 79.1% agreed that the absence of WIL may have a possible indirect impact on the workflow and productivity levels of professional practitioners and organisations that appoint technicians/technologists for support in the execution of field operations and facilitating deliverables.

The above quantitative data is complemented by some legitimate concerns expressed by employers. The comments (qualitative) generally reaffirm the notion that the exclusion of WIL may not be beneficial to the students, industry, or the institution. The key concerns revolve around the qualification offering; student's employability prospects with respect to the quality, capability, enthusiasm, and competency of student/graduate; required skills and work experience; and employer confidence when recruiting graduates. Below are direct quotes from practitioners which highlight their various perspectives.

> The essence of studying towards a technical qualification at a University of Technology is to prepare students to be hands on and practical. By only providing theory, you will not achieve a well-rounded, competent and skilled graduate.
>
> Students who have completed their theoretical part of the academic programme should have at minimum a good understanding of the basic principles of surveying. Many students lack sound understanding of theoretical concepts and have to be mentored from scratch when they commence their WIL programme. In my opinion, eliminating WIL from the academic programme will have a strong negative impact on the quality of students produced by DUT. Rather, DUT should be looking at increasing WIL through industry collaboration.
>
> With the lack of WIL in the new programme, industry needs to be aware of the sudden change of the type of students that will be exposed to the work force once graduated. Currently vacancies for technicians would require a minimum of 1 year work experience. Technologists would vary between 3 to 5 years. These new graduates will fall short. Many companies do not have graduate programmes unless it is for a land surveyor. Reintroducing some form of WIL into the programme would assist industry on gaining knowledge on the type of students that would be expected in the years to come
>
> We have permanently employed three of our WIL students. Some of these employees are now currently employed with the company for more than five years. The WIL period allows the employer to evaluate the potential of the students and possibly grant bursaries to assist some of the students that are in need of financial assistance. Employers would also be more confident in permanently employing new graduates, if they have previously demonstrated their capability, motivation, and enthusiasm during the WIL period. Besides the much required knowledge and confidence with regards to survey equipment, software and fieldwork experience, students get to 'network' with other personnel in the industry, which may assist in advancing their ambitions for employment after graduation. I therefore believe that students with the new geomatics qualification would definitely be at a disadvantage considering the points raised above.
>
> I have seen students come out with no idea about what the work is actually like. Their practical knowledge and competency has been very low. I believe that the current DUT course practicals are failing. Once exposed to actual work, some students have changed careers, which would mean that a student with no WIL may waste 4 years on a programme only to do something else later.
>
> I am concerned that students will leave university looking for well paid jobs without the ability to perform the more simple tasks. As a business we need staff to be productive from day 0. We

need to be able to generate more than their pay, car, assistants, insurance, fuel, equipment, software and hardware.

WIL is important as standards are dropping at Universities and Technikons. Group projects in my opinion in place of WIL will not benefit students as the stronger students carry the weaker or lazy students.

I have had the privilege of training around 20 students in my 20 plus years of surveying. Most only had a rudimentary understanding of what was required in the profession. I am happy to also say that after the experience was complete, most were competent. The training was essential for them, as it was for me when I studied. I am a strong believer in the need for training as part of qualification but also recognize the problems students face in obtaining this experience. Plus, Covid has made things even harder for the prospective student. I am sad to say that for the first time in my career we have been unable to take on a new student this year (we legally cannot hire - as we have been on short time since the outset of the pandemic). That said, this is an employment problem, not a training problem. The removal of WIL won't rectify this. It simply devalues the qualification.

Thus, Theme 2 fulfils Objectives 2, 3 and 4 of the study.

Question D23: This question aimed to establish if greater emphasis on core academic knowledge in the geomatics curriculum to reinforce key fundamental concepts was preferred over a period of workplace learning to better prepare and equip students for the WOW. This question utilised the Likert scale and the results reflecting the frequency, percentage and mean are illustrated in Table 4.11 below.

Table 4.11: Focus on core academic knowledge (industry)

Item	***Responses as Frequency (%)***					***n***	***Mean (SD)***	***t***	***df***	***P-value***
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
D23: *A greater emphasis on core academic knowledge and theoretical content in the geomatics curriculum is preferred over a period of actual workplace learning, to better prepare and equip students for the WOW.*	8 (6.5%)	41 (33.1%)	32 (25.8%)	29 (23.4%)	14 (11.3%)	124	**3.00** (1.133)	0.000	123	<.1.00

The mean value is exactly 3.00 indicating that there is neither a significant agreement nor disagreement. Industry members remain almost equally divided on this, and it is likely due to the notion that both academic knowledge and industry practice play a pivotal role in the overall development of the student’s proficiencies, in inculcating a deeper understanding and appreciation linking theoretical knowledge and real-world industry practices. One employer however did express his strong desire for a more academic theoretical based approach as opposed to WIL.

> First and foremost - theory, theory and more theory. Learning skills and WIL is secondary to theory. I want students that understand what the maths is doing, does the answer look right, what is that machine actually doing with that signal, will gravity affect what I am doing and if so will it be significant, what does ITRF actually mean, what is code and phase in a GPS signal and how does it work etc. etc. I can give them WIL afterwards but WIL without the theory does not give me confidence. WIL or articles or post qualification training - whatever one calls it i.e., 'experience' - will come, but one needs the theory, not button pushers.

4.3.3 Theme 3: Importance and relevance of WIL

Question D24, D26, D28, D29: These four questions have been grouped into Theme 3 to evaluate the importance and relevance of WIL; they cover the broad aim of the study from an industry perspective. However, the overall results are represented in separate tables and figures since two different question types were employed i.e., Likert scale and semantic differential scale.

Question D24 utilised the Likert scale and the results reflecting the frequency, percentage and mean are illustrated in Table 4.12.

Table 4.12: Relevance of WIL in developing graduates

Item	*Responses as Frequency (%)*					*n*	*Mean (SD)*	*t*	*df*	*P-value*
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
D24: *WIL may be relevant in order to: develop responsible, productive and accountable graduates, enhance theoretical knowledge and practical skills acquisition, effect knowledge and skills transfer, increase work readiness and student competence for the competitive work sector.*	1 (0.8%)	3 (2.4%)	11 (8.9%)	**62 (50.0%)**	**47 (37.9%)**	124	**4.22** (0.771)	17.587	123	<.001*

* indicates significance at the 95% level

Table 4.12 reflects a <u>mean value of 4.22</u>. Further, a total of <u>87.9%</u> of respondents were in firm agreement that WIL may be relevant for the geomatics qualification in developing responsible, productive and accountable graduates with the necessary attributes, qualities, skills, and competencies required by the competitive labour market.

<u>Question D26, D28 and D29</u> utilised the Semantic differential 7-point rating scale type questions and the results are illustrated in Table 4.13 and Figure 4.11 below.

Table 4.13: Importance and relevance of WIL (industry)

Item	*n*	*Mean (SD)*	*t*	*df*	*P-value*
D26: *Rate the level of importance/relevance you believe, that WIL has in developing 'employability skills' such as: responsibility and reliability; professionalism; problem solving abilities and critical thinking; judgement and decision making; self-management; teamwork and collaboration; leadership; time management skills; communication skills; interpersonal skills; organisational skills; application of numeracy, information technology skills, application of modern tools/instrumentation; entrepreneurship and innovation; business and client awareness.*	124	**6.02** (1.189)	18.878	123	<.001*

D28: *Rate the level of importance you believe that employability skills, graduate attributes, core individual competencies and skills sets, and discipline specific knowledge have, in terms of productivity of the labour force in the engineering, geomatics and built environment sectors.*	124	**5.89** (1.084)	19.393	123	<.001*
D29: *Rate the level of importance/relevance you believe that WIL/workplace learning has with respect to: academic progression; enhancement of work-related capabilities and work readiness; work experience; increase in technological skills acquisition; networking; professional identity; work ethic; motivation and confidence; productivity and efficiency; and career prospects of students.*	124	**5.88** (1.207)	17.336	123	<.001*

* indicates significance at the 95% level

Table 4.13 shows that all mean values are > 5.8 while the bar graph in Figure 4.11 further confirms that majority of respondents indicated a score of 6 and 7 on the semantic scale. The supporting data reiterates industry's perception on the importance and relevance of WIL as an essential component for a modern-day geomatics graduate.

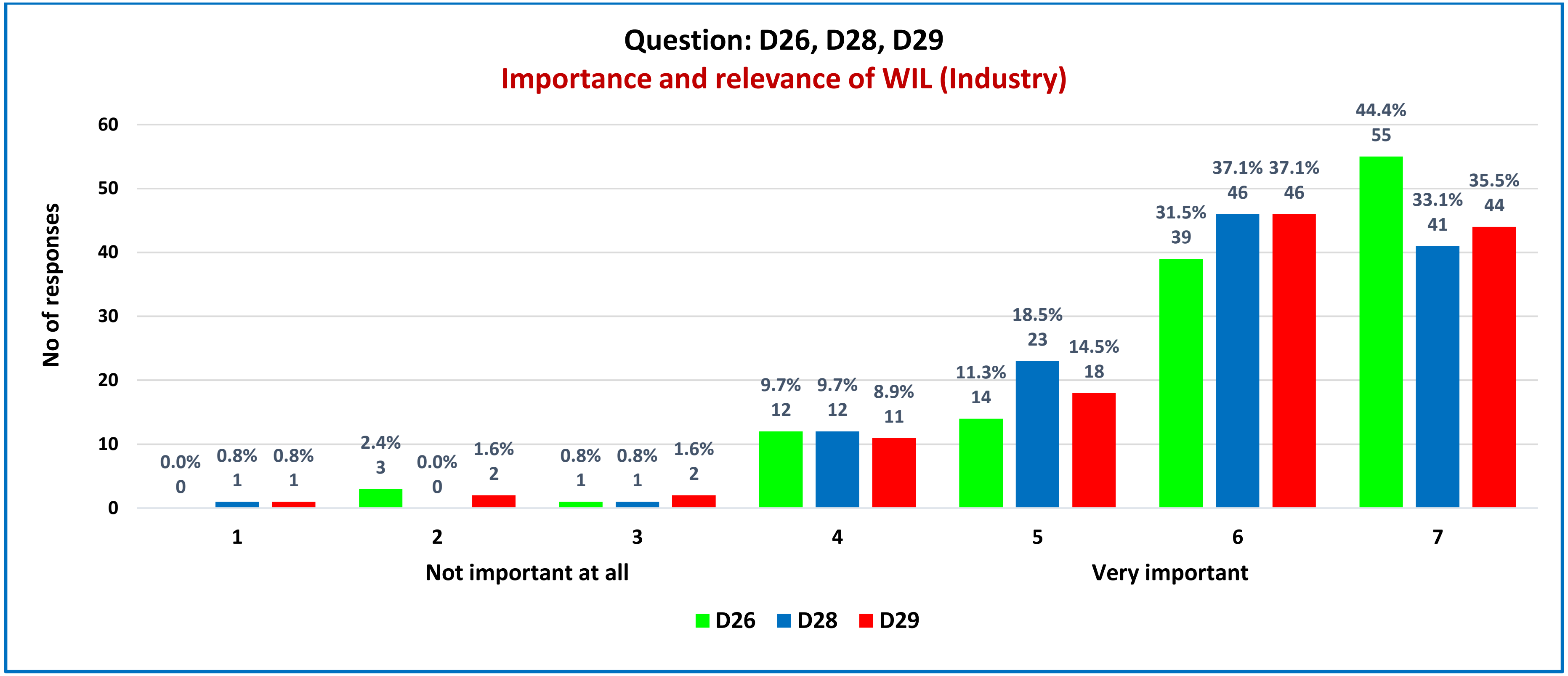

Figure 4.11: Importance and relevance of WIL (Industry)

The quantitative data is further validated by employers' comments (qualitative) enclosed in the form of direct quotes below, which demonstrate the substantial value and emphasis that industry has placed on WIL. Employers emphasised the importance of producing all-round modern-day technical graduates that possesses essential hands-on practical capabilities, key attributes, employability skills, competencies, and discipline specific knowledge which emanates from real industry exposure and contributes to their knowledge base and productivity. This, they believe, would appeal to the labour sector and assist students in securing gainful employment and preparing them to becoming contributors to the economy and society at large.

> WIL is important for technologists to work in industry.

> Students need a lot of practical experience before they become comfortable in dealing with problems.

> My inservice training was more important that the theoretical knowledge I learned studying.

> I am of the opinion that WIL is the best way to learn, and if I could have my way, WIL should be the only way to teach/learn. Practical real industry experience in a real work environment should be combined with chunks of relevant theory. Theory without practical experience is so abstract that students completely forget all their theory by the time they start working.

> Yes. WIL plays a vital part in any student's academic life. It gives them an insight of how the outside world works within the industry, and it prepares them for the industry when it is time to leave the institution and work for any sector within the built environment. 60% of the theory you've learned at school is what you apply in the real world within the industry. The other 40% comes from training and exposure through WIL. It's a fundamental tool that equips the student with the necessary attitude, attributes and knowledge of the industry outside of the institution especially when it comes to construction work.

> Practical skills experience and training must be a requisite in any geomatics academic qualification no matter what the difficulty may be. Any obstacle and challenges must be overcome if the graduate is to initially obtain meaningful employment and contribute to enhancing the profession/industry

> Most students choose geomatics, with no idea of the actual work requirements. In my 20 years of survey, I have had 2 inservice students that changed their careers after inservice training. Inservice training allows the individual to get a bit of insight of their career path chosen within the first year of studies. Humans excel in careers that form part of their person characters. Thus, making an efficient and positive minded work force.

WIL has always been an integral part in developing a student and by scheduling it in the middle of the academic programme will enhance the student's ability and appreciation for the more difficult final year of the academic programme. With WIL under the belt, the university can concentrate on refining the skills achieved in that final year of academics. Experience has shown that students fresh out of the first year of the old programme (post S2), who enter the 'experiential training' part of the programme do not possess the skills or maturity to work unsupervised. By undertaking this year of WIL, it is the mentor's duty to prepare the student, skill them and instil values that move them towards having the skill, maturity and professionalism to work unsupervised and produce work of exceptional standards. This, I believe will only enhance the student's employability tenfold. It also provides an opportunity for the student to network in an environment that is not wholly pressurised as they are not yet marketable without the degree. Supervised work integrated learning sets a UoT apart from a traditional University. UoTs are not in the business to provide academics and thinkers only but the 'doers' and hands on, practical technicians. This is where I believe the DUT and other UoTs are losing the plot. For decades they have been producing top-notch technical graduates ready for the market and contributors to the economy and society, not only in RSA but internationally. The WIL is an integral component and is the identity of a technical university. The essence of this should not be lost by passing the responsibility on acquiring the WIL to the student"

As a university graduate, I did not have to undertake any compulsory WIL during the degree course, however, my experience showed to me that it is extremely important. I undertook a "voluntary" WIL by spending nearly all my vacations working for a land surveyor who was extremely accommodating in using me for tasks that fit in with what had been covered so far at university. I feel that this made the university work far more relevant, and I was able to understand the course work in a more practical light than some of the other students who did not have this experience. By the time that I was in my final year and on graduating I was already able to undertake most types of survey work on my own with minimal supervision as required by the regulations in the case of cadastral work. I was immediately a productive member of the team. Again this was not the case with fellow students who only started their WIL on completion of the degree. In my experience and opinion there is a direct synergy between WIL and course work as each helps to make the other more relevant

It is important that students impart new techniques and experience in new products to the firms they are employed at. In my case I specialise in sectional title work. I have very little experience in engineering work i.e. precise levelling. I like the idea of learning new ideas and expand my business into different survey fields.

The BBE curriculum structure should be built mainly from the ideas from the vast different working sectors and the students should engage the working sectors……

Thus, Theme 3 fulfils/reaffirms the broad aim of the study – To evaluate the importance/relevance of WIL in the geomatics programme at the DUT.

Question D31: The question utilised the semantic differential 7-point rating scale and the results are illustrated in Figure 4.12 below.

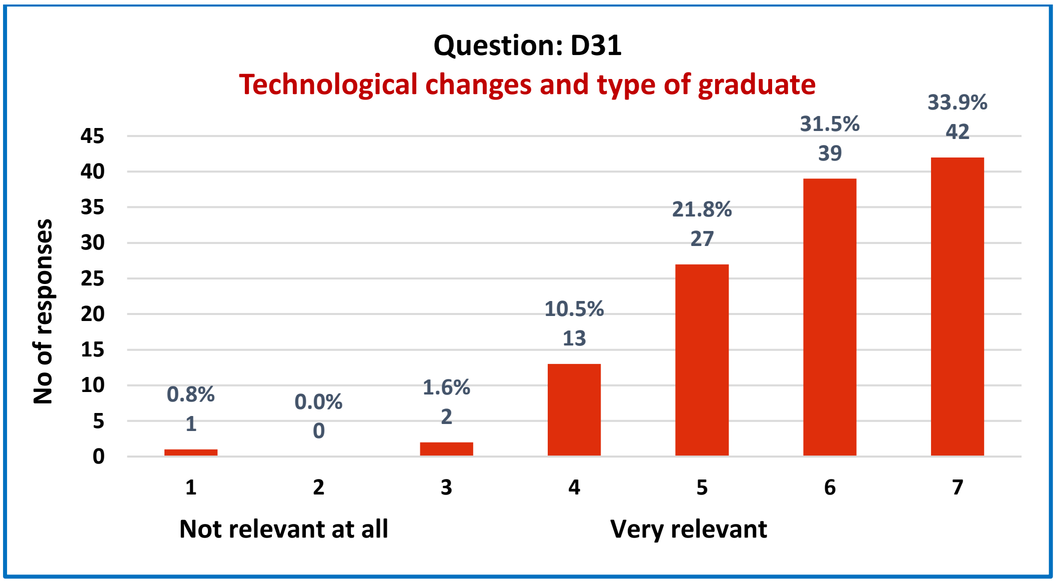

Figure 4.12: Technological changes and type of graduate

The aim of this question was to establish the degree of relevance regarding the application of modern technology in the 4IR in shaping the type of graduate with the required skill sets and core competencies as technological advancements continue to disrupt and transform the modern workplace. The analysis produced a mean value of 5.82 which shows that it is relevant. The bar graph in Figure 4.12 further indicates that a large percentage of respondents indicated a score of between 5 and 7, with the majority selecting 6 and 7 which confirms the relevance of technology and the influence/impact that 4IR may have in producing the required graduate type.

4.3.4 Theme 4: Alternate forms of WIL

Question D32 to D35: These four questions have been grouped into Theme 4 and explore the possible alternate options to actual workplace learning. All questions utilised the Likert scale and the results reflecting the frequency, percentages and means are illustrated in Table 4.14 and Figure 4.13.

Table 4.14: Alternate forms of WIL (industry)

Item	***Responses as Frequency (%)***					***n***	***Mean (SD)***	***t***	***df***	***P-value***
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
D32: *The establishment of a geomatics practical survey camp through a university-industry collaborative partnership to enhance student's practical and technical proficiencies should be considered in the absence of workplace learning and in preparation for the WOW.*	3 (2.4%)	15 (12.1%)	11 (8.9%)	**44 (35.5%)**	**51 (41.1%)**	124	**4.01** (1.101)	10.199	123	<.001*
D33: *Problem based learning (PBL) through work simulation encompassing industry-oriented problem-based activities and tasks to enhance critical thinking skills and problem-solving abilities, should be considered as a possible alternative to workplace learning to prepare students for the WOW.*	3 (2.4%)	17 (13.7%)	30 (24.2%)	**45 (36.3%)**	**29 (23.4%)**	124	**3.65** (1.061)	6.773	123	<.001*
D34: *Project based learning (PJBL) through a university-industry collaborative initiative encompassing real-world projects in an industry controlled setting, should be considered as a possible alternative to workplace learning to prepare students for the WOW.*	1 (0.8%)	11 (8.9%)	21 (16.9%)	**62 (50.0%)**	**29 (23.4%)**	124	**3.86** (0.905)	10.621	123	<.001*
D35: *The introduction of a geomatics practical survey camp, PBL and PJBL may not produce the same level of desired impact and potential benefit compared to a period of actual structured and monitored professional practice industry workplace learning.*		9 (7.3%)	13 (10.5%)	**66 (53.2%)**	**36 (29.0%)**	124	**4.04** (0.830)	13.952	123	<.001*

* indicates significance at the 95% level

Table 4.14 shows that all mean values are > 3. The bar graph in Figure 4.13 further illustrates that there is a significant agreement that alternate forms of WIL could be considered in the absence of actual workplace learning.

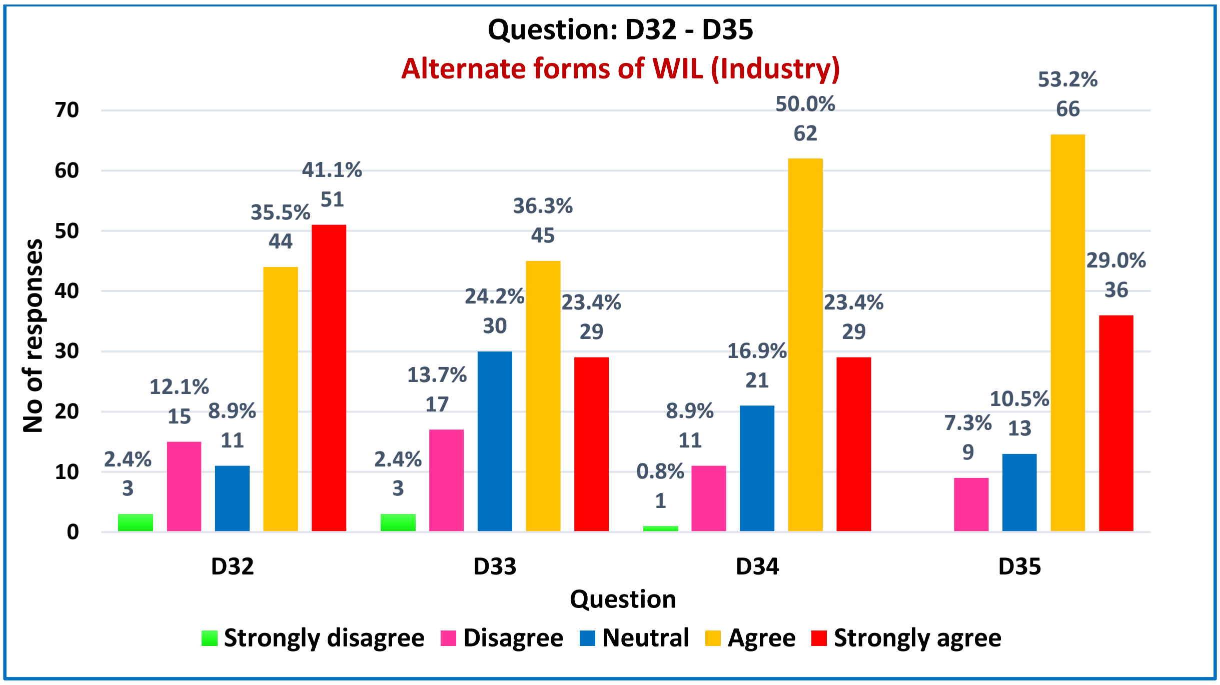

Figure 4.13: Alternate forms of WIL (Industry)

A total of 76.6% of respondents were in agreement, that the establishment of a geomatics practical survey camp through a university-industry collaborative partnership could be considered in the absence of WPL and in preparation for the industry sector.

A total of 59.7% were in agreement, that PBL through work simulation encompassing industry-oriented problem-based activities to enhance critical thinking skills and problem-solving abilities, could be considered as a possible alternative to WPL to prepare students for the work sector. However, 24.2% were not fully convinced of this and were on the fence, indicating ‘neutral’.

A total of 73.4% were in agreement that PJBL through a university-industry collaborative initiative encompassing real-world projects in an industry-controlled setting, could be considered as a possible alternative to WPL to prepare students for the work sector. Industry members seem to be in favour of this option possibly because of the emphasis on the use of 'real-world' projects in an actual work environment to adequately equip and prepare students.

A total of 82.2% were in agreement, that the introduction of a survey camp, PBL and PJBL may not produce the same level of desired impact and potential benefit compared to a period of actual structured and monitored professional practice industry WPL. So, while industry appears to be supportive of the concept on alternate forms of WIL, in their view it is evident that this may not supersede actual WPL in a professional setting.

The quantitative data is complemented by some of the employer's comments (qualitative) enclosed in the form of direct quotes below, which support the notion that alternate forms of WIL should be explored to enhance the effective acquisition of work experience. Some employers expressed concern that students were being exploited by some companies and suggested a more structured approach for WIL, including survey camps and survey school as a beneficial and effective alternative. Another recommended that industry practitioners could conduct lectures explaining past projects and share their experiences about different methods used on site.

> WIL is highly effective with good hands-on practical work and personal supervision of learners. Used as "cheap" skilled labour and unsupervised is not assisting the learners in any way. A combination of a 3-week survey camp together with 6 months WIL is my opinion is optimal.

> I think incorporating practicals and a 2-week camp as part of the course is important, but also include in one of the courses, a topic on professionalism, ethics and the Geomatics Act and Conduct Rules, unless this is already incorporated. I assume that the PBL and PJBL topics will be post qualification mentored work experience.

> Survey school 6 months.

> WIL and the outcomes thereof are highly dependent on the company at which the student is employed and the level of knowledge the student comes with. It is difficult to remain productive while teaching basic survey principles to students who should know this already. I am of a strong opinion that structured survey camps would offer the best outcome for students. These survey camps will have to promote independent thinking and execution of tasks if they are to become worthwhile and hold any merit. A theoretical and practical exam at the end of the camp will highlight any shortcomings of the students tuition. Some firms may not have the students' interest at heart and will employ students as a form of "cheap labour".

A student will therefore spend 12 months at a firm and come out severely lacking compared to a student who attended several structured survey camps during the duration of their degree.

Perhaps a helpful alternative to on-site training is for experienced surveyors to lecture the students on past projects -with photos- and then train/test the students with some of the practical skills required for such a project. Again this will never beat true on site experience but perhaps this way in a short space of time the students can be exposed to many different projects and many different surveyors with slightly different methods.

It is unfortunate that WIL was dropped from the curriculum, however like at UKZN, they do not incorporate a WIL in the course but they do have practicals as well as the 2 week camp as part of the curriculum. If a student wishes to be a PLS, then they register with SAGC as a PLS in training and complete their articles or the period of training as prescribed.

Question D36 and D37: These two questions explore the possibility of incorporating WIL into the degree based on industry feedback. The nominal scale was used here to determine what period of WIL would be appropriate and which year of study to place it in. It was analysed using the chi-square goodness of fit test to establish if any response options are selected significantly more than the others.

Table 4.15: Possibility of including WIL in the degree (Industry)

Item	*Responses as Frequency (%)*				X^2	*df*	*P-value*
D36: *If it is established that WIL should be included in the Geomatics degree, what period of workplace learning will be appropriate, considering that the essential theoretical & academic content must also be achieved as part of the new qualification?*	**3 Months**	**6 Months**	**9 Months**	**12 Months**			
	10 (8.1%)	**49 (39.5%)**	11 (8.9%)	**54 (43.5%)**	54.645	3	<.001*
D37: *If it is established that WIL should be included in the Geomatics degree, in what year of study should the workplace learning ideally take place?*	**Year 2 - semester 1**	**Year 2 - semester 2**	**Year 3 - semester 1**	**Year 3 - semester 2**			
	14 (11.3%)	35 (28.2%)	40 (32.3%)	35 (28.2%)	12.968	3	<.005*

* indicates significance at the 95% level

From Table 4.15, it's clear that the significant majority have opted for <u>6 months (39.5%)</u> and <u>12 months (43.5%)</u> of industry practice. Additionally, it appears that a significant few do not prefer it in year 2 semester 1 (11.3%). The rest of industry is almost evenly divided in which semester the WIL should be administered, with (28.2%) opting for year 2 semester 2; (32.3%) opting for year 3 semester 1; and (28.2%) opting for year 3 semester 2.

Traditionally WIL has been ‘sandwiched’ in the second year of the Diploma programme, however incorporating WIL in a degree programme will necessitate some careful improvisation in prioritising curriculum content and balancing WIL practices to provide a valuable holistic learning experience for the student and mutually beneficial collaborations with industry partners and stakeholders.

The following direct quotes (qualitative) from some of the employers reflect their views regarding the possibility of incorporating WIL into the new degree. Their comments seem to lean towards six months of WIL in the final year of study.

> I would like to see WIL implemented at the end of the degree rather than in the middle, like articles for the PLS graduates, but as a pre-requisite for graduation from the BBE degree.

> I still maintain that the 6 months theory alternating with 6 months practical till completion is the best curriculum, where at the end the student graduates.

> WIL is necessary in producing an equipped graduate for the workplace. 3-6 months of WIL should be considered.

> It might be difficult to implement, but I think distance learning is the way to go. Students can enrol for modules on a part time basis while they work in the survey industry. It will take much longer to attain a degree but I think this will produce much better graduates

4.3.5 Theme 5: WIL industry support and collaboration

Question D38 to D43: These six questions have been grouped into theme 5 to evaluate the industry’s support and commitment in recruiting and providing quality training and work experience for students/graduates, as well proposed increased collaboration efforts. However, the overall results are represented in separate tables and figures since different scale type questions were employed i.e., Likert scale and ratio scale.

Question D38 utilised the Likert rating scale and the results are illustrated in Figure 4.14 below. The question is coded as: *1 = Very unlikely to 5 = Very likely*. The central test value = 3. A significant likelihood has been interpreted with a mean score > 3 and a significant unlikelihood with a mean score < 3.

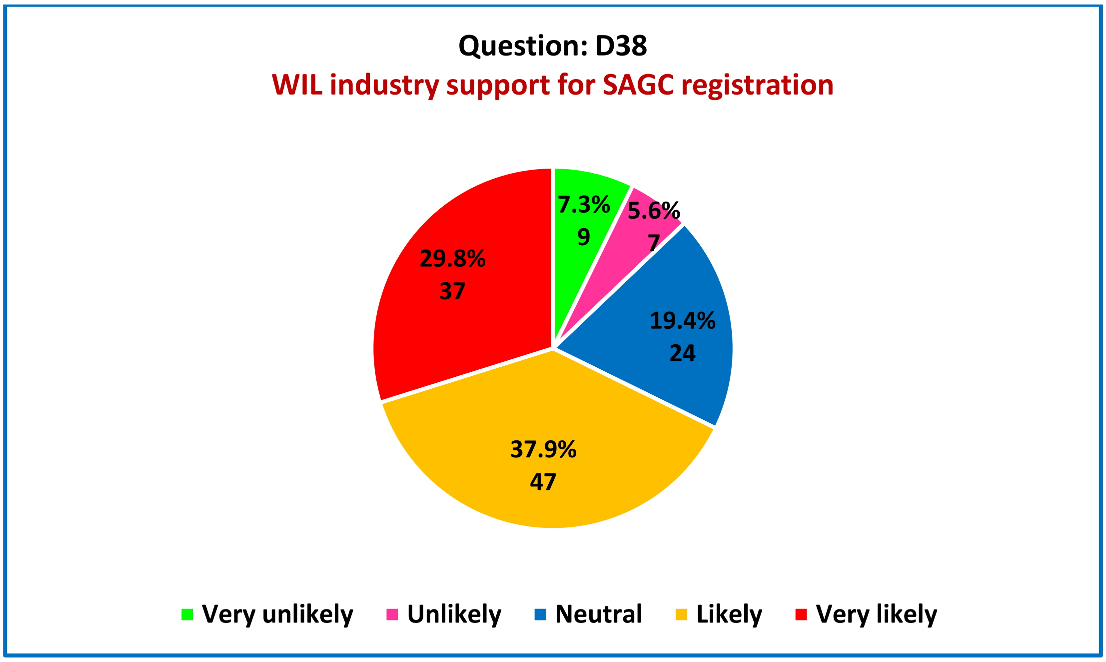

Figure 4.14: WIL industry support for SAGC registration

The analysis revealed a mean value of 3.77. The pie chart in Figure 4.14 further indicates that a total of 67.7% of respondents would most likely provide WIL opportunities for students seeking industry exposure for SAGC registration or work experience purposes which is an encouraging sign of commitment from industry employers.

Questions D39 and D40 utilised the Likert scale question and the results reflecting the frequency, percentages and means are illustrated in Table 4.16 and Figure 4.15 below.

Table 4.16: WIL industry support for work-based programmes

Item	*Responses as Frequency (%)*					*n*	*Mean (SD)*	*t*	*df*	*P-value*
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree					
D39: *As an employer, I support the professional development of Geomatics graduates and is prepared to educate, train, or supervise students/graduates through a formal work-based programme such as an internship or learnership e.g. SETAs or, National skills fund initiatives.*	1 (0.8%)	3 (2.4%)	22 (17.7%)	**62 (50.0%)**	**36 (29.0%)**	124	**4.04** (0.800)	14.473	123	<.001*
D40: *As an employer, I support the professional development of Geomatics graduates and is prepared to educate, train, or supervise students/graduates on a formal contract appointment basis, through minimal investment of time, financial and human resources.*	1 (0.8%)	4 (3.2%)	25 (20.2%)	**67 (54.0%)**	**27 (21.8%)**	124	**3.93** (0.788)	13.108	123	<.001*

* indicates significance at the 95% level

Table 4.16 shows that all mean values are > 3. The bar graph in Figure 4.15 further illustrates that there is substantial consensus in terms of industry support and commitment to providing WIL opportunities for students/graduates either through a formal work-based programme or formal contractual based means.

A total of 79% of respondents were in agreement and committed to supporting the professional development of geomatics graduates through a formal work-based programme such as an internship or learnership e.g., SETAs or National Skills Fund initiatives.

A total of 75.8% were also in agreement and committed to supporting the professional development of geomatics graduates through a formal employment or contract appointment basis.

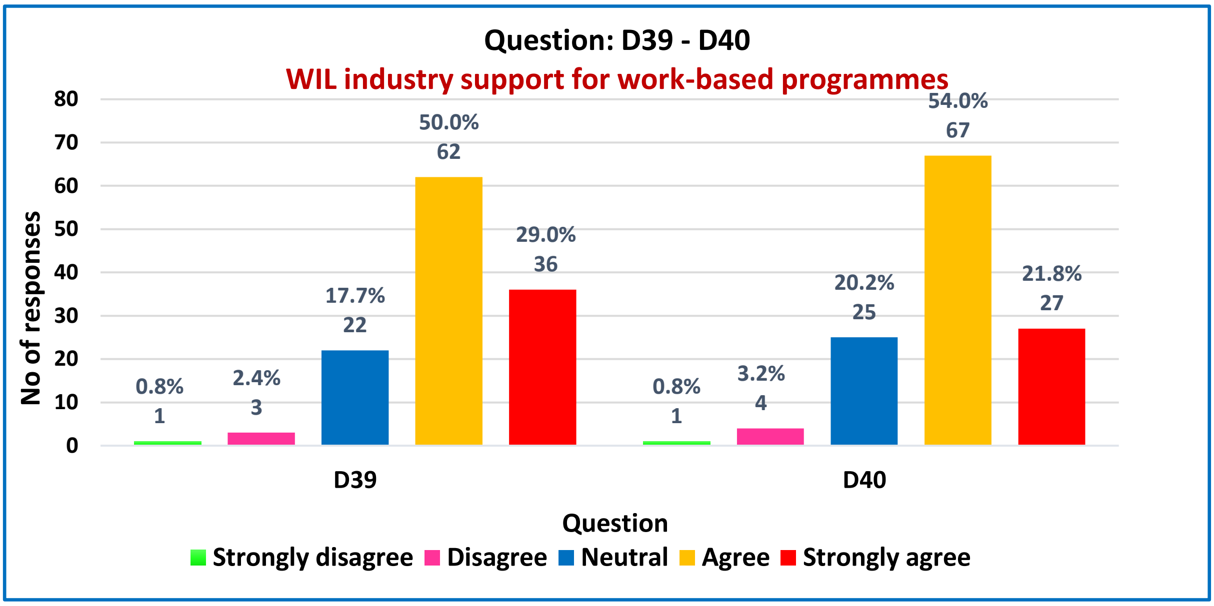

Figure 4.15: WIL industry support for work-based programmes

Question D41 and D42 utilised the ratio scale to determine the number of students that could be accommodated for WIL by keen employers in a specific numerical range category. It was analysed using the chi-square goodness of fit test to establish if any response options are selected significantly more than the others.

Table 4.17: Number of students that could be accommodated for WIL

Item	*Responses as Frequency (%)*					X^2	*df*	*P-value*
D41: *As an employer, how many students on average do you estimate, you may be able to accommodate for WIL in a 3 - 12 month period through a formal work-based internship/learnership programme?*	23 (18.5%)	**78 (62.9%)**	16 (12.9%)	1 (0.8%)	1 (0.8%)	169.697	4	<.001*
D42: *As an employer, how many students on average do you estimate, you may be able to accommodate for WIL in a 3 - 12 month period through a formal contract appointment basis?*	**0**	**1 - 3**	**3 - 6**	**6 - 9**	**> 9**			
	26 (21.0%)	**84 (67.7%)**	8 (6.5%)	1 (0.8%)		143.084	3	<.001*

* indicates significance at the 95% level

Table 4.17 reveals that the significant majority are keen to accommodate between 1 and 3 students in a 3 to 12 months training period either through a formal work-based programme (62.9%) or a formal employment/contract appointment basis (67.7%). The 1 – 3 range appears to be a reasonable indication since most survey practices are small business operations with limited financial and human resources. Furthermore, the Covid-19 pandemic has had huge implications for SMMEs and the labour market. Nevertheless, the commitment to recruit and train students paints an encouraging picture in terms of knowledge and skills acquisition for the next generation of practitioners.

Question D43: This question was to establish whether there should be an increased engagement and collaboration between HEIs, the industry sector and relevant stakeholders. The Likert scale was utilised and the results reflecting the frequency, percentages and means are illustrated in Table 4.18 and Figure 4.16 below.

Table 4.18: Collaboration between all stakeholders (industry)

Item	***Responses as Frequency (%)***					***n***	***Mean (SD)***	***t***	***df***	***P-value***
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
D43 :*There should be an increased engagement between the Universities, government, students, communities, professional bodies, and Industry stakeholders from the public & private sectors to facilitate the professional development and career progression of students/graduates to promote a knowledge-driven economy and for societal impact.*	1 (0.8%)		8 (6.5%)	**59 (47.6%)**	**56 (45.2%)**	124	**4.36** (0.679)	22.359	123	<.001*

* indicates significance at the 95% level

Table 4.18 indicates a mean value = 4.36 which shows significant consensus. The bar graph in Figure 4.16 further confirms that an overwhelming total of 92.8% were in strong agreement that there should be increased collaboration between all stakeholders and partners including universities, students, communities, public and private sectors, and professional bodies to facilitate the professional development and career progression of students/graduates to promote a knowledge-driven economy and for societal impact.

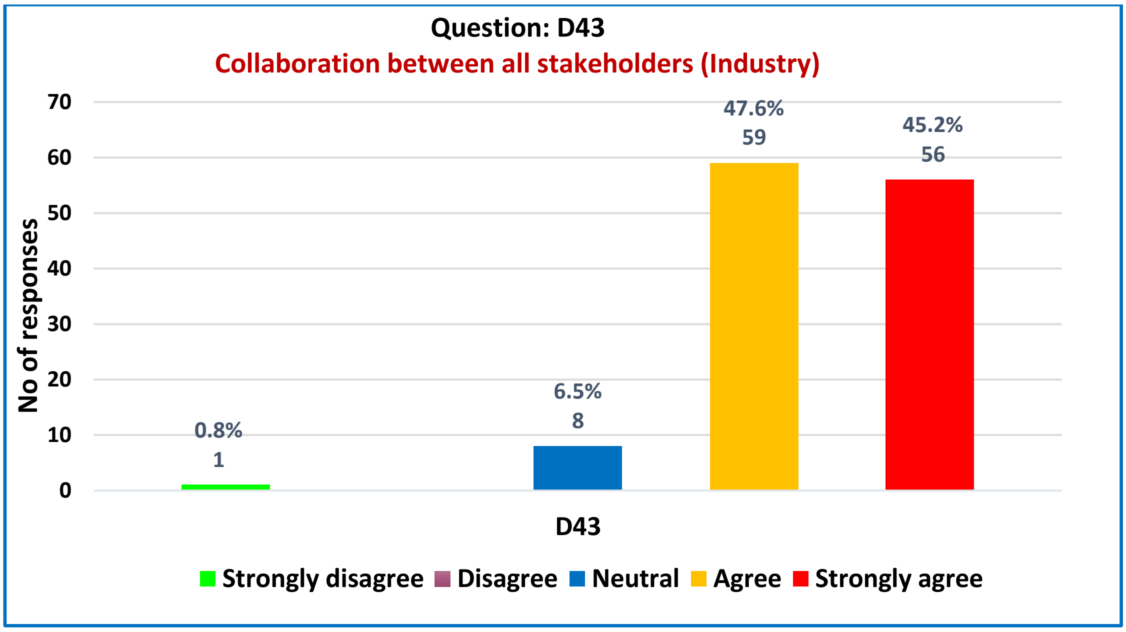

Figure 4.16: Collaboration between all stakeholders (Industry)

The quantitative data is further corroborated by the employer's comments (qualitative) in the form of direct quotes below, which reflect industry's commitment and support for providing WIL placement opportunities through increased collaboration initiatives. Employers believe that avenues of engagement between all stakeholders including government should be improved to foster stronger partnerships and establish joint ventures with the industry. Employers were concerned about the financial aspect and felt that government should create tax incentives to facilitate and fund the WIL placements which would be beneficial to both the industry and students.

Learnerships and internships programmes e.g. SETAs were also proposed as a further structured mechanism to support, facilitate and fund WIL placement initiatives. Some were of the opinion that SETAs could be made more easily accessible to encourage greater industry participation in providing WIL opportunities. Another employer recommended that a formal contract between respective parties outlining clear goals and responsibilities be established in terms of competencies and salary expectations.

High collaboration between ALL industry stakeholders IS ESSENTIAL.

I would also like to add that there must be formal bodies set up to oversee and manage WIL. At the moment, industry collaboration in this regard is sorely lacking I'm afraid. Incentives should be provided to businesses and other organisations in RSA to provide the WIL.

There could well be more support from SETA to provide learnership / internship funding for students. This is a major stumbling block for many small firms. Even as a large firm we have had to scale back on the number of students we train due to funding / cash-flow challenges. Good study, and would be interesting to get an industry wide picture from all institutions.

Government departments e.g. DOT, Water Affairs, Department of Works etc. should play the major role in WIL for students. It is very sad that students have to turn to private sector for training

I have yet to come across a practitioner who has benefited from the SETA programme. Maybe DUT could spend some R&D in assisting practitioners to making SETA more easily accessible

Our firm has given practical experience to lots of students over may years. In the past we used allocated government township work. These funds allowed us to employ lots of students and allowed our practices to grow organically. In fact we needed the students help to get the work done. It was a win, win situation. Due to BBBEE this no longer occurs. If the government could create some incentive scheme via TAX or work we would be in a better place to train and employ students. If this work was provided by government then it would not matter how much training is given to the students as part of their studies as the cost to do in house training would be offset by the work provided. I believe our in-house training and work experience is preferable. Students need to have these skills to make them relevant for me i.e. scanning, drones and especially new software

If the Universities / Technikons worked together with the survey industry in both ensuring that government departments partnered with the industry it would be beneficial for all. For instance, our company was recently not allowed to tender for a job as we were not BEE compliant. Thus if a BEE status excludes us from receiving work, how do we have sufficient work in place then to offer WIL opportunities? Just a thought.

Perhaps a way forward in discussions with employers would be along the lines of setting a number of "goal lines" in terms of proven competencies, which are linked to a salary expectation. Ideally there should be a body made up of educators and industry representatives charged with testing these goals and mediating disputes, to oversee the process. There should also be a recommended contract setting out the duties of the employer in terms of providing the necessary mentorship and the duties of the student to accept the discipline of learning and the salary linked to the learning goals. Only on completion of the WIL up to the final goal, the student would then be able to register with SAGC and find employment on the open market

Question D44: This question was to gauge the level of concern that industry may have relating to the Covid-19 pandemic on the economy in terms of the impact it may have on the development and recruitment of capable and competent geomatics graduates from the DUT. This question utilised the semantic differential 7-point rating scale and the analysis produced a mean value of 5.65.

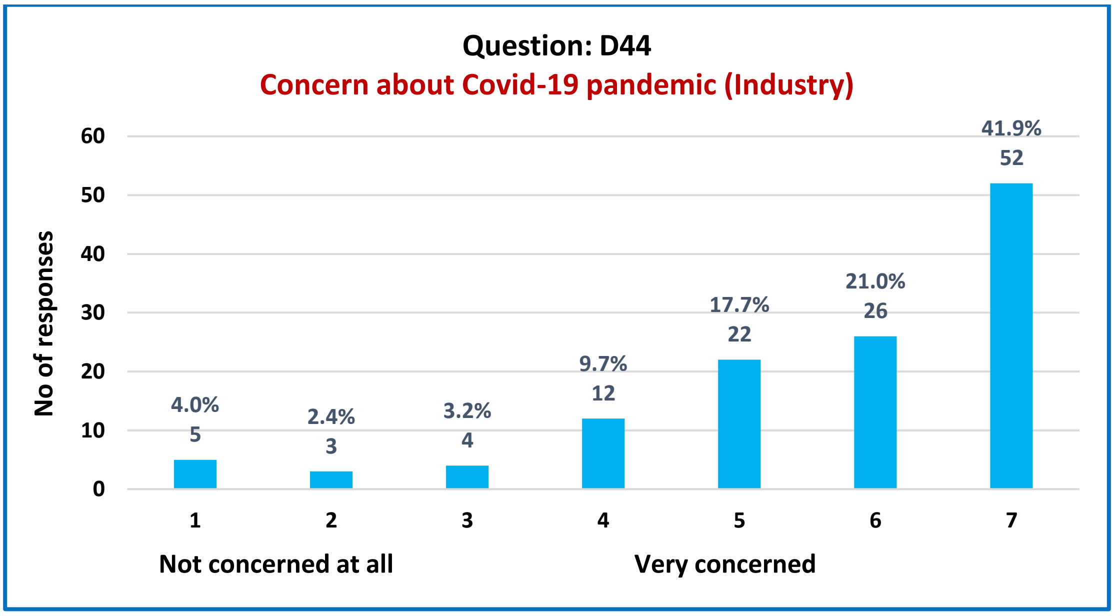

Figure 4.17: Concern about Covid-19 pandemic (Industry)

The bar graph in Figure 4.17 indicates that that the majority of respondents selected a score of between 5 and 7 making up a total of 80.6% of respondents who expressed significant concern about the impact of the pandemic on the economy and recruitment of knowledgeable, skilled, and competent graduates. This may be viewed as a legitimate concern that requires university intervention to reassure the various sectors and stakeholders that the calibre of graduate will not be compromised. The following direct quotes (qualitative) from some of the employers reflect their concerns regarding the Covid- 19 pandemic on the economy and the potential impact on the geomatics graduates.

Practical training I believe is absolutely crucial however the Covid pandemic unfortunately has and in my opinion will have an incredibly negative impact on the above. Difficult to provide the training required as jobs hard to come by. Bigger firms shrinking by the day. Emigration on

> increase. Employment of suitable labour difficult. Sustainability of survey firms difficult due to economic climate (even without Covid).

> The pandemic has had a huge impact on the work available and I am sure that there will not be many work opportunities until the economy picks up.

Question D45: This open-ended question was qualitative in nature. The responses were examined where common words and phrases were identified, analysed, and presented as direct quotes in the various themes to support and enhance the findings of the quantitative data where applicable.

4.3.6 Theme 6: Industry challenges and concerns about WIL

Theme 6 briefly highlights some of the challenges and concerns that industry practitioners have with regard to the implementation of WIL. Employer's concerns include financial and economic reasons, student's salary expectation, limited opportunities, work readiness for industry etc. These are valid concerns that perhaps, with some constructive dialogue and engagement, can be appropriately addressed, considering that over 90% of the employers were in agreement that that there should be increased collaboration between all partners and stakeholders to support and facilitate the professional development and career progression of students/graduates.

> I would like to provide workplace learning for students but, (like many surveyors), I am a one man survey company and have very little work at the moment, and what work I have is at very low rates. At the moment it is economically very difficult to "employ" students, even if on a very low wage, as it costs just to get them on site i.e. medicals, safety equipment, inductions, additional transport costs to fetch them and drop them off, travel/sustenance costs when working away - which our clients will not pay for.

> It is expensive to equip and train students who have work experience or not. Without financial support we will never employ enough students irrespective of their education or lack thereof.

> In my experience and from discussions with colleagues the biggest source of problems is money and salary expectations. The student should understand that this period of WIL, whether it be during the degree course, or only starting thereafter, is part of their education and as such they cannot be regarded as or expect to be treated as a fully productive staff member. The salary paid to the WIL student, and his/her salary expectations, should be consistent with his/her abilities at any time. I think that this would help both parties. The employer will not feel that he is not "getting value for money" or wasting time teaching someone something that he/she

should already know. The student will get better training as the mentor will not be under pressure to just use the student for basic tasks that will generate income to pay his/her salary, and thereby ignore the "time wasting" aspect of the teaching and mentoring.

WIL is very important when training a student/s, however this becomes a huge problem if students can't get in-service training due to limit of space available in the construction /survey companies/ government sectors hence the student have to wait as he/ she can't graduate without it

Yes I agree the workplace learning is important/useful but my concern is I know a lot of students that did not get companies to offer workplace training. That ended, changing the qualification. I am happy with the BBE Geomatics Degree system.

There appears to be quite a bit of work that needs to be put into students and graduates to get them industry ready. Several don't seem to have a reasonable understanding of business and how they are run particularly in the survey field. Maybe that gap needs to be reduced as that plays just as an important role as being a surveyor does.

From the employer's point of view, the young graduate wanting mentorship and employment during a period of articles, or a technical student wanting employment, should realise that they have no immediate useful skills that can be used to generate income to the business while they are learning the job and refining their skills.

I retired 3 yrs ago. My answers relate to when I was a survey manager but I am no longer a member of SAGI or registered with SAGC. Our experience was that generally most students came to us with insufficient knowledge of any type of survey - so we had to teach them from scratch.

Any practical training benefit depends on both the quality of the student and the attitude of the mentor. Too many students are abused by mentors who do not provide the needed training and holistic skill set. So I understand the move away from this training. At least the student completes their degree! But a well prepared and willing student will always find opportunity to train and be mentored by industry.

4.3.7 Theme 7: Other proposals on WIL

This theme focuses on some of the alternate proposals on practicals and WIL as expressed by a few employers. It has been determined earlier that a minority of 14% agreed with the exclusion of WIL. Here some are suggesting a more theoretical approach to enhance the student's understanding prior to practicals, with a focus on computer literacy and specialised survey/geomatics software, as they found practical experience at a learning institution to be of minimal benefit. One employer felt that the student should be given a choice to explore an academic path as opposed to working in industry.

Others suggested a period of articles as a means of preparation for the work sector and stated that the removal of WIL may allow more attention to the theory in the context of changing technology. It should be noted, however, that articles differ significantly from WIL, as the former is conducted post-qualification with the main intention of facilitating professional registration with the statutory body (SAGC) while elevating competence, whereas WIL is embedded in the professional academic qualification to enhance practical proficiencies, competencies and work readiness in the course of study; and is ultimately centred on a career focused education encompassing an integration of classroom-based and workplace-based forms of learning to enable the transfer of discipline-based theory and skills gained in formal education to an authentic work environment. The following direct quotes (qualitative) from employer's illustrate this range of opinions on WIL.

> I believe that it is not the function of a university to teach a student to do a specific job in the workplace but to enable the student to go on to a career, not necessarily in the direct field of study. Therefore, I feel that compulsory WIL should not form part of the course work for a degree.

> A student who is most likely wanting to follow an academic career shouldn't be forced to do workplace learning or experiential training as part of the course in order to complete their degree. After completing the degree, they can further their academic studies and go into the research field or register with SAGC as a Technician or Surveyor in training and complete the period of articles as prescribed. This is a choice a student should be allowed to make once they have completed their degree.

> I have trained many students over a period of time and found that the practical experience at a learning institution was of minimal benefit. I believe that one needs a strongly enhanced theoretical knowledge prior to the exposure of practical applications. Should the student prove to be of a certain intellectual capacity the exposure to practical application in the final year of study or in the workplace thereafter will be best served. Kind of modelled on accountants, attorneys and medical doctors with 1 to 2 years articles in-house training. Practical survey competencies have, to some extent, been diluted by the advent of GPS. Theoretical understanding and a high level of computer literacy with professional software related to the survey/geomatics field play, in my opinion, a more enhanced role

> WIL is not lost but aligns with the BSC articles as a requirement for registration. Therefore, registration with SAGC will show competency, not the Degree or Diploma. The current students

entering the workplace to undertake WIL cannot apply the theoretical knowledge to the work place. So undertaking training past qualification will not change the status. WIL and articles just makes a person technically competent, professionalism comes with working post registration next to another professional, and not while being taught as a student. I think the removal of WIL outside the qualification is a good thing for the following reasons: 1) It give the institution the ability to include instruction on the changing technology and the theory behind it - removing the WIL allows more time for this training 2) Articles now makes it a necessity for registration and the proof of competency - more weighting will now be placed on registration

4.4 Factor analysis: Employer survey

Factor analysis was also applied to the following items to determine if there are any underlying latent factors with which clusters of items are correlated. According to Costello and Osborne (2005), using an orthogonal rotation such as varimax results in a loss of valuable information if the factors are correlated. As a result, an oblique rotation such as the promax rotation should theoretically render a more accurate, and perhaps more reproducible solution.

Factor analysis with promax rotation was applied to 19 Likert scale items. The Kaiser-Meyer-Olkin (KMO) value of 0.872 and the significant Bartlett's test of sphericity indicate that successful factor extraction took place. Three factors were extracted which account for 65.96% of the variance in the data; and rotation converged in four iterations. Along the way four items were removed because they did not load strongly onto any axis.

The factor loadings for the three factors are found in Table 4.19 below.

Table 4.19: Factor analysis loadings (industry)

Item	***Factor***		
	1	***2***	***3***
D25: The exclusion of WIL/workplace learning in the geomatics degree will impact on the student's employability and entrepreneurial and innovative attributes, which may negatively influence the production of entrepreneurs and SMMEs.	0.865		
D20: The absence of WIL/workplace learning in the geomatics degree may in time create a vacuum of knowledgeable, skilled, experienced, competent and accountable technicians and technologists in industry.	0.844		
D24: WIL may be relevant in order to: develop responsible, productive and accountable graduates, enhance theoretical knowledge and practical skills acquisition, effect knowledge and skills transfer, increase work readiness and student competence for the competitive work sector.	0.837		

D30: The absence of WIL/workplace learning may have a possible indirect impact on the workflow and productivity levels of professional practitioners and organisations that appoint technicians/technologists.	0.835		
D18: The absence of WIL in the geomatics degree may have a significant impact on the type and quality of graduate entering the work sector.	0.819		
D21: The exclusion of WIL/workplace learning in the geomatics degree, may disadvantage students in terms of their personal growth and professional development; and may negatively impact on the employability skills, graduate attributes, job prospects etc. of the graduates.	0.780		
D22: The exclusion of WIL in the geomatics degree may disrupt the student's ability to link and integrate theoretical knowledge with professional practice-based knowledge gained through workplace learning.	0.771		
D27: The exclusion of WIL/workplace learning in the geomatics degree may possibly contribute to an unexpected and indirect increase in the unemployment rate amongst university graduates.	0.769		
D19: The new geomatics graduate may be perceived as one with possibly diminished practical kills/technical expertise and lacking essential knowledge and capability necessary for the execution of surveying/geomatics field operations.	0.654		
***D17R:** The exclusion of WIL/workplace learning in the geomatics degree is not a major concern and may not affect the student's employability as graduates will have to obtain post qualification work experience.	0.620		
D33: Problem based learning (PBL) through work simulation encompassing industry-oriented problem-based activities to enhance critical thinking skills and problem-solving abilities, should be considered as a possible alternative to workplace learning to prepare students for the WOW.		0.907	
D34: Project based learning (PJBL) through a university-industry collaborative initiative encompassing real-world projects in an industry controlled setting, should be considered as a possible alternative to workplace learning to prepare students for the WOW.		0.807	
D32: The establishment of a geomatics practical survey camp through a university-industry collaborative partnership to enhance student's practical & technical proficiencies should be considered in the absence of workplace learning and in preparation for the WOW.		0.691	
D39: As an employer, I support the professional development of geomatics graduates and am prepared to educate, train, or supervise students/graduates through a formal work-based programme such as an internship or learnership e.g. SETAs or, National Skills Fund initiatives.			0.980
D40: As an employer, I support the professional development of geomatics graduates and am prepared to educate, train, or supervise students/graduates on a formal contract appointment basis, through minimal investment of time, financial and human resources.			0.845

* indicates reverse coding was applied

Reliability of each factor was measured using Cronbach's alpha. An alpha value that exceeds 0.7 indicates that a composite measure formed by calculating the average of the items in a single factor is reliable. These are summarised in Table 4.20.

Table 4.20: Summary of factors (Industry)

Factor	***Construct***	***Label***	***Items included***	***Variance extracted***	***Cronbach's alpha***
1	Impact of excluding WIL	IEWIL	17*– 22; 24 – 25; 27; 30	42.21	0.937
2	Alternate WIL	AWIL	32 – 34	12.78	0.838

3	WIL support	SUPP	39 – 40	11.47	0.907

A one sample t-test was performed on the composite variables and is summarised in Table 4.21 below.

Table 4.21: Composite measures (Industry)

Item	***n***	***Mean (SD)***	***t***	***df***	***P-value***
Impact of excluding WIL	124	**4.0290** (0.72826)	15.734	123	<.001*
Alternate WIL	124	**3.8387** (0.89107)	10.481	123	<.001*
WIL support	124	**3.9839** (0.75959)	14.424	123	<.001*

* indicates significance at the 95% level

The above data reaffirms earlier findings. There is significant agreement that the exclusion of WIL will negatively impact on the students and industry sector. There is significant consensus that alternative forms of WIL should be considered. There is also significant agreement and support for work-based programmes.

4.5 Data analysis and interpretation: Student survey

Part A – Informed consent:

Question A1: All respondents consented to participate in the study (100%).

Part B – General:

Questions B2: All respondents confirmed that they were either a currently registered student at DUT or have been a registered student at DUT, studying the BBE: geomatics qualification (100%).

Question B3: This question utilised the nominal scale to establish the academic level categories of the geomatic students. The frequency and corresponding percentage figures are presented in the bar graph below (Figure 4.18).

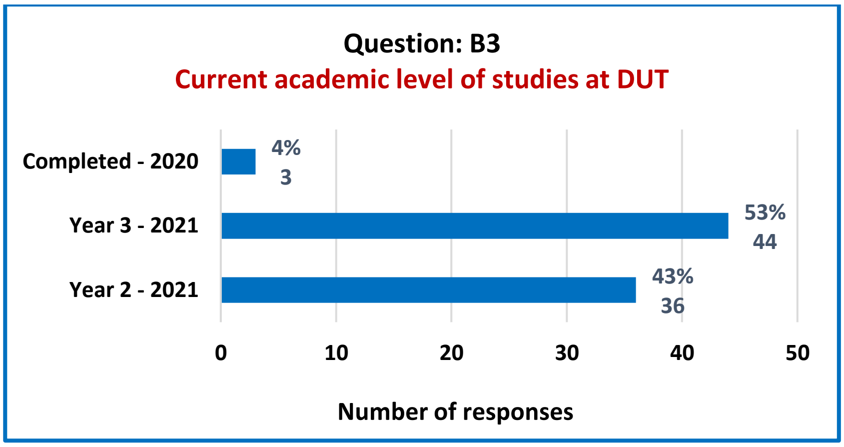

Figure 4.18: Current academic level of studies at DUT

Part C – Work integrated learning (BBE: Geomatics):

Question C4: The nominal scale was used here to determine the level of general understanding the students had regarding WIL and workplace learning. It was analysed using the chi-square goodness of fit test to establish if any response options are selected significantly more than the others.

Table 4.22: Students understanding of WIL

Item	*Responses as Frequency (%)*			X^2	*df*	*P-value*
C4: *Select the option below that confirms and best describes your level of general understanding on the educational practices of WIL / Workplace learning and Experiential learning.*	**Good understanding**	**Fair / moderate understanding**	**Basic understanding**			
	30 (36.1%)	**39 (47.0%)**	14 (16.9%)	11.590	2	<.003*

* indicates significance at the 95% level

Table 4.22 above shows that all students understand the concept of WIL, with a significant number (83.1%) having at least a fair to good understanding of WIL.

Question C5 and C6: These two questions utilised the Nominal scale and was analysed using the 'Binomial test' to determine if a significant proportion responded with either *Yes* or *No* to the respective questions. This is indicated in Table 4.23 and Figure 4.19.

Table 4.23: Students awareness on the exclusion of WIL

Item	*Frequency (%)*		*N*	*P-value*
	Yes	*No*		
C: *Were you aware that the BBE: Geomatics qualification did not include a WIL/ Workplace learning component?*	47 (56.6%)	36 (43.4%)	83	<.272
C6: *Do you agree with the exclusion of WIL/ Workplace learning in the BBE: Geomatics qualification?*	30 (36.1%)	**53 (63.9%)**	83	<.015*

* indicates significance at the 95% level

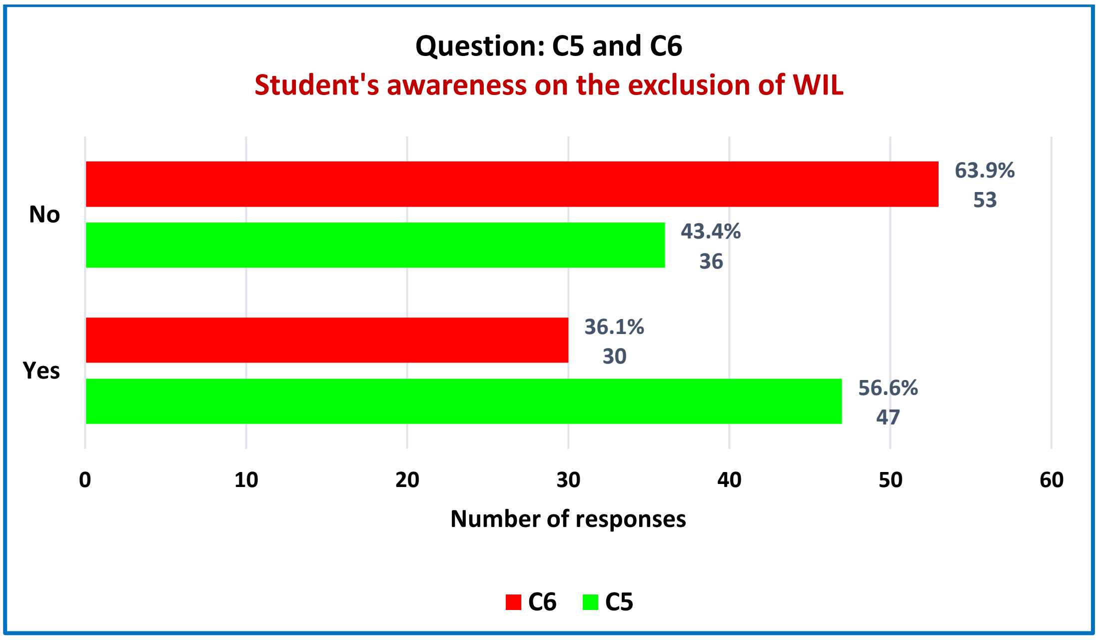

Figure 4.19: Students' awareness on the exclusion of WIL

More than half of the students (56.6%) were aware of the exclusion of WIL in the geomatics qualification. Further, a significant 63.9% did not agree with the exclusion of WIL. This is important as it reveals that students could possibly be in favour of a WIL component in the new qualification.

4.5.1 Theme 1: Impact of excluding WIL

Question C7, C10, C11, C12, C14: These five questions were grouped into Theme 1 as this then specifically addresses Objectives 2 and 4 of the study from a student perspective. The questions evaluate the impact of excluding WIL from the degree, and how this was perceived by one of the most important stakeholders, the students, in terms of the possible negative implications. All questions here utilised the Likert scale and the results reflecting the frequency, percentages and means are illustrated in Table 4.24 and the bar graph in Figure 4.20 below.

Table 4.24: Impact of excluding WIL (Student)

Item	*Responses as Frequency (%)*					*n*	*Mean (SD)*	*t*	*df*	*P-value*
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
C7: *The lack of WIL/Workplace learning in the Geomatics degree may be regarded as a valid concern as theoretical learning and campus survey practical's alone, may be insufficient for industry requirements and employment opportunities.*	2 (2.4%)	4 (4.8%)	8 (9.6%)	**27 (32.5%)**	**42 (50.6%)**	83	**4.24** (0.983)	11.505	82	<.001*
C10: *The absence of WIL in the Geomatics degree may have a significant impact on the type and quality of graduate entering the work sector.*	1 (1.2%)	4 (4.8%)	12 (14.5%)	**26 (31.3%)**	**40 (48.2%)**	83	**4.20** (0.947)	11.592	82	<.001*
C11: *The absence of WIL/Workplace learning in the Geomatics degree, may disadvantage students in terms of their personal & professional development, and may impact on job prospects and employment opportunities.*	2 (2.4%)	8 (9.6%)	12 (14.5%)	**30 (36.1%)**	**31 (37.3%)**	83	**3.96** (1.064)	8.250	82	<.001*
C12: *The exclusion of WIL/Workplace learning in the Geomatics degree may possibly contribute to an unexpected and indirect increase in the unemployment rate amongst university graduates.*		8 (9.6%)	13 (15.7%)	**31 (37.3%)**	**31 (37.3%)**	83	**4.02** (0.962)	9.694	82	<.001*

C14: *The exclusion of WIL in the Geomatics degree may disrupt the student's ability to link and integrate theoretical (classroom-based) knowledge with professional practice-based knowledge gained through Workplace learning.*	4 (4.8%)	6 (7.2%)	22 (26.5%)	**29 (34.9%)**	**22 (26.5%)**	83	**3.71** (1.088)	5.952	82	<.001*

* indicates significance at the 95% level

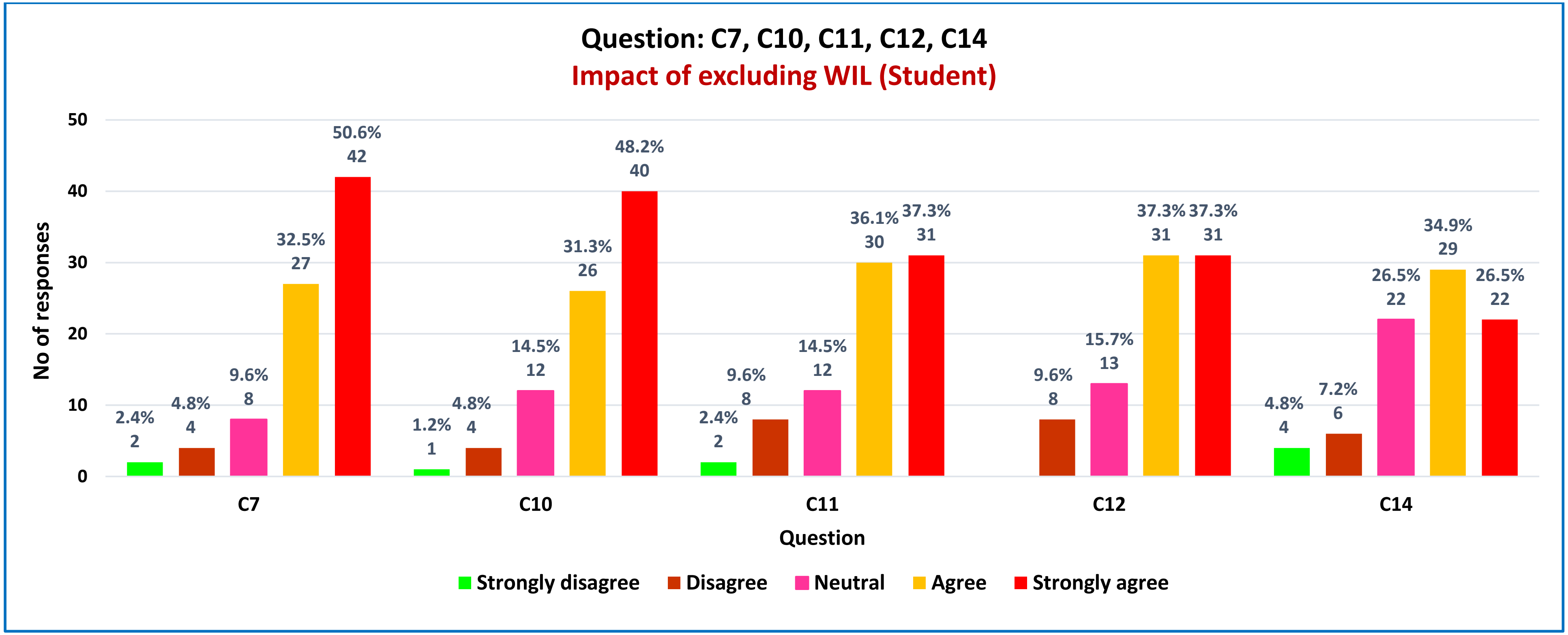

Figure 4.20: Impact of excluding WIL (Student)

It is evident from Table 4.24 that all mean values are > 3. The bar graph in Figure 4.20 further demonstrates that there is a significant agreement that the exclusion of WIL in the degree may have a detrimental impact on the student/graduate.

- A total of 83.1% of respondents were in agreement that the lack of WIL is a valid concern since theoretical learning and campus survey practicals alone may be insufficient for industry requirements and employment opportunities.
- A total of 79.5% were in agreement that the absence of WIL may have a significant impact on the type and quality of graduate entering the work sector.
- A total of 73.4% were in agreement that the absence of WIL may disadvantage students in terms of their personal and professional development, which could impact on job prospects and employment opportunities.
- A total of 74.6% were in agreement that the absence of WIL may possibly contribute to an unexpected and indirect increase in the unemployment rate amongst university graduates.
- A total of 61.4% were in agreement that the absence of WIL may disrupt the student's ability to link and integrate theoretical knowledge with professional practice-based knowledge gained through WPL.

The quantitative data above highlighting the aspect of employability is further supported by comments (qualitative) from the students regarding their views on job prospects and work placement. The comments are shown in the form of direct quotes below.

> Looking at the first batch of students that have graduated, not even one of them has placement in a job involving geomatics. The department should look into partnering with companies to assist newly graduates in getting jobs just like other departments at the institution.

> The workplace learning is a very important aspect that should be considered as one that would really help students concerning workplace and also it could help reduce the number of graduates that are unemployed, because after graduation with the lack of information regarding workplaces many graduates don't know what should be the next move.

Thus, Theme 1 fulfils Objectives 2 and 4 of the study.

Question C8 and C15: These two questions seek to establish whether the exclusion of WIL in the degree, is of negligible concern to the students in terms of confidence in their skills and capabilities, and employability prospects. The Likert scale was utilised and the results reflecting the frequency, percentages and means are illustrated in Table 4.25 below.

Table 4.25: Opposing views on WIL (Student)

Item	***Responses as Frequency (%)***					***n***	***Mean (SD)***	***t***	***df***	***P-value***
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
C8: *The exclusion of WIL/ workplace learning in the geomatics degree is not a critical concern and may not affect the student's employability as graduates will have to obtain post qualification work experience.*	**16 (19.3%)**	**26 (31.3%)**	16 (19.3%)	16 (19.3%)	9 (10.8%)	83	**2.71** (1.283)	-2.053	82	<.043*
C15: *As a student/graduate, I feel confident in my capability of adapting to the requirements and expectations of the industry environment, even without any WIL or workplace experience.*	5 (6.0)	26 (31.3%)	20 (24.1%)	19 (22.9%)	13 (15.7%)	83	3.11 (1.190)	0.830	82	<.409

Half of the students (50.6%) rejected the notion and disagreed that the exclusion of WIL was not of critical concern in affecting employability prospects, while a total of 30.1% agreed with the statement. Further, the matter of student confidence in adapting to the work environment without WIL was inconclusive, as students were equally divided on the subject, with a fair number 'on the fence' selecting 'neutral'.

4.5.2 Theme 2: Importance and relevance of WIL

Question C9, C13, C17, C18: These four questions were grouped into Theme 2 to evaluate the importance and relevance of WIL from a student perspective. The results are represented in separate tables and figures since two different question types were employed i.e., Likert scale and semantic differential scale.

Questions C9, C13, and C17 utilised the Likert scale and Question C18 the semantic differential 7-point rating scale. The results reflecting the frequency, percentage and mean are reflected in Table 4.26.

Table 4.26: Importance and relevance of WIL (Student)

Item	***Responses as Frequency (%)***					***n***	***Mean (SD)***	***t***	***df***	***P-value***
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
C9: *WIL/Workplace learning is regarded as an essential component of a professional career focused education and a means of obtaining 'real-world' practical skills and should be considered for introduction in the Geomatics degree.*			9 (10.8%)	**25 (30.1%)**	**49 (59.0%)**	83	**4.48** (0.687)	19.647	82	<.001*
C13: *WIL may be relevant in order to: develop responsible, productive & accountable graduates, increase work readiness & student competence, improve problem solving abilities, and enhance technical knowledge, skills and individual capabilities for the competitive work sector.*			13 (15.7%)	**29 (34.9%)**	**41 (49.4%)**	83	**4.34** (0.737)	16.529	82	<.001*
C17: *WIL/workplace learning may be beneficial to students in terms of improved academic performance, positive attitude, motivation, professionalism, work ethic and improved work-related capabilities, after exposure to the workplace.*		1 (1.2 %)	5 (6.0%)	**26 (31.3%)**	**51 (61.4%)**	83	**4.53** (0.669)	20.844	82	<.001*
C18: *Rate the level of importance/relevance you believe that WIL has in developing 'employability skills' such as: responsibility and reliability; professionalism; problem solving abilities; decision making; self-management; teamwork and collaboration; leadership; time management skills; communication skills; organisational skills; IT skills, application of modern tools and instrumentation; entrepreneurship etc.*						83	**6.17** (1.177)	16.783	82	<.001*

* indicates significance at the 95% level

Table 4.26 indicates that all mean values are > 3 for the Likert scale questions, while the semantic scale question (C18) produced a mean score of 6.17, since the majority of respondents indicated a score of between 5 and 7 on the scale, which all indicate substantial agreement. The bar graphs in Figure 4.21 and Figure 4.22 further confirm that there was significant consensus and acknowledgement from the students about the importance and relevance of WIL in terms of a professional career focused educational approach in developing responsible, productive, and accountable graduates for the evolving geomatics, engineering and built environment sectors.

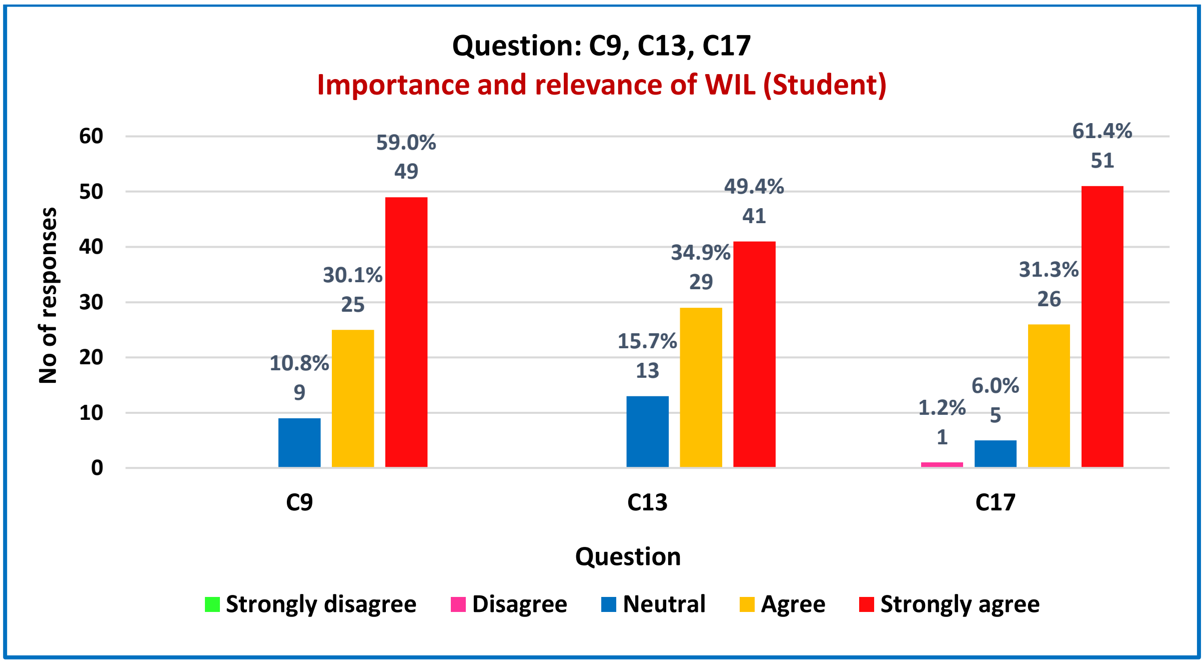

Figure 4.21: Importance and relevance of WIL (Student)

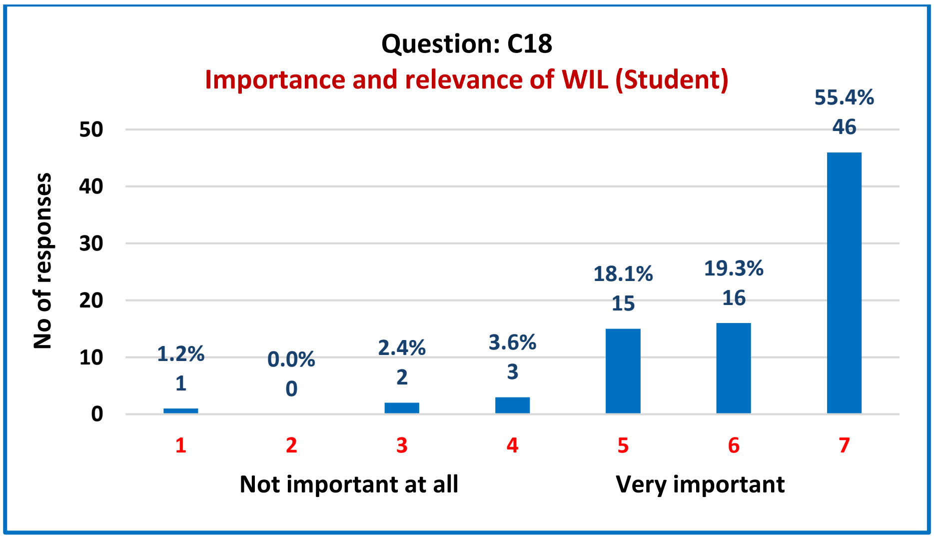

Figure 4.22: Importance and relevance of WIL (Student)

- A total of 89.1% of respondents agreed that WIL is an essential component of a professional career focused education and should be considered for introduction in the BBE: Geomatics degree.
- A total of 84.3% agreed that WIL may be relevant for the geomatics qualification in developing responsible, productive and accountable graduates with the necessary attributes, qualities, skills, and competencies required by the evolving labour market.
- An overwhelming total of 92.7% were in agreement that WIL may be beneficial to students in terms of improved academic performance, attitude and motivation to learn, professionalism, work ethic and improved work-related capabilities, after some exposure to the workplace.

The quantitative data is further validated by the students' comments (qualitative) enclosed in the form of direct quotes below, which reflect the student's perspective on the importance and relevance of WIL. Potential benefits of WIL noted by students include work experience, industry exposure, enhanced practicals, work readiness, career clarification, professional development, and improved employability prospects etc.

> Workplace integrated learning will be a solution to us. It is merely because it will make us experience fieldwork more than theory. We will reach the workplace company knowing what we are required to do.

> I think work integrated learning (WIL) is appropriate for geomatics as the results of good advantages which benefits each and every student. The knowledge outside the academic theory is needed before being exposed to the real world. To familiarise ourselves with industries as students is very important before we graduate.

> Work integrated learning will help increase interest in the course for students and help prepare them for real work.

> All I can say is that that the university should try by all means to bring back WIL because there is too much lacking for students when it comes to practicals.

> WIL is an exceptional concept and it will get better with time, and more practicality.

> Work integrated learning is an eye opening to students and can be essential to us as students, that exposure to the industry and combining both theory and practical work from the field can

be beneficial to students' academics. Not only academics but also in future profession. So it must be established.

WIL should be granted to us as students. We really need that experience to conquer our confidence.

The opportunity to work in a genuine business setting. ... Develop your sense and awareness of workplace culture. ... Enhance your soft skills and advance your theoretical knowledge. ... It can help you manage your future career aspirations and decisions.

WIL will at least give graduates a chance to find employment due to the industry exposed nature of the programme

The geomatics students in DUT are given sufficient knowledge by allowing students to undertake their practicals in groups. This is a good practice as it gives a student time to socialise and share their point of view. But I do not think this is sufficient because students has a lot in their minds as they make practicals for different subjects almost in the same time. It will be good if WIL is introduced for BBE: Geomatics as it will give graduates and students a solid understanding of one geomatics aspect at a single time

Thus, Theme 2 fulfils/reaffirms the broad aim of the study – To evaluate the importance/relevance of WIL in the Geomatics programme at the DUT.

Question C16: The Likert scale was utilised to establish if students believed that they were adequately prepared with an appropriate level of hands-on practical training and technical skills, achieved during practical sessions and demonstrations, to confidently venture out into the geomatics WOW. The results are shown graphically in the form of a pie chart in Figure 4.23 below.

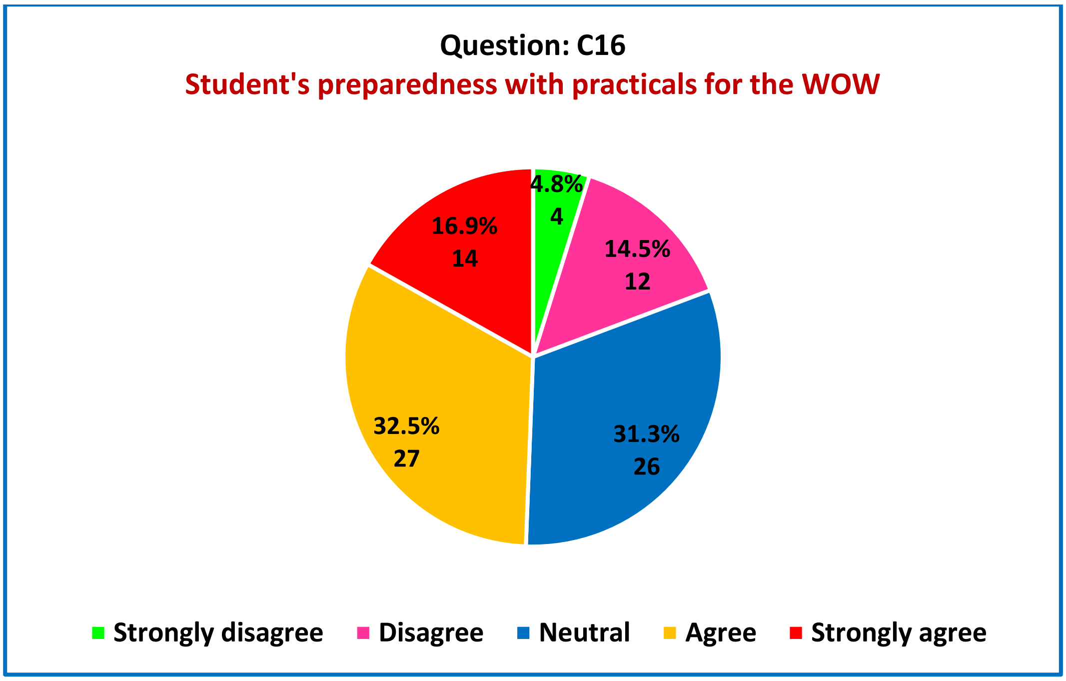

Figure 4.23: Student's preparedness with practicals for the WOW

A total of 49.4% of respondents believed that they were adequately prepared with hands-on practical training while a total of 19.3% shared the opposing view. 31.3% were uncertain and selected neutral.

Question C19: This question was to establish, from a student perspective, if greater emphasis on core academic knowledge in the geomatics curriculum to reinforce key fundamental concepts was preferred, over a period of workplace learning to better prepare and equip students/graduates for the labour sector. This question utilised the Likert scale and the results reflecting the frequency, percentage and mean are illustrated in Table 4.27 below.

Table 4.27: Focus on core academic knowledge (Student)

Item	***Responses as Frequency (%)***					***n***	***Mean (SD)***	***t***	***df***	***P-value***
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
C19: *A greater emphasis on core academic knowledge and theoretical content in the Geomatics curriculum is preferred over a period of actual workplace learning, to better prepare and equip students for the WOW.*	1 (1.2%)	10 (12.0%)	17 (20.5%)	**42 (50.6%)**	**13 (15.7%)**	83	**3.67** (0.925)	6.643	82	<.001*

* indicates significance at the 95% level

As can be seen in Table 4.27, the mean value is > 3. Further, a total of 66.3% agreed that greater emphasis on core academic and theoretical content in the geomatics curriculum is preferred over a period of actual WPL. Theme 2 confirmed that there is consensus from the students about the importance and relevance of WIL in making a positive impact on their professional development, however it is also apparent that they place some value on the core academic curriculum content in the production of a knowledgeable graduate.

4.5.3 Theme 3: Alternate forms of WIL

Question C20 to C23: These four questions were grouped into Theme 3 which explores the possible alternate options to actual workplace learning from a student perspective. All questions employed the Likert scale and the results reflecting the frequency, percentages and means are illustrated in Table 4.28 and Figure 4.24.

Table 4.28: Alternate forms of WIL (Student)

Item	*Responses as Frequency (%)*					*n*	*Mean (SD)*	*t*	*df*	*P-value*
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
C20: *The establishment of a Geomatics practical survey camp through a university- industry collaborative partnership to enhance student's practical & technical proficiencies should be considered in the absence of workplace learning and in preparation for the WOW.*		2 (2.4%)	14 (16.9%)	**26 (31.3%)**	**41 (49.4%)**	83	**4.28** (0.831)	14.001	82	<.001*
C21: *Problem based learning (PBL) through work simulation encompassing industry-oriented problem-based activities & tasks to enhance critical thinking skills and problem-solving abilities, should be considered as a possible alternative to workplace learning to prepare students for the WOW.*	2 (2.4%)	4 (4.8%)	9 (10.8%)	**46 (55.4%)**	**22 (26.5%)**	83	**3.99** (0.890)	10.110	82	<.001*
C22: *Project based learning (PJBL) through a university-industry collaborative initiative encompassing real-world projects in an industry controlled setting, should be considered as a possible alternative to workplace learning to prepare students for the WOW.*		4 (4.8%)	11 (13.3%)	**48 (57.8%)**	**20 (24.1%)**	83	**4.01** (0.757)	12.180	82	<.001*

C23: *The introduction of a Geomatics practical survey camp, PBL and PJBL may not produce the same level of desired impact and potential benefit compared to a period of actual structured and monitored professional practice industry workplace learning.*		3 (3.6%)	26 (31.3%)	**31 (37.3%)**	**23 (27.7%)**	83	**3.89** (0.856)	9.494	82	<.001*

* indicates significance at the 95% level

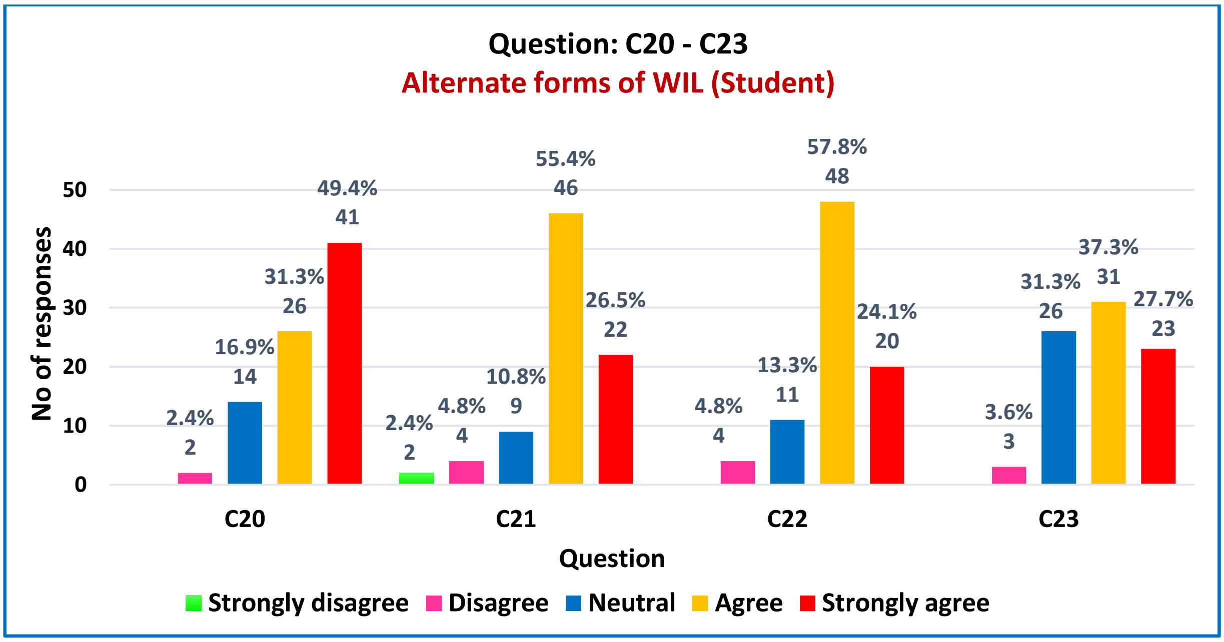

Figure 4.24: Alternate forms of WIL (Student)

- A total of 80.7% of respondents were in agreement that the establishment of a geomatics practical survey camp through a university-industry collaborative partnership could be considered in the absence of WPL and in preparation for the industry sector.
- A total of <u>81.9%</u> were in agreement that PBL through work simulation encompassing industry-oriented problem-based activities to enhance critical thinking skills and problem-solving abilities, could be considered as a possible alternative to WPL to prepare students for the work sector.
- A total of <u>81.9%</u> were in agreement that PJBL through a university-industry collaborative initiative encompassing real-world projects in an industry-

controlled setting, could be considered as a possible alternative to WPL to prepare students for the work sector.

- A total of 65% were in agreement that the introduction of a geomatics practical survey camp, PBL and PJBL may not produce the same level of desired impact and potential benefit compared to a period of actual structured and monitored professional practice industry WPL. While student respondents were fully supportive of the concept of alternate forms of WIL, it is evident that some do not believe that this will supersede actual WPL in a professional setting.

The quantitative data was complemented by a few of the students' comments (qualitative) enclosed in the form of direct quotes below, which support the view that alternate forms of WIL could be explored to enhance the effective acquisition of work experience. In the absence of WIL, students suggested an increase in practical and project work, the creation of a project-based module to mirror WIL industry practices, and conducting site visitations to gain industry exposure to real work practices.

> If the new BBE: Geomatics degree does not include WIL, the university or department should create a certain module each semester which is only project based where we learn more about the equipment used and we are exposed to different scenarios relating to the working world. This will mirror WIL in such that smaller parts are done each semester and by the end of the degree we would have had adequate understanding of equipment and the "know how" to go about conducting situations

> Since WIL is excluded in BBE Geomatics, there should be site visits where we will get an exposure.

> All practicals must be done by students, no simulation. This could make a balance. I have noticed that some of the companies have no idea of what are the geomatics graduates doing. So the institution must closely work with industries.

> More project work.

> More practice on how to actually setup and utilise surveying equipments such as the GPS based apparatus and the theodolite itself.

> I think practicals should be done more often so we can gain experience of what we should expect on the workplace.

Question C24 and C25: These two questions explore the possibility of incorporating WIL into the new degree from a student perspective. The nominal scale was used to determine what period of WIL would be appropriate and which year of study it should be placed in. It was analysed using the chi-square goodness of fit test to establish if any response options are selected significantly more than the others.

Table 4.29: Possibility of including WIL in the degree (Student)

Item	***Responses as Frequency (%)***				***X^2***	***df***	***P-value***
***C24:** If it is established that WIL should be included in the Geomatics degree, what period of workplace learning will be appropriate, considering that the essential theoretical & academic content must also be achieved as part of the new qualification?*	**3 Months**	**6 Months**	**9 Months**	**12 Months**			
	16 (19.3%)	**45** **(54.2%)**	5 (6.0%)	17 (20.5%)	42.060	3	<.001*
***C25:** If it is established that WIL should be included in the Geomatics degree, in what year of study should the workplace learning ideally take place?*	**Year 2 - semester 1**	**Year 2 - semester 2**	**Year 3 - semester 1**	**Year 3 - semester 2**			
	6 (7.2%)	11 (13.3%)	19 (22.9%)	**47** **(56.6%)**	48.422	3	<.001*

* indicates significance at the 95% level

Table 4.29 reveals that the majority (54.2%) opted for 6 months of industry practice. Furthermore, a substantial number of students (56.6%) believed that WIL should be administered in year 3 semester 2. Theme 2 has previously established that there was consensus from the majority of the students about the importance and relevance of WIL, hence the choice of a six-month period is perhaps an indication that students recognise that some minimal WIL experience may add value to their overall holistic development and increase employability prospects. The implementation of six months of WIL could be a realistic and achievable target but will require some brainstorming from educational committees and industry panels to find a best fit approach if implemented.

Question C26: This question sought to establish whether there should be increased engagement and collaboration between HEIs, the industry sector and relevant stakeholders from a student perspective. The Likert scale was utilised and the results reflecting the frequency, percentages and means are illustrated in Table 4.30 and Figure 4.25 below.

Table 4.30: Collaboration between all stakeholders (Student)

Item	*Responses as Frequency (%)*					*n*	*Mean (SD)*	*t*	*df*	*P-value*
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**					
C26 *There should be an increased engagement between the Universities, government, students, communities, professional bodies, and industry stakeholders from the public & private sectors to facilitate the professional development and career progression of students/graduates which is beneficial to civil society and the economy.*			5 (6.0%)	**33 (39.8%)**	**45 (54.2%)**	83	**4.48** (0.612)	22.057	82	<.001*

* indicates significance at the 95% level

Table 4.30 indicates a mean value = 4.48 which shows substantial agreement.

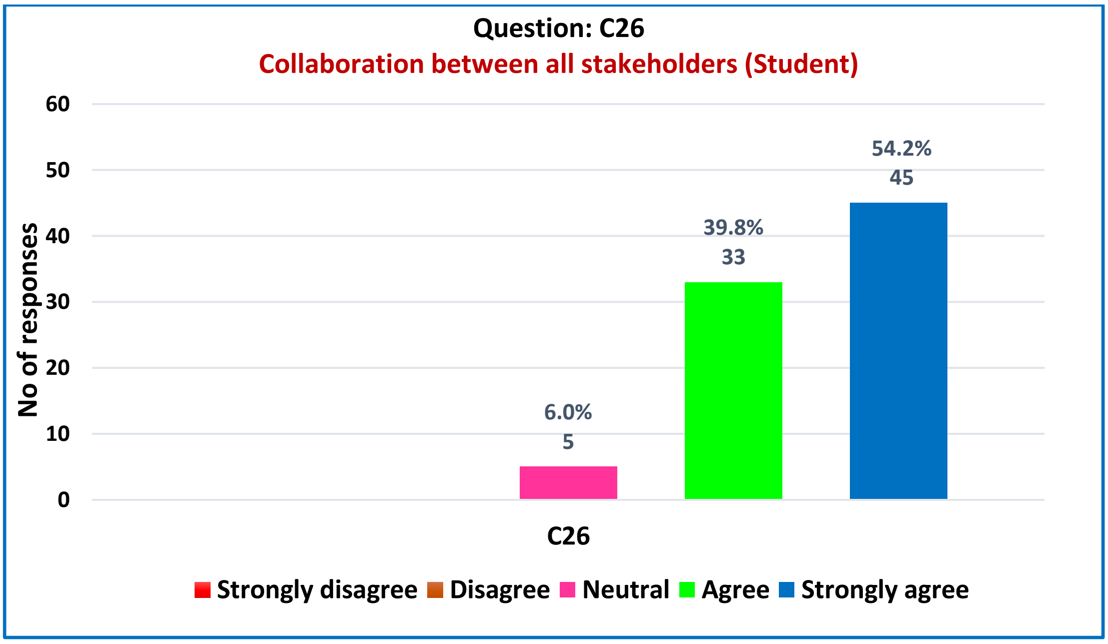

Figure 4.25: Collaboration between all stakeholders (Student)

The bar graph in Figure 4.25 further confirms that an overwhelming total of 94.0% of respondents were in strong agreement that there should be increased collaboration between all stakeholders and partners including universities, students, communities, public and private sectors, and professional bodies to facilitate the professional development and career progression of students/graduates.

The following direct quotes (qualitative) from students reveal their perspectives regarding the proposed increased engagement and collaboration between all role players. Some students believe that avenues of meaningful engagement and collaboration between all stakeholders from public and private sectors should be improved to revive the industry. Another recommended that guest lecturers be invited to share their professional experience and effect knowledge transfer. Site visitations to municipal offices was also proposed.

> Meaningful collaboration and engagement between the relevant stakeholders could be to the benefit of the students/graduates, especially during a pandemic where solutions are needed to revive the state of the industry

> We need an active interaction relationship between the University and the industry. Maybe private/ public companies or municipalities. Maybe include some guest lectures during the academic year where professionals will come share their experience in the industry. Frequent visits to the municipal office or industries will be a good benefit to the students.

Question C27: The aim of this question was to gauge the level of concern that student respondents had related to the effect of the Covid-19 pandemic on the economy in terms of the challenges it may present in securing employment upon graduation. This question utilised the semantic differential 7-point rating scale and the analysis produced a mean value of 6.17.

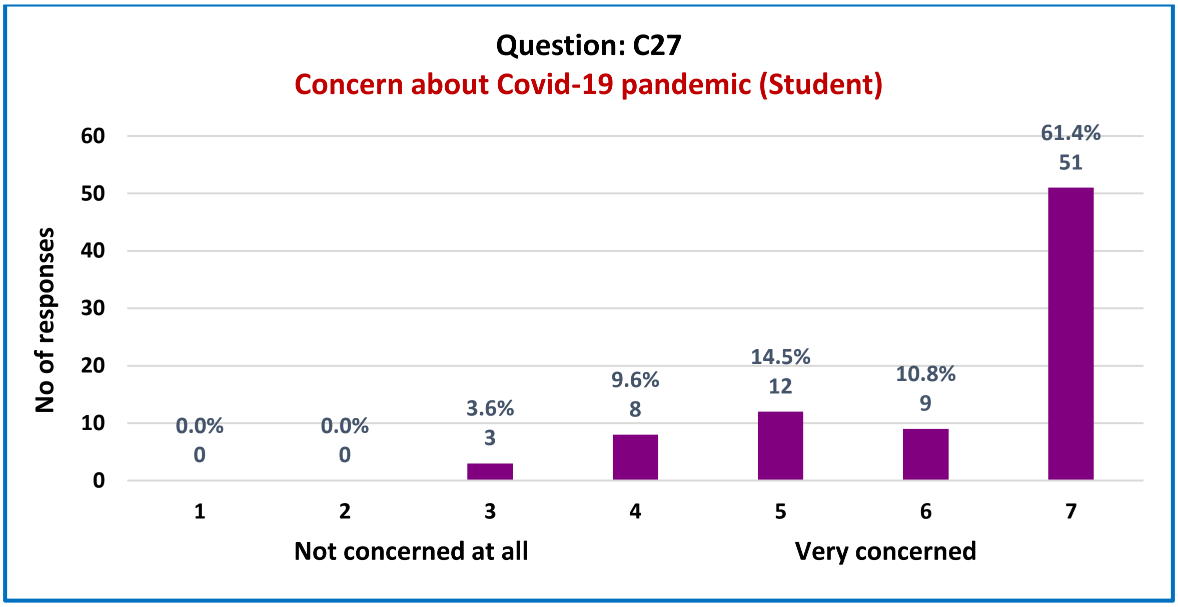

Figure 4.26: Concern about Covid-19 pandemic (Student)

The bar graph in Figure 4.26 indicates that the majority of respondents selected a score of between 5 and 7 making up a total of 86.7%, indicating a serious concern about the possible challenges the pandemic may present in securing suitable employment. This is a valid concern that requires higher education and government intervention to reassure the students that they can be marketable to the labour sector in securing gainful employment and becoming contributors to the national economy.

Question C28: This open-ended question was qualitative in nature. The responses were examined where common words and phrases were identified, analysed, and presented as direct quotes in the various themes to support and enhance the findings of the quantitative data where applicable.

4.6 Factor analysis: Student survey

Factor analysis was applied to the following items to determine if there are a number of underlying latent factors with which clusters of items are correlated.

Factor analysis with promax rotation was applied to 17 Likert scale items. The Kaiser-Meyer-Olkin (KMO) value of 0.740 and the significant Bartlett's test of sphericity indicate that successful factor extraction took place. Three factors were extracted which account for 46.44% of the variance in the data; and rotation converged in six iterations. Along the way three items were removed because they did not load strongly onto any axis.

The factor loadings for the three factors are found in Table 4.31 below.

Table 4.31: Factor analysis loadings (Student)

Item	***Factor***		
	1	***2***	***3***
C12: The exclusion of WIL/workplace learning in the geomatics degree may possibly contribute to an unexpected and indirect increase in the unemployment rate amongst university graduates.	0.757		
C9: WIL/Workplace learning is regarded as an essential component of a professional career focused education and a means of obtaining 'real-world' practical skills and should be considered for introduction in the geomatics degree.	0.674		
C10: The absence of WIL in the geomatics degree may have a significant impact on the type and quality of graduate entering the work sector.	0.648		
C17: WIL/workplace learning may be beneficial to students in terms of improved academic performance, positive attitude, motivation, professionalism, work ethic and improved work-related capabilities, after exposure to the workplace.	0.629		
C11: The absence of WIL/workplace learning in the geomatics degree, may disadvantage students in terms of their personal and professional development, and may impact on job prospects and employment opportunities.	0.616		
C7: The lack of WIL/workplace learning in the geomatics degree may be regarded as a valid concern as theoretical learning and campus survey practical's alone, may be insufficient for industry requirements and employment opportunities.	0.565		
C26: There should be an increased engagement between the universities, government, students, communities, professional bodies, and industry stakeholders from the public and private sectors to facilitate the professional development and career progression of students/graduates which is beneficial to civil society and the economy.	0.535		
C13: WIL may be relevant in order to: develop responsible, productive and accountable graduates, increase work readiness and student competence, improve problem solving abilities, and enhance technical knowledge, skills and individual capabilities for the competitive work sector**.**	0.529		
C16: As a student / graduate, I believe that we are adequately prepared with an appropriate level of hands-on practical training and technical skills, achieved during on-campus Survey practical sessions and demonstrations, to confidently venture out into WOW.		0.822	
C15: As a student/graduate, I feel confident in my capability of adapting to the requirements and expectations of the industry environment, even without any WIL or workplace experience.		0.786	
C19: A greater emphasis on core academic knowledge and theoretical content in the geomatics curriculum is preferred over a period of actual workplace learning, to better prepare and equip students for the WOW.		0.457	
C8: The exclusion of WIL/Workplace learning in the geomatics degree is not a critical concern and may not affect the student's employability as graduates will have to obtain post qualification work experience.		0.442	
C21: Problem based learning (PBL) through work simulation encompassing industry-oriented problem-based activities to enhance critical thinking skills and problem-solving abilities, should be considered as a possible alternative to workplace learning to prepare students for the WOW.			0.766
C22: Project based learning (PJBL) through a university-industry collaborative initiative encompassing real-world projects in an industry controlled setting, should be considered as a possible alternative to workplace learning to prepare students for the WOW.			0.744

* indicates reverse coding was applied

Reliability of each factor was measured using Cronbach's alpha. An alpha value that exceeds 0.7 indicates that a composite measure formed by calculating the average of the items in a single factor is reliable. These are summarised in Table 4.32.

Table 4.32: Summary of factors (Student)

Factor	*Construct*	*Label*	*Items included*	*Variance extracted*	*Cronbach's alpha*
1	Impact of WIL	IMPWIL	7; 9 – 13; 17; 26	24.92	0.824
2	Opposing views on WIL	OPWIL	8; 15; 16; 19	15.26	0.734
3	Alternate WIL	AWIL	21; 22	6.26	0.783

A one sample t-test was performed on the composite variables and is summarised in Table 4.33 below.

Table 4.33: Composite measures (Student)

Item	*n*	*Mean (SD)*	*t*	*df*	*P-value*
Impact of WIL	83	**4.2831** (0.56817)	20.574	82	<.001*
Opposing views on WIL	83	**3.2289** (0.84121)	2.479	82	<.015
Alternate WIL	83	**4.0000** (0.74898)	12.164	82	<.001*

* indicates significance at the 95% level

The above data confirms earlier findings. There is significant consensus and acknowledgement from the student respondents about the impact/importance of WIL. There is some agreement that students believe they are adequately prepared with practical training. There is significant consensus that alternative forms of WIL should be considered.

4.7 Summary of findings and discussion of results

Comprehensive data analysis has addressed and fulfilled the aim of the study and the key objectives through the use of applicable themes/categories. Below is a summary of the findings.

At the outset it was established that a substantial majority disagreed with the exclusion of WIL in the degree with both employers (86%) and students (64%) not in favour of this decision. The results showed that 61% of the practitioners disagreed with the perception that the exclusion of WIL will have a negligible or minimal impact on industry, while 75% disagreed that the exclusion of WIL was not considered as a major concern. This is important as it revealed that employers and students may be in support of a WIL component and possible introduction in the new qualification.

4.7.1 Impact of ET in the Diploma

In this theme of the study, it was established that EL had a substantial positive and meaningful impact on the professional development of the Diploma student/graduate with 61% in agreement that graduates were adequately prepared for the WOW. It was further determined that over 74% believed that the Diploma graduate was adequately equipped with an appropriate level of academic knowledge and practical skill to cope in an industry environment. Additionally, the employer data revealed that the majority agreed with the perspective that EL contributed significantly in many facets of the student's professional development throughout their training, particularly in developing key attributes and competencies and refining employability and work readiness skills necessary for the labour market as evident in the mean values which were all > 6 on the 7-point semantic scale.

Students' personal skills and performance appraisals indicated mostly satisfactory to good scores which highlighted the student's capabilities and progression over the period of ET. The early industry exposure would have improved their prospects of employment upon graduation, as practitioners indicated they were more likely to recruit graduates with some prior work experience. In fact, responsible, diligent, and motivated students who have performed well and demonstrated potential and productivity are often recruited by the companies where they were based for WIL upon graduation, as they had proven the necessary proficiencies valued by the work sector. This is confirmed by Ferns, Campbell and Zegwaard (2014) who stated that having WIL students placed within the organisation was well recognised by companies as a means of recruiting new graduates prior to graduation. Borg, Turner and Scott-Young

(2017) further stated that the degree to which graduates are ‘work ready’ is seen as indicative of their potential in terms of work performance and career progression, maintaining that a work ready graduate is recognised as one that is equipped with the requisite knowledge, skills and expertise to make a smooth and successful transition into the workforce, and is therefore capable of making a positive contribution to their new organization or employer.

4.7.2 Impact of excluding WIL

This theme reveals the potential impact of excluding WIL from the geomatics programme, both from an employer and student perspective. From an employer perspective, it was established that that there was significant consensus that the exclusion of WIL will have a detrimental impact on the student/graduate and the industry sector.

The results revealed that 89% of respondents were in agreement that the absence of WIL may have a significant impact on the type and quality of graduate, and they may be perceived as lacking sufficient practical knowledge, skills and technical expertise to cope with the industry expectations. It was also apparent that 76% agreed that the absence of WIL may create a vacuum of knowledgeable, skilled, competent, and accountable technicians/technologists affecting productivity, workflow, and economic growth. Further, it was determined that 86% were in agreement that the exclusion of WIL may disadvantage students in terms of their personal growth and professional development; and negatively impact on their employability skills, graduate attributes, job prospects and career opportunities. In addition, 89% agreed that the exclusion of WIL may disrupt students' ability to link and integrate theoretical knowledge with professional practice-based knowledge while 79% agreed that it may impact on students' employability and entrepreneurial and innovative attributes. Data also indicated that 76% agreed that the exclusion of WIL may contribute to an unexpected and indirect increase in the unemployment rate amongst graduates, while 79% agreed that it may have an indirect impact on the workflow and productivity levels of professional practitioners who depend on technicians/technologists for the execution of field operations and facilitating deliverables. It is apparent that there are many notable negative outcomes that are likely to emanate from the exclusion of WIL. In contrast, some beneficial impacts of including WIL in an academic programme have been reaffirmed by Smith, Ferns and Russell (2014) who stated that the Organisation for Economic Co-operation and Development Centre for Educational Research and Innovation viewed WIL as a mechanism for linking the theoretical and practical components of professional knowledge producing a well-rounded employee with the aptitude to apply knowledge and skills in a range of various contexts. They further elaborated that including WIL in the curriculum was critical to universities developing work-ready graduates, thereby addressing the skills deficit and contributing to strong economic growth and sustainability. Jackson (2013) further highlighted that

> WIL has attracted considerable attention as an instrument for enhancing professional practice and developing work-readiness in new graduates and was widely considered as a point of difference in developing graduate employability by enhancing skill outcomes, such as team-work, communication, self-management and problem solving, employment prospects and student understanding of the WOW.

Meanwhile, Dressler and Keeling (2004, cited in Jackson 2013) established that students who have engaged in WIL, have more favourable outcomes in securing employment, career advancement, and remuneration.

From a student perspective, it was also established that that there was substantial agreement that the exclusion of WIL may have a negative impact on the student/graduate. Student data revealed that 83% of respondents were in agreement that the lack of WIL was considered to be a valid concern since theoretical learning and campus survey practicals alone may be insufficient for industry requirements and employment opportunities. The results also indicated that 80% were in agreement that the absence of WIL would have a significant impact on the type and quality of graduate. Furthermore, 73% agreed that the absence of WIL may disadvantage students in terms of their personal and professional development, which could impact on job prospects and employment opportunities, while 75% agreed that it may possibly contribute to an unexpected and indirect increase in the unemployment rate amongst university graduates. In addition, 61% agreed that the lack of WIL may disrupt the students' ability to link and integrate theoretical knowledge with professional practice-based knowledge.

4.7.3 Importance and relevance of WIL

This theme evaluated the importance and relevance of WIL which is the broad aim of the study both from an employer and student perspective. From the employer perspective, it was established that that there was significant consensus regarding the importance and relevance of WIL in delivering a professional career focused educational approach that can facilitate the development of responsible, productive, competent, and accountable graduates for the evolving geomatics, engineering and built environment sectors.

The results revealed that 88% of respondents were in firm agreement that WIL is relevant for the geomatics qualification in developing graduates with the necessary attributes, qualities, skills, and proficiencies required by the competitive labour market. Furthermore, the data indicated that the majority agreed with the perspective on the importance and relevance of WIL as an essential component for a modern-day geomatics graduate in terms of its contribution to the many aspects of the students' professional development, including developing key employability skills, graduate attributes, competencies, productivity, and work readiness skills for the evolving labour market, as evident in the mean values which were all > 5.8 on the 7-point semantic scale. This is consistent with Rowe and Zegwaard (2017) who state that WIL improves students' employability outcomes in various ways: firstly, by providing opportunities for students to increase their level of confidence in professional practice and developing a deeper appreciation of the value and importance of employability skills; and, secondly through the development of skills such as teamwork, professional judgement, communication, and problem-solving. Further evidence demonstrates that WIL can improve student work readiness and development of generic and professional skills, prepare students for transition into the workforce, encourage higher earning potential/employment rates, contribute to career advancement, and aid in the formation of a professional identity.

From a student perspective, it was apparent that there was significant consensus and acknowledgement from the students about the importance and relevance of WIL in producing a well-rounded graduate for the industry sector.

The results indicated that 89% of student respondents were in firm agreement that WIL is an essential component of a professional career-focused education and should be considered for introduction in the geomatics degree. Further, 84% agreed that WIL is relevant for the geomatics qualification in developing responsible, productive and accountable graduates with the necessary attributes, skills, and competencies required by the evolving labour market. An overwhelming 93% were in agreement that WIL may be beneficial to students in terms of improved academic performance, attitude and motivation to learn, professionalism, work ethic and improved work-related capabilities. Additionally, the student data revealed a mean score of 6.2 on the 7-point semantic scale relating to the level of importance and relevance that WIL has in developing various employability skills, again showing substantial agreement. As Martin and Rees (2018) explain, the

> WIL experience can be more than just increasing graduate attributes and employability, adding that these WIL experiences challenge students to push their comfort zones, developing greater personal self-awareness and enhanced professional career readiness by engaging in a wide range of activities.

They noted that students described developing a comprehensive range of skills and work experiences and learning outcomes that better prepared them for employment following graduation. Edwards *et al*. (2015) state that it is critical to ensure that universities provide graduates with capabilities that not only meet employer expectations, but also enable a smooth and effective transition into the workforce for maximum productivity. “In the case of STEM, an area at the forefront of innovation, this need is arguably even more profound if the future workforce is to be at the forefront of scientific knowledge and expertise” (Edwards *et al.* 2015).

4.7.4 Alternate forms of WIL

This theme explored the possible alternate options to WPL, to enhance the effective acquisition of work experience both from an employer and student perspective.

From the employer perspective, it was established that there was significant agreement that alternate forms of WIL should be explored further. The results indicated that 77% agreed that the establishment of a survey camp through a university-industry collaborative partnership could be considered in the absence of WPL and in preparation for working in the industry sector. Furthermore, it was determined that 60% were in agreement that PBL through work simulation encompassing industry-oriented problem-based activities to enhance critical thinking skills and problem-solving abilities could be considered as a possible alternative to WPL, although 24% were not fully convinced of this and were on the fence, indicating 'neutral'. Winberg *et al*. (2011) commented that in order to be successful, PBL challenges students to be active learners, accountable for their own learning, and to be able to efficiently and effectively manage their time as in self-directed learning. Additionally, the data revealed that 73% agreed that PJBL through a university-industry collaborative initiative encompassing real-world projects in an industry-controlled setting could be considered as a possible alternative. Industry members appear to prefer this option more, perhaps because of the emphasis on the use of 'real-world' projects in an authentic work environment to adequately prepare students. According to PBLWorks (2021),

> PJBL enables students to develop deep content knowledge including skills such as critical thinking, collaboration, creativity, and communication, which has been known to release a creative energy among students and teachers, leading to increased student engagement and improved learning outcomes for all.

Further, some HEIs are exploring creative ways of incorporating the trusted traditional WIL workplace practice into a more structured curriculum format, by investigating the option of WIL simulation to satisfy concerns about the lack of sufficient industry practice and work preparedness of the graduates. Simulated workplace environments, according to Edwards *et al.* (2015, cited in Sachs, Rowe and Wilson 2016), are intended to mimic authentic workplaces in terms of function, equipment, and mode of operation, allowing students to participate in, and experience, a range of scenarios and interconnected activities on or off campus. Simulations can be utilised for a variety of purposes, including preparing learners for professional contexts, developing and applying professional and occupational skills, and increasing student motivation and enhancing self-efficacy (Sachs, Rowe and Wilson 2016).

However, it was noted that while industry appears to be supportive of the concept on alternate diverse forms of WIL, in their view this will not supersede actual WPL, as the results revealed that 82% concurred that the introduction of a survey camp, PBL and PJBL may not produce the same level of desired impact and potential benefit compared to a period of actual structured and monitored professional practice WPL. It was concluded by Smith, Ferns and Russell (2014) in a study to determine the impact of WIL on the development of employability capabilities of students, that work placements have continually made a distinctive contribution to the development of employability skills, noting that the higher the quality of the placement, the greater the benefits for students. Simulation did, however, contribute to the development of employability capabilities, but not to the same extent or level of consistency as placement across the various aspects of employability.

The student perspective also revealed that there was significant agreement that alternate forms of WIL should be explored further. The data indicated that 81% agreed that the establishment of a survey camp through a university-industry collaborative partnership could be considered in the absence of WPL and in preparation for the industry sector. Furthermore, it was determined that 82% were in agreement that PBL through work simulation encompassing industry-oriented problem-based activities; and PJBL through a university-industry collaborative initiative encompassing real-world projects in an industry-controlled setting, could both be considered as possible alternatives to WPL to prepare students for the work sector. However, it was noted that while the majority are fully supportive of the concept on alternate diverse forms of WIL, it is evident that some students do not believe that this will supersede actual WPL in a professional setting, as the results indicated that 65% agreed that the introduction of a survey camp, PBL and PJBL may not produce the same level of desired outcome and potential benefit compared to a period of actual structured and monitored professional practice WPL.

4.7.5 WIL industry support and collaboration

This theme evaluated industry's support and commitment to recruiting and providing quality training and work experience for students/graduates, as well as proposed increased engagement, and collaboration efforts.

It was determined that 68% of respondents would most likely provide WIL opportunities for students seeking industry exposure for SAGC registration or work experience purposes, which is an encouraging sign of commitment from industry employers amidst the challenging economic times. The data further illustrated that there was substantial consensus around the industry's support and commitment to providing WIL opportunities to facilitate the professional development of students/graduates either through a formal work-based programme or formal contractual based means, with 79% in support of a formal work-based programme such as an internship or learnership (SETAs or National Skills Fund initiatives); while 76% were in support of a formal employment or contract appointment basis.

Additionally, the data revealed that the majority are keen to accommodate between 1 and 3 students in a 3 to 12 months training period either through a formal work-based programme (63%) or a formal employment/contract appointment basis (68%). The 1 to 3 range appears to be a reasonable commitment since most survey practices are small business operations with limited financial and human resources, with the Covid-19 pandemic also negatively impacting on business operations for many SMMEs and the labour market in general. Nevertheless, the commitment to recruit and train students is commendable as it paints an encouraging picture in terms of knowledge and skills acquisition for the next generation of geomatics practitioners.

The question of whether there should be increased engagement and collaboration between HEIs, the industry sector and relevant partners and stakeholders, received unanimous consensus from both employers and students with an overwhelming 93%

of employers and 94% of students in firm agreement that avenues of engagement should be increased between universities, students, communities, public and private sectors, and professional bodies to facilitate the professional development and career advancement of students/graduates to promote a knowledge-driven economy and for societal impact. Smith, Ferns and Russell (2014) identified that stakeholders such as government, business, industry, community, and education providers acknowledged the significance of WIL as a mechanism for developing employability skills in students, and as an investment in the future human capital of society. They emphasised that mutually beneficial partnerships between tertiary institutions, industry and community organisations are integral to successful and transformational WIL initiatives. According to Govender and Wait (2017), WIL promotes partnerships with business, industry and government to stimulate and improve national economic growth. Ferns, Campbell and Zegwaard (2014) further elaborate that

> partnerships with industry, and community engagement, are key to executing an authentic and inclusive learning experience adding that the full benefits of WIL are only realised when the experiences are connected to a real world context through dynamic and flexible partnerships with external organisations emphasising that such an approach facilitates academic integrity, industry credibility, and assurance of graduates with transferable skills across different contexts.

When employers were asked about the possibility of incorporating WIL into the degree, 40% indicated that they preferred 6 months of industry practice while 44% opted for 12 months, with the majority selecting year 3 in which it should be administered. Student data revealed that 54% opted for 6 months of industry practice, also in the final year of study. Historically WIL has been ‘sandwiched’ in the second year of the Diploma programme. Incorporating six months of WIL in the degree appears to be a realistic and achievable target but will require careful improvisation in prioritising curriculum content and balancing WIL practices to provide a valuable holistic learning experience for the student and mutually beneficial collaborations with industry partners and stakeholders.

4.7.6 Industry challenges and concerns about WIL

This theme briefly highlights some of the challenges and concerns that industry practitioners have with regard to the implementation of WIL which include financial and economic reasons, student's salary expectation, limited opportunities, and work readiness for industry. These are valid concerns that with robust engagement and collaboration between all relevant parties can be appropriately addressed via educational and industry forums.

Concerns regarding the impact of the Covid-19 pandemic on the economy and the implications it may have on the development and recruitment of capable, knowledgeable, skilled, and competent graduates, revealed that 81% of employers expressed significant concern. This should be viewed as a valid concern and prompt university and quality assurance bodies to engage and reassure the various industry sectors, stakeholders, and professional bodies that the calibre of graduate will not be compromised. Students' concerns regarding the impact of the Covid-19 on the economy revolved around the many challenges it presents in securing employment upon graduation, with 87% expressing concern. This again is a legitimate concern that requires higher education and government intervention to reassure students that they can become more marketable to the labour sector in terms of key attributes, employability skills, and proficiencies required for securing lucrative employment and becoming contributors to the national economy, as well as responsible and productive members of society, as the country strives to revive the economy in the aftermath of Covid.

4.7.7 Other proposals on WIL

This theme focused on some of the alternate proposals on WIL as expressed by a few employers. It was determined that a minority of 14% agreed with the exclusion of WIL. One suggested a more theoretical approach to enhance the student's understanding prior to practicals, with a focus on computer literacy and specialised survey/geomatics software as they found practical experience at a learning institution to be of minimal benefit. It is evident from supporting literature that in order for theoretical knowledge to be understood, appreciated and beneficial to the learner, WIL is considered as an integral component to derive the full educational value of the learning experience and connect both elements. Winberg *et al*. (2011) stated that programmes of study that incorporate WIL provides opportunities for learners to prepare for, and learn from the workplace, to transfer discipline-based theory and a range of skills acquired in their formal education to an authentic context such as a professional work setting.

Another employer suggested a period of 'articles' as a means of preparation for the work sector and stated that the removal of WIL, will allow more attention to theory in the context of changing technology. Nevertheless, it should be noted that articles differ significantly from WIL, as the former is conducted post qualification with the primary intention of facilitating professional registration with the statutory body (SAGC) while acquiring the relevant compulsory work experience under the supervision of an experienced practicing professional practitioner approved by the council. Articles are a stipulated requirement of the SAGC for land surveyors in training or geomatics professionals in training, to comply with registration requirements and therefore does not form part of the academic qualification and consequently does not carry an academic credit. In contrast, traditional WIL is embedded in the professional academic qualification to enhance knowledge and professional skills acquisition, practical proficiencies, competencies, and work readiness during the programme of study; and is ultimately centred on a career-oriented education in preparation for the WOW. As a result, WIL modules constitute an academic credit towards the qualification and as such must be evaluated and satisfied in order to successfully complete the module or programme.

Since WIL is characteristic of both vocational and professional based qualifications, it may be incorporated into qualifications at all levels of the HEQSF (South Africa. Department of Higher Education and Training 2014). Martin and Hughes (2009) reiterated this, describing WIL as a bridge for the students between the academic present, and their professional future; the opportunity to apply and combine theoretical knowledge gained in academic studies to 'real world' workplace practical experiences; and to prepare the students for an enriching career by providing an opportunity to develop relevant professional skills.

The question of whether there should be a greater emphasis on core academic knowledge in the curriculum to reinforce key fundamental concepts, instead of a period of WPL to better prepare students for the WOW, proved to be inconclusive from an industry perspective as there was neither clear agreement nor disagreement. Industry members remain almost equally divided on this, which is probably due to the notion that the integration of both academic knowledge and industry practice plays a pivotal role in the overall development of the student's proficiencies in inculcating a deeper understanding and appreciation linking academic theory and real-world industry practices. Brown (2011, cited in Stirling *et al*. 2016) states that "good practice is not without good theory and good theory cannot be without good practice". This is reaffirmed by Winberg *et al*. (2011) who recommended that WIL programmes such as WDTL incorporate theoretical components which should be aligned with the practical or practice-based components through teaching and learning activities that merge theory and practice in meaningful ways. The theoretical components of WIL should include curriculum design that align disciplinary requirements with workplace applicability, thereby enhancing the academic quality of the programme.

From a student perspective, 66% agreed that a greater emphasis on core academic content is preferred over a period of WIL. It has been established earlier that there is consensus from the students about the importance and relevance of WIL in making a positive impact on their professional development, however it is also apparent that they place value on the core academic curriculum content in the production of a knowledgeable graduate. It may well be that there is a growing recognition that UoTs have transformed into portals for comprehensive content/theoretical knowledge and research activities usually associated with traditional academic universities. Meanwhile, Hager and Holland (2006, cited in Borg, Turner and Scott-Young 2017) highlighted the misconception often made by university students that academic skill sets are identical to skill sets required in the workforce or industry. The authors add that to expose students to the skills valued by industry, universities should deliver programmes that are accredited by recognised industry bodies or institutions.

4.8 Conclusion

The findings confirm that the experiential learning (EL) conducted in the National Diploma: Surveying had a positive and meaningful impact on the personal and professional development of the Diploma graduate. The findings further reaffirm that there is a significant consensus that WIL is highly valued by the majority of industry respondents in terms of its importance and relevance in promoting an enriching career focused education as a tool for facilitating the acquisition of discipline specific knowledge, practical proficiency, graduate attributes, employability skills, and key competencies that will culminate in the development of responsible, productive, competent, and accountable graduates to meet the demands and expectations of the modern geomatics, engineering and built environment sectors, and to succeed in a competitive and technologically evolving WOW.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The overall aim of this study was to investigate and evaluate the historical impact of experiential learning (EL) in the form of WIL in terms of the impact on the students' overall personal and professional development in the National Diploma: Surveying programme; and to evaluate the relevance WIL in the geomatics programme at the Durban University of Technology, through interactions with industry practitioners within the surveying and geomatics fraternity in the KwaZulu-Natal region.

The study confirmed that the experiential learning in the National Diploma: Surveying had a positive and meaningful impact on the development of the Diploma graduate. The findings further reaffirm that there is significant consensus from the industry sector and students regarding the importance and relevance of WIL in driving a professional career focused education that will lead to the much-desired acquisition of essential discipline specific knowledge, skills, attributes, and competencies in producing an all-round holistic graduate. It was further apparent that employers placed substantial value on WIL in developing responsible, competent, and accountable graduates to meet the expectations of the various industry sectors, and to further sustain a knowledgeable, productive, modern, and skilled workforce for the built environment.

There is an abundance of supporting literature highlighting the relevance and benefits of WIL for students, industry and institutions of higher learning, and has been widely acknowledged as a vehicle for contributing to student development and increasing graduate employability outcomes. Dressler and Keeling (2011, cited in Baker 2014), summarised over 100 research publications on the benefits of WIL regarding academic, personal, professional, and work skill development aspects. Further, an international review of 19 research studies on employer benefits of WIL, revealed more than 30 distinctive advantages, varying from improved recruitment and retention through to higher quality and more productive employees. Hence it is clear that HEIs can gain advantage through WIL programmes to differentiate courses, improve graduate employability, curriculum renewal, develop staff and align resources Braunstein *et al*. 2011, and Crump and Mary 2011 (cited in Baker 2014). Smith (2012, cited in Wingrove and Turner 2015) explains that WIL creates the opportunity for HEIs to design, refine and teach curricula that is responsive to current and future workplace requirements, to equip students with the knowledge and capability that extends beyond discipline knowledge, to actively engage students with industry and community partners and improve work readiness.

The geomatics, engineering, construction and built environment sectors benefits enormously from having ‘work ready’ graduates who can make an immediate and notable impact as SA attempts to recover economically from the Covid-19 aftermath. A qualified, capable, educated, skilled and motivated workforce in a practical technologically driven discipline can boost economic growth and infrastructure development by employing an advanced array of geomatics and geospatial tools, technologies, and systems. WIL is therefore recognised as the enabling mechanism that can drive the appropriate knowledge and skills acquisition early on in students’ careers to reduce unemployment and accelerate development.

Recent reports indicate that unemployment figures have continued to escalate into 2021 reflecting the urgency of the economic situation. The QLFS statistics provided by Statistics SA for the second quarter of 2021 revealed that the country’s unemployment rate has increased to another record high rising from 32.6% in the first quarter of 2021 to 34.4% in the second quarter of 2021, resulting in the number of unemployed persons increasing to 7.8 million (Businesstech 2021b). This escalating trend continued to surge in 2021, with the official unemployment rate increasing by 0.5% from 34.4% in the second quarter of 2021 to 34.9% in the third quarter of 2021, which is the highest since the start of the QLFS in 2008. WIL programmes can enhance graduate attributes and employability skills and help reduce the unemployment rate amongst qualified skilled youth and help alleviate the burden on the economy.

It is understood that upskilling remains a key government priority as there is a growing shortage of skilled labour facing the country, exacerbated by an exodus of workers in various disciplines for greener pastures abroad. A skills revolution could help offset the impact of Covid 19 and positively influence economic recovery and growth. Furthermore, in the current age of digitalisation, the reality is that continuous upskilling may become mandatory if students, practitioners, and even academic scholars themselves are to remain relevant and productive with current digital trends, innovations, and industry practices as technological trends continue to surge. WIL could be that important link to bridge the gap between academic and workplace practices, knowledge, and specialist technical skills, to support and complement the impact of the 4IR. Without WIL interventions the skills gap between HEIs and the workplace could widen with further detrimental outcomes for all.

Hence, the Department of Higher Education, Science and Innovation, in a bold move, announced in September 2021, that there would be an increased focus on WPL and apprenticeships in HEIs in a bid to improve job opportunities for students and reindustrialise the economy. Higher education minister Dr Blade Nzimande stated at a national skills conference that the HEIs would be 'restructured' to promote innovation and digitalisation in the skills development ecosystem. He stated that "substantial and constant changes to the curricula of our institutions remain critical to allow for students to develop capacities to deal with emergent and unknown challenges of the future brought by the 4IR" (Businesstech 2021a). Government has recognised the void created by the skills deficit and identified the critical need for skills development to revitalise the industrial sector and economy, which could be a significant step forward for the country.

Furthermore, the DUT ENVISION2030 refers to '*Society'* as one of the four strategic perspectives, meaning: "Society that leads to mutually beneficial collaborations, the practical application of knowledge and future-ready graduates". This illustrates DUT's role and mandate as a UoT in educating and training capable, knowledgeable, and work-ready graduates. HEIs are in fact viewed as a portal to relevant and advanced knowledge systems to address economic and societal imbalances and contribute to a better standard of living for the general population.

This perspective has been echoed by the VC of the University of the Free State, Prof Francis Petersen, who elaborated that the role of a university is now a societal one, adding that the focus is on utilising skills and knowledge to make a real difference in the societies they serve and draw their students from. He stated that universities need to deliver graduates who will build a better society, stressing that the higher education sector needs to focus on its strength which is research; offer advice and solutions; and educate and provide skills that will help uplift individuals, families, and communities through a system of engaged scholarship (Petersen 2021).

The relevance and benefits of WIL have been largely established in this study. Industry and student perspectives both indicate a strong desire for WIL programmes to be implemented in the degree as indicated by the results of the data analysis. Incorporating WIL programmes alongside research activities to solve real world problems will be a means of creating societal impact and aligning to the university's Envision2030 strategic plan. Smith (2012, cited in Edwards *et al*. 2015) stated that "institutions market their industry links and WIL programmes to attract students, and to obtain national and international grants for collaborative research projects and sponsorship from different industries". Arising from the study, the following recommendations have been formulated to support informed decision making and best practices going forward:-

5.2 Recommendations

5.2.1 Recommendation 1: Implementation of a 6-month WIL programme

The introduction of a formalised WIL workplace component comprising six months of mandatory industrial practice. Programme re-curriculation or remodelling will be necessary to accommodate this component and allow for the core academic module content to be covered. Refer to the Table below 5.1 reflecting the current Year 3 geomatics degree modules. In the current degree, the six-month project module titled *Survey Project 3B* (32 credit), is offered in Year 3 – Semester 2. However, it is proposed that this be moved from Year 3 – Semester 2 to Year 3 – Semester 1 and be offered over the entire duration of the year.

Table 5.1: Current year 3 geomatics degree modules

Name of module	*Code*	*Study level*	*NQF level*	*NQF credits*
Year 3 – Semester 1				
Geodesy 3A	GDSY301	3	7	16
Cadastral Surveying 3A	CDSV301	3	7	12
Theory of Errors and Network Adjustment 3A	TENA301	3	7	20
Geographic Information System 3A	GISS301	3	7	12
Computer Applications 3A	CPTA301	3	7	12
Town and Regional Planning: Layout & Design 3A	TRLD301	3	6	12
Total Credits for semester 1:				**84**
Year 3 – Semester 2				
Project Management	PRMA301	3	7	8
The Global Environment	GENV101	3	6	8
Survey Project 3B	SVPJ301	3	7	32
Total Credits for semester 2:				**48**

Another viable option would be to essentially swop Year 3 – Semester 1 and Year 3 – Semester 2 modules around in terms of their delivery. The WIL component should be incorporated into *Survey Project 3B* module which will enable the six months of WIL to be administered at the start of the academic year, in addition to a mini-research dissertation during the second part of the academic year. With the effected change, any modules done concurrently with the WIL in *Survey Project 3B*, can be effectively and successfully delivered utilising multimodal, blended learning and online digital and e-learning platforms such as Moodle, Blackboard and MS Teams, so students would not be required to present themselves physically on campus, which can assist in the logistical work and study arrangements.

Furthermore, importantly during the WIL internship, students will have an opportunity to find an appropriate research topic related to an industrial or community problem encountered in the field, which could form part of their research proposal in the second semester, while any related course work for the module can be delivered via virtual online learning platforms described above. Incorporating WIL together with research activities to solve real world problems will of course be an added advantage for learners and will align well to the aims and strategic objectives of a UoT. The WIL should be well structured, purposeful, and ideally be administered in Year 3 of the programme to derive the full value of the learning experience. The internship should include at least one site visitation and interview with the employer and student to monitor progress and report back. The placement of students and formal agreements between eligible employers/training providers/mentors and the DUT must be drawn up in an official contract, outlining clear roles and responsibilities and facilitated jointly through the DUT Department of Co-operative Education and the Department of Geomatics. In this way all parties will be legally obligated to comply with the provisions of the agreement and deter parties from deviating from the key objectives of the WIL programme. All necessary resources and allocated budgets must be made accessible via the university's ENVISION2030 strategic plan and available government grants (e.g. SETAs) for a smooth streamlined process with quality control measures in place to ensure the students are receiving the relevant quality work experience and compulsory categories of training as per the approved SAGC WIL training schedules.

The overall management of WIL can be achieved through the implementation of the university's WIL online University Management System (OLUMS). This portal facilitates the effective management of WIL pertaining to student placements, managing the academic departments in the supervision/monitoring of students, quality assurance processes, student portfolios and progress reports, and assessment reports by providing the online interface between the Department of Co-operative Education, academic departments, academics, employers, supervisors, mentors, and students. This live system can be used to intelligently monitor and track student placements and progress including actual site visitations throughout the internship period (DUT 2021d). A similar mobile application should also be developed and be made customisable for students to individually monitor their progress and communicate directly with their departmental reps/training co-ordinators and supervisors/mentors, using their devices which will make the process even more efficient and effective, adding greater value to the learning experience, and thus avoiding any delays. With these interventions in place, any deficiencies can be promptly addressed thereby expediting the WIL practice.

The WIL programme encompassing the compulsory categories of work experience should be closely aligned to the SAGC WIL training schedules. Furthermore, the training schedule should be updated to reflect all modern surveying, geomatics and geospatial practices as well as technological elements consistent with global industry trends and Industry 4.0, inclusive of 3-D scanning and reality capture, LiDAR systems and remote sensing, point cloud processing, UAVs and drones, building information modelling (BIM), digitalisation, smart cities, artificial intelligence (AI) etc. At the same time, outdated surveying practices (e.g. triangulation) should be removed from the schedule and replaced with items of relevance. A proposed updated specimen sample of a WIL logbook training schedule incorporating some of the above technological practices for geomatics engineering technicians and technologists is illustrated in Table 5.3. All logbook entries should be recorded in chronological order and signed off by the respective supervisors/mentors and the student. Since this is only six months of industry practice, it essentially means that students will receive anything between 100 – 120 days of training during this period. In order to meet the SAGC guidelines for registration as an engineering surveying technician/geomatics technician, students will then require another 100 days post qualification training to meet the stipulated total of 220 days of mandatory work experience, as well fulfil any other criteria set out in the SAGC guidelines. The design and implementation of an electronic or digital logbook interfaced with OLUMS will be an added advantage. If such a system could be devised, it could be designed to perhaps allow for the addition of e-signatures or digital signatures from industry or academic personnel to endorse any work done by the student for official records. The entire system can become a 'live' WIL portal and change the way we function as a network of professionals.

The introduction of WIL will give students the opportunity to network and establish meaningful associations with practitioners during their placement which may lead to increased employment opportunities and other potential job prospects upon graduation. The work experience will enhance their knowledge and skills adding significant value to their remaining modules, making a lot more academic sense in the process, and thus improving student performance and subsequent grades, while facilitating a speedier path to graduation.

5.2.2 Recommendation 2: Implementation of a 12-month WIL programme

Consider extending the geomatics degree by another year resulting in a four-year qualification, much like the traditional university degree, through purposeful restructuring of the curriculum to accommodate the inclusion of one year (12 months) of structured and monitored WIL in Year 3 of study. The WIL must include a clear induction process at the start and facilitated opportunities for reflection on experiences at the end, so both staff and students have clearly defined goals and objectives. The internship should include at least one site visitation and interview with the employer and student to monitor progress and report back. An official training competency certificate should be issued by the institution upon completion of the WIL.

The WIL can culminate with the SAGC law examinations for technicians based on the Geomatics Profession Act 19 of 2013, being administered at the end of the qualification (Year 4) in consultation with the council, to facilitate registration as an engineering surveying technician/geomatics technician, and to essentially ensure that graduates can demonstrate a comprehensive knowledge of the applicable legislation, are 'work-ready' and 'industry compliant' thereby reassuring employers that exiting graduates are SAGC registered prior to entering the WOW for formal employment. Subsequent registration thereafter in the category of engineering surveyor/geomatics technologist and professional engineering surveyor/geomatics professional will strictly follow the applicable rules and regulations as set out by the SAGC, together with the prescribed mandatory work experience.

However, for registration as a technician, a stipulated total of 220 days of constructive WIL as per the present SAGC requirements should be complied with, however the category of training and number of prescribed days have been modified as shown in Table 5.2.

Table 5.2: Categories of WIL training

Type of survey	*Number of days*
Compulsory training	
Control Surveys/Traverse/GNSS/GPS	15
Levelling Spirit/Digital/Trig/Precise	15
Engineering/Construction Survey	15
Topographical Survey/Detail survey	15
Computer Data Processing/Information Technology	15
Reality capture/3D scanning/3D Modelling/BIM	5
Digital photo/Remote sensing/ LiDAR/UAVs/Mobile mapping	5
Total days of compulsory training:	**85**
Additional training	
Cadastral Surveys	
Precise Engineering Surveys/Deformation/Monitoring surveys	
GIS/LIS/Spatial database management	
Project management/Business practice/Entrepreneurship	

The compulsory training constitutes 85 days while a further 135 days of additional training will be required in any of the selected categories shown in Table 5.2. However, the additional training may also comprise days from the compulsory category as laid out in the WIL schedule (Table 5.3).

Table 5.3: Revised specimen sample of WIL training schedule for engineering technicians and technologists

NAME (Block Letters).. **Page .... of .... pages**

DATE	TASK DESC	COMPULSORY TRAINING														ADDITIONAL TRAINING									
		Control Surveys/ Traverse/ GNSS/ GPS/		Levelling Spirit/ Digital/ Trig/ Precise		Eng/ Const Surveys		Comp Data Process/ IT		Reality capture/ 3D scanning/ 3D Modelling/ BIM		Topo surveys/ Detail surveys		Digital photo/ Remote sensing/ LiDAR/ UAVs/ Mobile mapping		GIS/ LIS/ Spatial Database management		Cadastral Surveys		Proj management/ Business practice/ Entrepreneur ship/		Precise Eng Surveys/ Deformation/ Monitoring surveys		Other (Specify)	
		F	O	F	O	F	O	F	O	F	O	F	O	F	O	F	O	F	O	F	O	F	O	F	O
	Brought Fwd																								
	TOTAL																								

Each page must be signed by the Supervisor(s) and the student/candidate F – Fieldwork O - Office (includes calculations, draughting and admin work)

Mentor signature: .... **Date:** .... **Print name:**................................

SAGC registration: .... **Student/Candidate signature:** .... **Date:** ....…..........................

Source: Adapted from SAGC (2019)

5.2.3 Recommendation 3: Increase in industry engagement and collaboration

While increased collaboration is not a new phenomenon, it is far more pertinent now due to growing calls from all sectors of society as it is apparent that the relationship between HEIs and industry employers appears to be lacking in terms of active and constructive engagement. Smith, Ferns and Russell (2014) indicated that relationships between universities and industry and community partners should be “structured, intentional and resourced”. There should be an increase in WIL industry engagement by establishing and maintaining ongoing collaborative partnerships with various industry sectors including public and private sector employers, government organisations, businesses, community organisations, and other relevant stakeholders to better prepare the workforce of the future. Since no formal agreements or contracts exist between the Department of Civil Engineering and Geomatics at DUT and industry sectors, strategic partnerships should be formalised through means of official contracts or MoU so that all entities understand their roles and responsibilities in working towards the fulfilment of the objectives of the WIL programme. The sector includes land and engineering surveyors, geomatics and geospatial practitioners, municipalities, DRDLR, Department of Transport, Eskom, civil engineering and construction companies, associated government agencies, built environment professionals, and instrument/software suppliers.

Sachs, Rowe and Wilson (2016) explained that successful student WPL can be realised by establishing, maintaining and maximising productive and mutually beneficial relationships between university, industry and community groups, and providing high-quality experiences to enhance student learning, improve graduate employability outcomes, develop active citizenship skills, and meeting industry needs.

The student or graduate should therefore ultimately become the focal point of the WIL programme with associated sectors contributing towards this goal as illustrated by a simplified WIL framework (refer to Figure 5.1). All associated sectors should view the student as an investment in a future professional candidate that will deliver in knowledge and expertise to the industry in years to come. Hence an investment in education and training is the key to realisation of a skilled labour force.

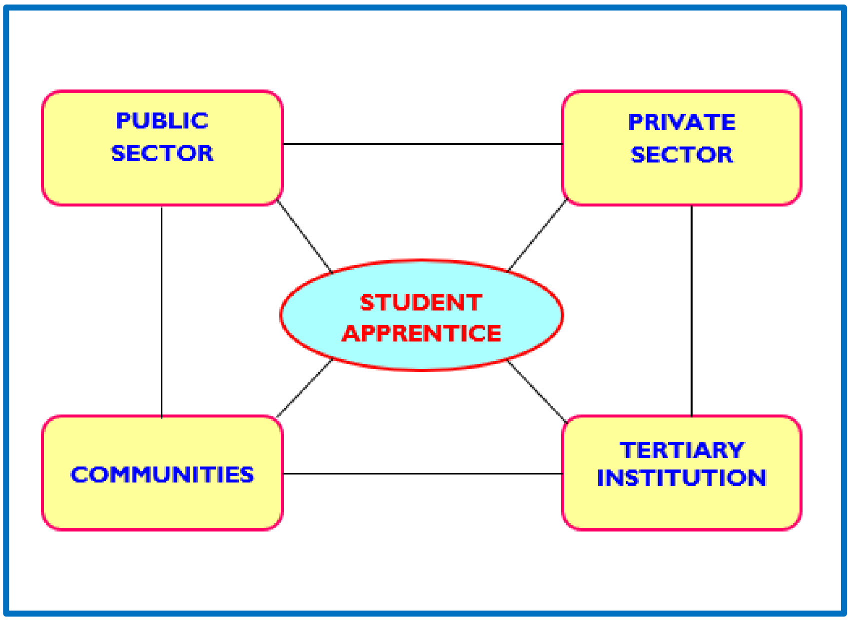

Figure 5.1: Simplified WIL framework
Adapted from Dhliwayo (2008)

Industry partners and employers should also become active in the design, development and renewal of the curriculum so that it is responsive to the needs of both society and industry; and further collaborate on education and training matters, responsibilities, employability criteria, supervision of students, assessment methods, and feedback. Smith (2012, cited in Edwards *et al*. 2015) indicated that "through participation in WIL, industry has the opportunity to inform curricula and contribute to developing work-ready graduates". These important conversations must occur at official advisory board events, industrial liaison meetings, workshops, industry/educational forums, and seminars to ensure that relevant discipline knowledge, modern practices, and technological elements are all incorporated into a curriculum that is universally accepted and endorsed by academic and industry professionals alike, which is beneficial to all. Industry specialists should be recruited to provide guest lectures on relevant topics to enlighten students and provide an opportunity to network with professionals from various sectors hence igniting greater interest in the profession. Industry mentoring programmes can greatly assist in supporting and encouraging learners throughout their academic journey. Another way to improve the WIL interaction is through university career open days and the DUT WOW careers exhibition annual event where prospective employers can be invited to engage directly with the students and offer greater insights into the profession. Industry sponsored prizes and awards to recognise students' academic achievements will also motivate learners to aim high. Instrument suppliers and vendors could be approached to conduct practical field demonstrations to showcase the latest instrumentation, tools, and technologies at their disposal.

Other calls for increased collaboration were noted by Du Plessis (2007, cited in Govender and Taylor 2015) who proposed a memorandum of understanding (MoU) amongst government, educational providers and employers towards maintaining and sustaining excellent WIL experience for the student. Billett (2015), Fleming and Martin (2007), Martin *et al*. (2010), and Orrell (2011) (all cited in Stirling *et al*. 2016) emphasised that "the strategic involvement of all stakeholders in the WIL partnership, including re-conceptualising and organising WIL purposefully to combine scientific knowledge and professional practice, was critical to effective student learning". Universities Australia (2019) noted that partnerships between universities and employers had been strengthened through the development of a National Strategy on WIL in University Education which incorporated various stakeholders from the higher education sector, business councils, trade and industry, and government to facilitate deeper connections and promote the benefits of WIL for all stakeholders (Universities Australia 2019). CEO of the CHE, Narend Baijnath urged for greater expertise in the designing of WIL programmes and greater flexibility on how WIL is achieved owing to the issue of reduced WIL opportunities due to economic challenges facing industry. Baijnath also called for research to investigate matters related to WIL management and coordination, and assessment of generic skills (Dell 2018).

5.2.4 Recommendation 4: Implementation of WIL simulation methods

In the absence of actual WPL, the Department of Civil Engineering and Geomatics at DUT should consider other alternate effective means of incorporating WIL elements successfully into the programme. While WIL simulation methods do not yield the same level of impact and success as actual WPL, it does provide some benefits that cannot be overlooked. Smith *et al.* (2014, cited in Sachs, Rowe and Wilson 2016) confirmed that high quality work placements have been found to have a greater influence and impact on student employability outcomes than simulation and other “non-placement” forms of WIL. Meanwhile Edwards *et al*. (2015) are of the view that WIL strategies can be authentic or simulated, and can take place in the workplace, at the university, virtually, in person, or through a combination of the above. Although traditional WIL is often associated with work placement, remunerated or voluntary student industry placements are an essential but not a compulsory component of WIL. Other forms of WIL initiatives involve relevant industry projects and simulated work experiences. WIL activities, such as work placements may attract a study credit with some being designed as part of the university programmes, or alternatively may be optional and not attract credits. Others are driven by the initiative of the student rather than a university requirement for a course (Edwards *et al.* 2015).

With appropriate engagement, careful planning and co-ordination, WIL simulation methods including work-directed theoretical learning (WDTL), project-based learning (PJBL) and problem based learning (PBL) can be embedded in the curriculum design to cover a variety of industry-based projects from first year to final year level to bring across the traditional elements of WPL into a modern education system through the process of simulation. The industrial projects should be co-developed with industry practitioners and subject/module specialists to better equip learners for the real working world. The projects could further be structured and designed to align with the categories of training, task requirements and work experience according to the SAGC training schedules, thereby ensuring a smooth transition for the learner from university to the workplace. According to Winberg *et al.* (2011), PJBL can aid in the acquisition of an extensive, integrated knowledge base which students can draw on and apply to the analysis and solution of problems. While the problems in PBL are fully simulated with the learning occurring in a university setting, in PJBL the projects could entail learning through practice in a real work context, such as community or service learning or in a university-industry collaborative research project. The projects are a mechanism of engaging students in complex, work-related problems, through which they can develop and transfer knowledge and skills. Having actual WPL with components of PBL and PJBL integrated into a structured modern curriculum will however be the most ideal and desirable approach.

5.2.5 Recommendation 5: Establishment of a survey camp

The suggestion of including a survey camp is not intended to replace WPL, but to supplement other WIL initiatives through interventions that can support the acquisition of relevant industry knowledge and skills within available time in the academic programme, including vacation or recess periods, which can benefit the learners. The Department of Civil Engineering and Geomatics at DUT should consider introducing a 2 to 3 week intensive survey camp in Year 2 and Year 3 of the current degree, in partnership with industry practitioners from the public and private sector covering a range of current survey methodologies. The survey camp can be incorporated as a subject/module which constitutes an academic credit towards the qualification.

Students will gain some valuable industry exposure and increase their proficiencies alongside seasoned industry professionals and experienced academics to combine and integrate theoretical knowledge and workplace practices into a final year capstone project that will determine student's competencies and address any deficiencies prior to entering the WOW. Additionally, students could also be evaluated as per the designated tasks or projects to satisfy assessment criteria to successfully complete the module/s.

Local municipal agencies can be approached to establish a partnership whereby students can also be seconded out to acquire essential work experience on real municipal projects in the built environment under the supervision and guidance of industry experts and officials. These work experiences can be translated into a final year project perhaps in *Survey Project 3B* including an essay component covering the professional practice of surveyors/geomatics practitioners as well as ethical aspects in the workplace.

5.2.6 Recommendation 6: Increase in skills development through WIL

DUT and other HEIs should invest aggressively in skills development and upskilling initiatives to address the growing issue of skills shortages facing the various industrial and economic sectors, through a high priority government funded WIL learnership/internship programme to drive skills acquisition sought after by industry for the modern future workplace.

Du Pré (2013) reiterated that according to the SDA, skills development involves enabling and empowering individuals through the acquisition of in demand skills and competencies. He identified one of the principles as ‘lifelong learning’ stating that “communities and workplaces were constantly changing and if citizens were to shape these changes and derive some benefit from them to improve the quality of lives, they needed to constantly upgrade and improve their skills”, further adding that the learnership model provided sufficient scope for individuals to add value to their abilities, experience and skills through a constant process or “upskilling”, “reskilling” and “multiskilling”. Moreover, Universities Australia (2019) concluded that graduates needed to be career-ready, flexible, adaptive, and equipped in the application of their technical skills to real-world situations to compete in the global economy. They elaborated that to invest and support the acquisition of these skills, WIL offered a variety of practical experiences designed to provide students with valuable exposure to work-related activities, so to produce the highly skilled workforce that the community and industry requires, universities and employers should collaborate to offer students internships, projects, simulations, fieldwork, and other activities.

In terms of the geomatics, engineering, and the built environment sectors, this will contribute substantially towards developing a competent, motivated, and productive workforce that will stimulate economic growth. WIL has been identified as one such mechanism to address this and attain the desired objectives. This can be achievable through the establishment of a system of government funded learnerships/internships that can be facilitated by the DHET and the DRDLR through the creation of a specific SETA for the surveying, geomatics and geospatial sciences discipline which should be made easily accessible to employers and practitioners. The Department of Co-operative Education should then assist employers and companies in the application process to become a registered and accredited training provider. In this way, potential employers will feel encouraged and motivated to provide WIL internship opportunities thereby promoting upskilling of the youth population and addressing unemployment.

This will create a firm foundation for students to experience the WOW and put them on a path to a successful enriching career in an exciting yet challenging field of geomatics.

5.2.7 Recommendation 7: Implementation of WIL service learning

The Department of Civil Engineering and Geomatics at DUT should implement WIL Service learning (SL) initiatives in terms of its civic and social responsibility and as a means of increased community engagement to develop and foster stronger ties with developing communities which is consistent with the University's Envision2030 strategy. Gardner and Bartkus (2014) and Warren (2012) (both cited in Sachs, Rowe and Wilson 2016) state that service learning is concerned with the "development of social responsibility, civic engagement and personal transformation, and usually occurs in community settings with the aim of strengthening communities and contributing to student learning outcomes".

These strategic partnerships should aim to address real community issues such as poor infrastructure, spatial planning, building and construction challenges, and provide solutions in the context of geomatics, engineering, and the built environment industries to uplift such communities. This should involve community organisations in important civic and social activities so as to allow them to make a meaningful contribution in the process. These initiatives again call for increased industry collaboration with the university to ensure that students are actively engaged in the learning process by applying the appropriate knowledge and skills under the expert guidance and mentorship of learning facilitators and industry practitioners, to solve real world problems and make a meaningful contribution to society at large while promoting economic and social development in these communities. Formal agreements or contracts, perhaps even a MoU between the university, industry, community partners and service providers can be established, as well as the allocation of adequate resources to ensure a successful outcome for all concerned. Community engagement can involve, amongst others, NGO's, religious organisations, housing shelters, civic associations, humanitarian organisations, community halls, schools and educational facilities, clinics and other healthcare facilities, libraries, and old age facilities. WIL service learning can also be embedded or integrated into PJBL where the community projects become ‘real world’ projects, enabling students to gain constructive industry exposure and learn through practice, develop transferable skills, and apply critical thinking to solve problems connected to the built environment. Again, these projects should conclude with a final year capstone project assessment to evaluate student’s competencies and address any deficiencies prior to entering the WOW.

5.2.8 Recommendation 8: Implementation of the EIP to enhance WIL

The Department of Civil Engineering and Geomatics at DUT should consider the implementation of the Employability Improvement Project (EIP) administered by the Department of Co-operative Education, in the final year of study to enhance the quality of WIL programmes and equip learners with the necessary employability skills required for the WOW. The EIP was designed to improve the quality of workplace-based learning during the WIL programme and develop more employable graduates for the labour market as well as to nurture their life-long careers.

Employability skills will assist students to transit seamlessly from classroom-based learning to workplace-based learning and change the learning attitude from passive to active. DUT DVC of Research, Innovation and Engagement, Prof. Moyo, expressed her support for the EIP programme in 2017 stating:

> For DUT, employability is a key issue and since technology, business, and lifestyles have been changing globally, employability has been increasing its value and recognition as never before. We at DUT want to make sure that our students are employable and are able to be innovative entrepreneurs.

The EIP is a creative vehicle to promote effective WIL practices and encourage employability outcomes.

5.2.9 Recommendation 9: Reintroduction of the WIL empowerment project

The Department of Civil Engineering and Geomatics at DUT should consider the reintroduction of the successful WIL student empowerment project established in the early 2000s, particularly if a WIL WPL component is to be included in the degree.

Similar to the earlier project, the department should have a structured in-house training facility/unit, with the aim of providing students with a variety of ‘real world’ quality work experiences in the field of surveying, geomatics, GIS, geospatial and other related disciplines through joint ventures or collaborative initiatives with industry partners, to assist learners in increasing their core discipline knowledge, skills and proficiencies as well as developing core transferable skills necessary to become more employable to the labour market. In the current age of digitalisation students should be able to additionally acquire the necessary technological skill sets and exposure emanating from modern forms of emerging technology (e.g. 3-D scanning, reality capture, digital twins, LiDAR systems, UAVs, BIM, smart cities etc.) which are gaining notable traction in the profession. Since WIL opportunities may be limited due to the impact of the pandemic, such an initiative will provide a viable solution that will benefit all sectors and contribute to the much-needed skills development and enhancement. The student empowerment project will ensure that the graduate throughput rate is not significantly affected as WIL placement opportunities will be made readily available through formal agreements and partnerships therefore streamlining the process.

Moreover, the empowerment programme can be aligned to the ENVISION2030 strategy, to embody the vision set out by the university in terms of key perspectives relating to adaptive graduates, community engagement, active citizenship, innovation and entrepreneurship, digital technology and systems, and societal impact. The strategy further exemplifies values such as transparency, honesty, integrity, respect, and accountability which are essential qualities that graduates should possess upon entering the WOW to become responsible and productive members of society.

In terms of financial and human resources, the project will initially require appropriate university funding, contracted staff including WIL co-ordinators, technical support staff as well as equipment, computers, vehicles etc for operational requirements to effectively administer and monitor the training of students. Additional sources of funding in the form of government and private sector sponsors will also add value and bolster the project. The project should be designed to be ideally self-sustainable through the income generated via actual industry projects, research initiatives, community engagements, student industry secondments, and consulting ventures with dedicated partners. The university will further benefit as this will present an opportunity for 3rd stream income for the institution. Income generated from the project can also fund student bursaries to further promote WIL research activities at a Master's and Doctoral level.

The end of the internship period can culminate with each student undergoing an individual skills/competency practical assessment administered jointly by academic staff and industry practitioners to evaluate and reaffirm the student's level of proficiency. Students can thereafter register with the SAGC as technicians in training, which will put them on a path to full registration upon completion of the qualification, entering the work sector, and meeting the outstanding requirements.

5.2.10 Recommendation 10: WIL staff industry secondment

To sustain an effective quality WIL programme, training co-ordinators, practitioners, lecturers, technicians, administrators, and support staff should be qualified, and adequately skilled, experienced, and supported, to ensure quality WIL practices and outcomes for all students. A department staff industry secondment programme is recommended at least once every three years to allow for continual professional development of respective personnel, to remain up to speed with changing technology and relevant practices that is in tune to industry norms. In addition to industry secondment, technical, technology and developmental workshops, seminars, and conferences as well as a variety of formal education, training, mentoring, self-study, and developmental activities all contribute towards a professional profile that will support a quality education and programme offering. According to SAGC (2012), continuing professional development (CPD) means the "systematic maintenance, improvement and broadening of knowledge and skills, and the development of personal qualities necessary for the execution of professional and technical duties throughout a person's geomatics career" (SAGC 2012). CPD will thus ensure the principles of professional competence, values, and ethics remain the cornerstone of the profession. These initiatives will further reinforce the design and development of a relevant and modern curriculum to meet education, industry, and accreditation body standards, as well as international benchmarks.

Since HEIs should not be functioning in isolation, and for the purposes of uniformity in the profession to allow for articulation, progression, and mobility between institutions, recommended future research should encompass a broader study comprising all HEIs offering surveying and geomatics programmes, including universities of technology, comprehensive universities, and research-intensive universities to evaluate the relevance and impact of WIL on a national scale.

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APPENDICES

Appendix A: Participant letter of information & consent form for Industry

LETTER OF INFORMATION

Title of the Research Study: ***Relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology.***

Principal Investigator/s/researcher: Mr A. Raghubar, B-Tech Surveying; B-Tech Management

Co-Investigator/s/supervisor/s: Prof D. Allopi, DTech (Civil Eng); MDT (Civil Eng); Postgrad Dip.Eng.; Dip. Datametrics (cum laude); PrTech Eng

Brief Introduction and Purpose of the study:
The Durban University of Technology (DUT) has phased out the National Diploma: Surveying and the B-Tech: Surveying qualifications and introduced a new qualification: Bachelor of The Built Environment (BBE): Geomatics in January 2018.

Work Integrated learning (WIL) has become an integral part of the teaching and learning pedagogy within the Surveying profession at a National Diploma level across many of the Technikons and Universities of Technologys (UoTs) nationally over the years, including the DUT. It has been widely recognized as the cornerstone of student development and their interactions with industry has led students to understand the mechanisms of real work place learning and the dynamics of a professional working environment. However, Work Integrated Learning (WIL) has now been excluded in the new BBE: Geomatics qualification.

The aim of this study is to investigate and evaluate the historical impact of Experiential learning (Work Integrated Learning) in terms of the impact on the student's overall personal and professional development, as conducted in the National Diploma: Surveying programme, and to evaluate the relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology, through interactions with industry practitioners within the Surveying and Geomatics fraternity, in the Kwa-Zulu Natal region.

The key objectives of the research are:-

- to determine whether the Experiential training (workplace learning) conducted in the National Diploma: Surveying, had a meaningful and positive impact in terms of the student's personal and professional development, and work placement.
- to determine whether the absence of WIL, will influence the type and quality of graduate entering the industry sector and if they will be perceived to be lacking substantive practical knowledge, skills and technical expertise to cope with the industry expectations.
- to establish whether the absence of WIL, will create a vacuum of knowledgeable, skilled, and competent technicians/technologists in industry thereby affecting industry productivity, workflow, output and economic growth.

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- to determine whether the absence of WIL, is perceived as an inhibitor to student's personal growth and professional development.
- to determine whether it will affect the employability skills, graduate attributes, employment opportunities and job prospects of the graduates.

The study will seek to increase our understanding of industry's and student's perspectives on WIL (Workplace learning), assist in terms of informed decision making and best practices, establish whether WIL is relevant in the BBE: Geomatics program and to possibly further establish if WIL could be effectively integrated into the new qualification, in accordance with industry and institutional requirements, to produce responsible, skilled, knowledgeable, ethical and competent practitioners, in an effort to maintain a high standard of professional conduct, work ethic and integrity, as stipulated in the Geomatics Profession Act (GPA) of 2013, and for the country's workforce and the built environment industries that we serve. This study will therefore be beneficial to all stakeholders including the University, employers, students, government, professional bodies and communities, through means of increased collaboration.

Your response to the questions will therefore be beneficial to the education and training sectors. The information will be treated with the utmost confidentiality, and will be used solely for the purpose of this study. **You are not required to include your name.**

Dear Sir / Madam,

Greetings,

Trust you are keeping well.

My name is Avidesh Raghubar and I am conducting research for a Masters of the Built Environment (MBE): Geomatics degree at the Durban University of Technology (DUT), with Prof Dhiren Allopi, in the Department of Civil Engineering & Geomatics, and Faculty of Engineering & the Built Environment.

You are kindly invited to participate in this research study titled:-

"Relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology".

This study is aimed at various Industry employers, partners and stakeholders, including Surveying / Geomatics practitioners, Municipalities, Eskom, Department of Rural Development and Land Reform (DRDLR), National Geo-spatial Information (NGI), KwaZulu-Natal Department of transport and the general Civil Engineering & Construction industry within the KwaZulu-Natal region.

What is Research: Research is a systematic search or enquiry for generalized new knowledge.

Outline of the Procedures: Please answer all questions in a fair and objective manner to ensure ethical standards and credibility in the study. The study will include a random selection of employers (*n=130 – 150*) from various sectors of the Surveying / Geomatics industry within the Kwa-Zulu Natal region to obtain a meaningful response rate that will form the basis for informed decision-making and be used as a tool to better understand the deficiencies and address any shortcomings.

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Data collection will be achieved mainly by Quantitative research methods and comprises of a closed-ended questionnaire which will be administered via online web-based means i.e. Google forms and paper-based forms if deemed necessary.

Participants will each receive an electronic information pack containing the following:-

- *Letter of information*
- *Participant letter of consent*
- *Email invitation with Web link to online Google form survey questionnaire*

The actual survey link to the *Google form survey questionnaire* is contained in the email communication and is also shown below. The informed consent is embedded in the online *Google form survey questionnaire* for convenience.

Link to Online Employer Survey: **https://forms.gle/CTbih3hzNzkrww37A**

Preferably use Microsoft Edge, Google Chrome or FireFox Internet browser. Alternatively, you may also use a Smart phone or Mobile device to access the survey.

The expected time needed to complete the questionnaires would range between 10 – 15min. Data will be stored in a secure environment for a period of 5 years and thereafter will be discarded. It must be emphasized that names/identities are not compulsory and one can remain anonymous. Once complete the data from the questionnaires, will be collected and analyzed.

Risks or Discomforts to the Participant: There are no risks to the participants since confidentiality is assured.

Reason/s why the Participant may Be withdrawn from the Study: Participation in this study is completely voluntary and anonymous. Information gathered during the research will be used solely for the purpose of this study and all efforts will be made to ensure the confidentiality of participants' personal information. If you decide not to participate there will not be any negative consequences. If you do decide to participate, you will be given this information sheet to keep and be prompted to accept the informed consent that is embedded in the online Google form survey questionnaire or asked to sign a written consent form (attached). Please be aware that if you decide to participate, you are free to withdraw from the study at any time and your data will be returned to you or destroyed.

Benefits: This study will be beneficial to all stakeholders including the University, employers, government, professional bodies, communities and students, through means of increased collaboration, and establishing the relevance of WIL in a modern education system, and how it may possibly be effectively integrated into the BBE: Geomatics program, to produce skilled, competent, responsible, ethical and knowledgeable graduates for the country's workforce and the built environment industries that they serve. The researcher may publish an article in a journal arising from the study.

Remuneration: There is no remuneration allocated for this study.

Costs of the Study: The participant will not be expected to cover any costs towards this study.

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Confidentiality: Information gathered during the research will be used solely for the purpose of this study and all efforts will be made to ensure the confidentiality of participant's personal information. Please note that while your name (if provided) may be recorded with the data, it will not be used in the report. If you decide not to participate, there will not be any negative consequences.

Results: The results of the study will be included in a Research dissertation where the data collection, data analysis, research findings, discussions and recommendations will be reported on. The results will be made available to participants if requested.

Research-related Injury: There is no compensation for research-related injury or adverse reaction.

Storage of all electronic and hard copies including tape recordings: Hard copies of your answers will be stored by the researcher for a period of 5 years in a locked cupboard/filing cabinet and all identifiable electronic data will be stored securely on a computer with password-restricted access and only the researcher, supervisor, and ethics committee members may have access to it. All identifiable information will be destroyed at the end of the study or after 5 years, whichever comes first.

Persons to Contact in the Event of Any Problems or Queries: If you would like to be informed of the final research findings or should you require any further information about any aspect of this study, please contact the researcher, Mr A. Raghubar (Ph: 031-373 2095), the supervisor, Prof D. Allopi, (Ph: 031-373 2310), or the Institutional Research Ethics Administrator on 031 373 2375. Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za.

General:
Participation in this study is completely voluntary and anonymous. The approximate number of participants to be included in this study is between 130 – 150. The expected time needed to complete the questionnaires is between 10 – 15min. A copy of the information letter will be issued to participants via email.

Thank you for taking the time to participate in this research study.

6 August 2020

CONSENT

Full Title of the Study: ***Relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology.***

Names of Researcher/s: Mr A. Raghubar; Prof D. Allopi

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Mr A. Raghubar, about the nature, conduct, benefits and risks of this study – Research Ethics Clearance Number: 088/21.
- I have also received, read and understood the above written information (Participant letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis (if provided) will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

Full Name of Participant Thumbprint	**Date**	**Time**	**Signature / Right**

I, Mr A. Raghubar herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

AVIDESH RAGHUBAR	02 AUGUST 2021	
Full Name of Researcher	**Date**	**Signature**
Full Name of Witness (If applicable)	**Date**	**Signature**
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

6 August 2020

Appendix B: Participant letter of information & consent form for Student

DUT DURBAN UNIVERSITY OF TECHNOLOGY

INSTITUTIONAL RESEARCH ETHICS COMMITTEE

LETTER OF INFORMATION

Title of the Research Study: ***Relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology.***

Principal Investigator/s/researcher: Mr A. Raghubar, B-Tech Surveying; B-Tech Management

Co-Investigator/s/supervisor/s: Prof D. Allopi, DTech (Civil Eng); MDT (Civil Eng); Postgrad Dip.Eng.; Dip. Datametrics (cum laude); PrTech Eng

Brief Introduction and Purpose of the study:
The Durban University of Technology (DUT) has phased out the National Diploma: Surveying and the B-Tech: Surveying qualifications and introduced a new qualification: Bachelor of The Built Environment (BBE): Geomatics in January 2018.

Work Integrated learning (WIL) has become an integral part of the teaching and learning pedagogy within the Surveying profession at a National Diploma level across many of the Technikons and Universities of Technology's (UoTs) nationally over the years, including the DUT. It has been widely recognized as the cornerstone of student development and their interactions with industry has led students to understand the mechanisms of real work place learning and the dynamics of a professional working environment. However, Work Integrated Learning (WIL) has now been excluded in the new BBE: Geomatics qualification.

The aim of this study is to investigate and evaluate the historical impact of Experiential learning (Work Integrated Learning) in terms of the impact on the student's overall personal and professional development, as conducted in the National Diploma: Surveying programme, and to evaluate the relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology, through interactions with industry practitioners within the Surveying and Geomatics fraternity, in the Kwa-Zulu Natal region.

The key objectives of the research are:-

- to determine whether the Experiential training (workplace learning) conducted in the National Diploma: Surveying, had a meaningful and positive impact in terms of the student's personal and professional development, and work placement.
- to determine whether the absence of WIL, will influence the type and quality of graduate entering the industry sector and if they will be perceived to be lacking substantive practical knowledge, skills and technical expertise to cope with the industry expectations.
- to establish whether the absence of WIL, will create a vacuum of knowledgeable, skilled, and competent technicians/technologists in industry thereby affecting industry productivity, workflow, output and economic growth.

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- to determine whether the absence of WIL, is perceived as an inhibitor to student's personal growth and professional development.
- to determine whether it will affect the employability skills, graduate attributes, employment opportunities and job prospects of the graduates.

The study will seek to increase our understanding of industry's and student's perspectives on WIL (Workplace learning), assist in terms of informed decision making and best practices, establish whether WIL is relevant in the BBE: Geomatics program and to further establish if WIL could be effectively integrated into the new qualification, in accordance with industry and institutional requirements, to produce responsible, skilled, knowledgeable, ethical and competent practitioners, in an effort to maintain a high standard of professional conduct, work ethic and integrity, as stipulated in the Geomatics Profession Act (GPA) of 2013, and for the country's workforce and the built environment industries that we serve. This study will therefore be beneficial to all stakeholders including the University, employers, students, government, professional bodies and communities, through means of increased collaboration.

Your response to the questions will therefore be beneficial to the education and training sectors. The information will be treated with the utmost confidentiality, and will be used solely for the purpose of this study. **You are not required to include your name.**

Dear Sir / Madam,

Greetings,

Trust you are keeping well.

My name is Avidesh Raghubar and I am conducting research for a Masters of the Built Environment (MBE): Geomatics degree at the Durban University of Technology (DUT), with Prof Dhiren Allopi, in the Department of Civil Engineering & Geomatics, and Faculty of Engineering & the Built Environment.

You are kindly invited to participate in this research study titled:-

"Relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology".

This study is aimed at Geomatics students and graduates from the Durban University of Technology.

What is Research: Research is a systematic search or enquiry for generalized new knowledge.

Outline of the Procedures: Please answer all questions in a fair and objective manner to ensure ethical standards and credibility in the study. The study will include a random selection of students (*n=80 – 100*) including the first cohort of Geomatics graduates (2020) and the second/third year Geomatics students, to gauge an appropriate level of feedback and a meaningful response rate that will form the basis for informed decision-making and be used as a tool to better understand the deficiencies and address any shortcomings.

Data collection will be achieved mainly by Quantitative research methods and comprises of a closed-ended questionnaire which will be administered via online web-based means i.e. Google forms and paper-based forms if deemed necessary.

6 August 2020

Participants will each receive an electronic information pack containing the following:-

- *Letter of information*
- *Participant letter of consent*
- *Email invitation with Web link to online Google form survey questionnaire*

The actual survey link to the *Google form survey questionnaire* is contained in the email communication and also shown below. The informed consent is embedded in the online *Google form survey questionnaire* for convenience.

Link to Online Student Survey: **https://forms.gle/hW6aXkgUqvDVPYvL9**

The expected time needed to complete the questionnaires would range between 8 – 10min. Data will be stored in a secure environment for a period of 5 years and thereafter will be discarded. It must be emphasized that names/identities are not compulsory and one can remain anonymous. Once complete the data from the questionnaires, will be collected and analyzed.

Risks or Discomforts to the Participant: There are no risks to the participants since confidentiality is assured.

Reason/s why the Participant may Be withdrawn from the Study: Participation in this study is completely voluntary and anonymous. Information gathered during the research will be used solely for the purpose of this study and all efforts will be made to ensure the confidentiality of participants' personal information. If you decide not to participate there will not be any negative consequences. If you do decide to participate, you will be given this information sheet to keep and be prompted to accept the informed consent that is embedded in the online questionnaire or asked to sign a written consent form (attached). Please be aware that if you decide to participate, you are free to withdraw from the study at any time and your data will be returned to you or destroyed.

Benefits: This study will be beneficial to all stakeholders including the University, employers, government, communities and students, through means of increased collaboration, and establishing the relevance of WIL in a modern education system, and how it may be effectively integrated into the BBE: Geomatics program, to produce skilled, competent, responsible, ethical and knowledgeable graduates for the country's workforce and the built environment industries that they serve. The researcher may publish an article in a journal arising from the study.

Remuneration: There is no remuneration allocated for this study.

Costs of the Study: The participant will not be expected to cover any costs towards this study.

Confidentiality: Information gathered during the research will be used solely for the purpose of this study and all efforts will be made to ensure the confidentiality of participant's personal information. Please note that while your name (if provided) may be recorded with the data, it will not be used in the report. If you decide not to participate, there will not be any negative consequences.

Results: The results of the study will be included in a Research dissertation where the data collection, data analysis, research findings, discussions and recommendations will be reported on. The results will be made available to participants if requested.

Research-related Injury: There is no compensation for research-related injury or adverse reaction.

6 August 2020

Storage of all electronic and hard copies including tape recordings: Hard copies of your answers will be stored by the researcher for a period of 5 years in a locked cupboard/filing cabinet and all identifiable electronic data will be stored securely on a computer with password-restricted access and only the researcher, supervisor, and ethics committee members may have access to it.
All identifiable information will be destroyed at the end of the study or after 5 years, whichever comes first.

Persons to Contact in the Event of Any Problems or Queries: If you would like to be informed of the final research findings or should you require any further information about any aspect of this study, please contact the researcher, Mr A. Raghubar (Ph: 031-373 2095), the supervisor, Prof D. Allopi, (Ph: 031-373 2310), or the Institutional Research Ethics Administrator on 031 373 2375. Complaints can be reported to the Director: Research and Postgraduate Support Dr L Linganiso on 031 373 2577 or researchdirector@dut.ac.za.

General:
Participation in this study is completely voluntary and anonymous. The approximate number of participants to be included in this study is between 80 – 100. The expected time needed to complete the questionnaires is between 8 – 10min. A copy of the information letter will be issued to participants.

Thank you for taking the time to participate in this research study.

6 August 2020

CONSENT

Full Title of the Study: ***Relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology.***

Names of Researcher/s: Mr A. Raghubar; Prof D. Allopi

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, Mr A. Raghubar, about the nature, conduct, benefits and risks of this study – Research Ethics Clearance Number: 088/21.
- I have also received, read and understood the above written information (Participant letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis (if provided) will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

____________________	__________	______	____________
Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I, Mr A. Raghubar herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

AVIDESH RAGHUBAR	27 JULY 2021	____________
Full Name of Researcher	**Date**	**Signature**
____________________	__________	____________
Full Name of Witness (If applicable)	**Date**	**Signature**
____________________	__________	____________
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

6 August 2020

Appendix C: WIL – Sample of WIL Industry / Employer Questionnaire

Geomatics Work Integrated Learning (WIL) / Workplace Learning - Employer Industry Questionnaire

Thank you for participating in this Research study.

The Durban University of Technology (DUT) has phased out the National Diploma: Surveying and the B-Tech: Surveying qualifications and introduced a new three academic qualification: Bachelor of The Built Environment (BBE): Geomatics in January 2018. Work Integrated Learning (WIL) / Workplace Learning is not included in the new qualification.

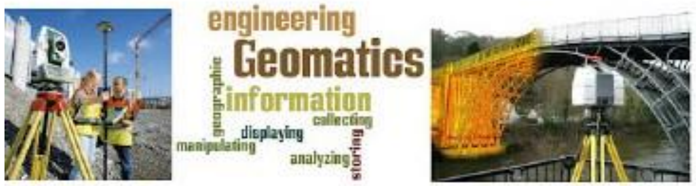
The purpose of this survey is to collect and analyze feed back pertaining to the historical impact of Experiential learning conducted in the National Diploma: Surveying programme, and to evaluate the relevance of Work Integrated Learning (WIL) in a Geomatics programme at the Durban University of Technology, through interactions with industry practitioners within the Surveying and Geomatics fraternity in the Kwa-Zulu Natal region.

Participation in this study is voluntary and anonymous. Your response to the following questions will be beneficial to the education and training sectors, and assist in terms of informed decision making and best practices to increase our understanding of industry's perspectives on WIL (Workplace learning). The information will be treated with the utmost confidentiality, and will be used solely for the purpose of this study. The expected time needed to complete the questionnaires is between 10 – 15min which consists of 5 sections.

Note: You are not required to include your name.

Tick the appropriate box for each item below to indicate your response or level of agreement for each of the following:-

*Required



Part A: Informed Consent

Names of Researcher/s: Mr A. Raghubar; Prof D. Allopi

Statement of Agreement to Participate in the Research Study:

1. I hereby confirm that I have been informed by the researcher, Mr A. Raghubar, about the nature, conduct, benefits and risks of this study.
2. I have also received, read and understood the above written information (Participant letter of Information) regarding the study.
3. I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis (if provided) will be anonymously processed into a study report.
4. In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
5. I may, at any stage, without prejudice, withdraw my consent and participation in the study.
6. I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
7. I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

==== ====== ====== ===== ====== ====== ====== ===== ====== ====== ====== ===== ====== ====== ====

I, Mr A. Raghubar herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

AVIDESH RAGHUBAR	2 August 2021
Full Name of Researcher	Date

1. 1. I have read and acknowledged the attached Participant letter of information provided and the above Statement of agreement, and hereby provide consent to participate in this research study. *

Mark only one oval.

( ) Yes - I provide consent

Part B: General

*Tick the appropriate box for each item below to indicate your response or level of agreement for each of the following:-

2. 2. Please indicate your category / sector of employment within the Kwa-Zulu Natal region. *

Mark only one oval.

- Private practitioner e.g. (Land Surveyor / Engineering Surveyor / Mine Surveyor / Geomatics practitioner)
- Land Surveying company
- Engineering Surveying company
- Geomatics / Geoinformatics / Geospatial company
- Civil Engineering / Construction / Built environment company
- Kwa-Zulu Natal Municipality (e.g. Ethekweni / Msunduzi / other)
- Eskom land development (Kwa-Zulu Natal)
- Department of Rural development & Land Reform (DRDLR) / National Geo-spatial Information (NGI)
- Kwa-Zulu Natal Department of Transport
- Other Government agency or organization
- Retired practitioner
- Other: ____________

3. 3. Please indicate if you are a member of the South African Geomatics Institute (SAGI). *

Mark only one oval.

- Yes
- No

4. 4. Please indicate if you are a member of the South African Geomatics Council (SAGC). *

Mark only one oval.

- Yes
- No

5. 5. If yes to the above, Please indicate the status of your Registration, if applicable. If you do not wish to indicate so, select 'Not applicable'. *

Mark only one oval.

- Professional Land Surveyor / Geomatics Professional
- Professional Engineering Surveyor / Geomatics Professional
- Professional Photogrammetric Surveyor
- Professional Mine Surveyor
- Professional GISc practitioner
- Professional Hydrographic Surveyor
- Engineering Surveyor / Geomatics Technologist
- Photogrammetric Surveyor
- Mine Surveyor
- GISc Technologist
- Engineering Survey Technician / Geomatics Technician
- Photogrammetric Survey Technician
- Mine Survey Technician
- GISc Technician
- Not applicable
- Other: ____________

Part C: Experiential Training (National Diploma: Surveying)

*Tick the appropriate box for each item below to indicate your response or level of agreement for each of the following:-

6. 6. Please confirm that as a Private practitioner / employer or as a Manager / Director / Supervisor of an organization / company, that you have previously employed, supervised or mentored, National Diploma: Surveying students for Experiential training from the Durban University of Technology (DUT). *

Mark only one oval.

- Yes, I confirm.

7. 7. As a Private practitioner / employer or as a Manager / Director / Supervisor of an organization / company; Approximately how many students in total would you estimate, you have employed, supervised or mentored during the last 10 years (2010 - 2020)? *

Mark only one oval.

- 0
- 1 - 5
- 5 - 10
- 10 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- > 30
- Other: ____________

8. 8. What categories of training were you as a Private practitioner / employer or as a Manager / Director / Supervisor of an organization / company able to provide to the students? *

Tick all that apply.

- [ ] Cadastral Surveys / Sectional Title
- [ ] Control surveys
- [ ] Engineering & Construction Surveys
- [ ] Precise engineering surveys / Deformation monitoring surveys / Advanced engineering surveys
- [ ] Topographical / Tache / Detail Surveys
- [ ] Mine Surveys
- [ ] Levelling Surveys
- [ ] GPS / GNSS / Satellite Surveying
- [ ] Digital Photogrammetery / Remote Sensing / LiDAR
- [ ] UAV's & Mobile mapping / Drone applications
- [ ] Geospatial, Geographical information science (GISc), Land information systems (LIS)
- [ ] Reality capture / 3-D scanning / Building Information Modelling (BIM)
- [ ] Project management / Business management / Entrepreneurship
- [ ] Digital Cartography & Geodesy
- [ ] Hydrographic Surveying / Coastal Engineering
- [ ] Computer Data processing / Office reductions & computations / Information Technology
- [ ] All of the above
- [ ] Not applicable

9. 9. The DUT National Diploma graduate was adequately prepared for the World of work, and performed to a reasonable level of expectation in a professional practice / Industry controlled setting. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

10. 10. The DUT National Diploma graduate was adequately equipped with the appropriate level of academic (theoretical) knowledge and practical / technical skill to cope with Industry requirements and expectations within a reasonably acceptable level. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

11. 11. Rate the level of importance and impact you believe, that Experiential training has had, in terms of contributing to holistic student development and work placement, taking into account the following attributes:- Work readiness; Work experience; Professionalism; Work ethic; Productivity & efficiency; Motivation & confidence; Teamwork & collaboration; Leadership; Time management; Life skills and Character building. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not important at all	◯	◯	◯	◯	◯	◯	◯	Very important

12. 12. Rate the level of importance and relevance you believe, that Experiential training has had on student progression and development, in terms of the following factors:- Responsibility & reliability; Initiative & problem solving ability; Human relations; Written communication skills; Oral communication skills and Occupational safety. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not important at all	◯	◯	◯	◯	◯	◯	◯	Very important

13. 13. Rate the level of importance and relevance you believe, that Experiential training has had on professional student development, in terms of key work competencies and skills acquisition related to:- Theoretical knowledge; Practical / Technical skills; Technological knowledge & skills; Quality of work; Communication skills; Organizational skills; Interpersonal skills; IT Skills; Literacy skills, Report writing skills etc. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not important at all	◯	◯	◯	◯	◯	◯	◯	Very important

Part D: Work Integrated Learning (BBE: Geomatics)

The new Bachelor of the Built Environment (BBE): Geomatics degree has replaced the National Diploma: Surveying and B-Tech: Surveying qualifications.

The purpose of the BBE: Geomatics programme (3 year academic degree) is for students to assimilate the necessary knowledge, understanding, and skills in Geomatics. This combined with a period of post qualification mentored work experience will enable them to become competent practicing engineering surveying technologists (engineering surveyors), able to apply Geomatics knowledge to make judgment, work independently and responsibly. To contribute to the critical mass of engineering surveyors educated specifically for the World of work and research, and who also play a pivotal role in the infrastructure development of our country, and make a contribution to the economy and national development (Civil Engineering and Geomatics handbook 2021. DUT)

*Tick the appropriate box for each item below to indicate your response or level of agreement for each of the following:-

14. 14. Were you aware that the BBE: Geomatics qualification did not include a Work integrated learning (WIL) / Workplace learning component? *

Mark only one oval.

- Yes
- No

15. 15. Do you agree with the exclusion of Work integrated learning (WIL) / Workplace learning in the BBE: Geomatics qualification? *

Mark only one oval.

- Yes
- No

16. 16. The lack of Work integrated learning (WIL) / Workplace learning in the BBE: Geomatics degree will have a negligible / minimal impact on the Industry sector, workforce and economy. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

17. 17. The exclusion of Work integrated learning (WIL) / Workplace learning in the BBE: Geomatics degree is not a major concern, and may not affect the student's employability; as graduates will have to obtain post qualification work experience to enable them to become competent practicing Engineering Survey Technologists. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

18. 18. The absence of Work integrated learning (WIL) in the BBE: Geomatics degree, may have a significant impact on the type and quality of graduate entering the work sector, due to the lack of actual Workplace learning in the academic programme. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

19. 19. The new Geomatics graduate entering the work sector, may be perceived as one with possibly diminished practical skills & technical expertise, and lacking essential knowledge & capability necessary for the execution of Surveying / Geomatics field operations & office computations to cope with Industry expectations, than the previous Industry recognized National Diploma: Surveying graduate. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

20. 20. The absence of Work integrated learning (WIL) / Workplace learning in the BBE: Geomatics degree, may in time create a vacuum of knowledgeable, skilled, experienced, competent and accountable Technicians & Technologists in Industry, which may negatively impact on business productivity, workflow, output, profitability, revenue, entrepreneurial opportunities and economic growth. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

21. 21. The exclusion of Work integrated learning (WIL) / Workplace learning in the BBE: Geomatics degree, may disadvantage students in terms of their personal growth and professional development; and may negatively impact on the employability skills, graduate attributes, job prospects and career opportunities of the graduates entering the labour market. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

22. 22. The exclusion of Work integrated learning (WIL) in the BBE: Geomatics degree may disrupt the student's ability to link and integrate theoretical (classroom-based) knowledge with professional practice-based knowledge gained through Workplace learning, thereby compromising the full value of the learning experience. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

23. 23. A greater emphasis on core academic knowledge and theoretical content in the BBE: Geomatics curriculum in order to reinforce key fundamental concepts is preferred, over a period of actual industry Workplace learning, to better prepare and equip students / graduates for the World of work. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

24. 24. Work integrated learning (WIL) / Workplace learning may be relevant for the Geomatics qualification in order to:- Develop responsible, productive & accountable graduates, Enhance theoretical knowledge & practical skills acquisition, Effect knowledge & skills transfer, Increase work readiness & student competence, Improve problem solving abilities, critical thinking & decision making and Increase technical knowledge & individual capabilities, for the technologically evolving world and competitive work sector. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

25. 25. The exclusion of Work integrated learning (WIL) / Workplace learning in the BBE: Geomatics degree, will impact on the student's employability and entrepreneurial & innovative attributes, which may negatively influence the production of Entrepreneurs and the establishment of Small, Medium and Micro Enterprises (SMMEs) such as Surveying / Geomatics business practices. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

26. 26. Rate the level of importance and relevance you believe, that Work integrated learning (WIL) has in developing 'Employability skills' such as:- Responsibility & reliability; Professionalism; Problem solving abilities & Critical thinking; Judgment & Decision making; Self-management; Team work & collaboration; Leadership; Positive attitude; Motivation; Time management skills; Communication skills; Interpersonal skills; Organizational skills; Ethics; Application of numeracy; Application of Information Technology (IT) skills; Application of modern tools, instrumentation & technology; Workplace adaptability; Entrepreneurship & innovation; Business & client awareness. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not important at all	◯	◯	◯	◯	◯	◯	◯	Very important

27. 27. The exclusion of Work integrated learning (WIL) / Workplace learning in the BBE: Geomatics degree, may possibly contribute to an unexpected and indirect increase in the unemployment rate amongst University graduates, as potential Employers may perceive graduates to be lacking discipline specific skills, employability skills and key competencies required for the World of work. *

Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly disagree

28. 28. Rate the level of importance you believe, that employability skills, graduate attributes, core individual competencies & skills sets, and discipline specific knowledge have, in terms of productivity of the labour force in the Engineering, Geomatics and Built environment sectors. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not important at all	◯	◯	◯	◯	◯	◯	◯	Very important

29. 29. Rate the level of importance and relevance you believe, that Work integrated learning (WIL) / Workplace learning has with respect to:- Academic progression; Enhancement of work-related capabilities & Work readiness; Work experience; Increase in Technological skills acquisition; Networking; Professional identity; Work ethic; Motivation & confidence; Productivity & efficiency; and Career prospects of students. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not important at all	◯	◯	◯	◯	◯	◯	◯	Very important

30. 30. The absence of Work integrated learning (WIL) / Workplace learning may have a possible indirect impact on the workflow and productivity levels of Professional practitioners and organizations / agencies that appoint Technicians / Technologists for support in the execution of field operations & activities, office computations and facilitating deliverables. *

Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly disagree

31. 31. In your view, what degree of relevance with regard to the application of modern technology, does the following statement have:- "The Fourth Industrial Revolution (4iR) makes it imperative to produce a 'modern fully-fledged' graduate for the evolving Geomatics industry; one who has a sound theoretical & practical foundation, is well informed of the latest technological developments & innovations, can effectively demonstrate the required skill sets & core competencies in a range of sub disciplines, display the desired technical aptitudes, embrace changes in technology, adapt to new work methodologies, and improve efficiency and productivity in the competitive World of work". *

Mark only one oval.

	1	2	3	4	5	6	7	
Not relevant at all	◯	◯	◯	◯	◯	◯	◯	Very relevant

32. 32. The establishment of a 2 to 3 week Geomatics practical Survey camp conducted annually, through a University-Industry collaborative partnership to enhance student's practical & technical proficiencies; should be considered in the absence of Workplace learning and in preparation for the World of work. *

Mark only one oval.

- ◯ Strongly Agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly Disagree

33. 33. Problem based learning (PBL) in the Geomatics curriculum, through work simulation at the University encompassing Industry oriented problem-based activities, tasks & assignments, to enhance critical thinking skills and problem solving abilities, should be considered as a possible creative alternative to Work place learning to prepare students / graduates for the World of work. *

Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly disagree

34. 34. Project based learning (PJBL) in the Geomatics curriculum, through a University-Industry collaborative initiative encompassing Real-world projects (e.g. Industry & community projects) in an Industry controlled setting, should be considered as a possible creative alternative to Workplace learning; as a means of preparing students / graduates for the World of work, by facilitating the acquisition & transfer of Real-world knowledge and skills. *

Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly disagree

35. 35. The introduction of a Geomatics practical Survey camp, Problem based learning (PBL) and Project based learning (PJBL) may not produce the same level of desired impact and potential benefit, compared to a period (e.g. 3 - 12 months) of actual structured and monitored professional practice Industry Workplace learning. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

36. 36. If it is established that Work integrated learning (WIL) should be included in the Geomatics degree, In your view, what period of Workplace learning will be appropriate, considering that the essential theoretical & academic content must also be achieved as part of the new qualification outcomes, to produce an all round graduate? *

Mark only one oval.

- 3 months
- 6 months
- 9 months
- 12 months

37. 37. If it is established that Work integrated learning (WIL) should be included in the Geomatics degree, In what year of study should the Workplace learning ideally take place? *

Mark only one oval.

- Year 2 - semester 1
- Year 2 - semester 2
- Year 3 - semester 1
- Year 3 - semester 2

38. 38. How likely are you to provide Workplace training to Geomatics students / graduates for the purposes of registration with the South African Geomatics Council (SAGC) or just for Industry work experience? *

Mark only one oval.

- Very likely
- Likely
- Neutral
- Unlikely
- Very unlikely

39. 39. As a Private practitioner / employer or as a Manager / Director / Supervisor of an organization / company, I support the professional development of Geomatics graduates and is prepared to educate, train, supervise or mentor students / graduates through a formal Work-based programme such as a Internship or Learnership e.g. Sector Education & Training Authority (SETAs), National skills fund initiatives or private Work-based programmes, to contribute to the career growth and development of graduates. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

40. 40. As a Private practitioner / employer or as a Manager / Director / Supervisor of an organization / company, I support the professional development of Geomatics graduates and is prepared to educate, train, supervise or mentor students / graduates on a formal employment / contract basis, through some minimal investment of time, financial and human resources, to contribute to the career growth and development of graduates. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

41. 41. As a Private practitioner / employer or as a Manager / Director / Supervisor of an organization / company; How many students on average do you estimate, you may be able to accommodate for Work integrated learning (WIL) in a 3 to 12 month period, through a formal Work-based Internship / learnership programme? *

Mark only one oval.

- 0
- 1 - 3
- 3 - 6
- 6 - 9
- > 9
- Other: ____________

42. 42. As a Private practitioner / employer or as a Manager / Director / Supervisor of an organization / company; How many students on average do you estimate, you may be able to accommodate for Work integrated learning (WIL) in a 3 to 12 month period, through a formal employment / contract basis? *

Mark only one oval.

- 0
- 1 - 3
- 3 - 6
- 6 - 9
- > 9
- Other: ____________

43. 43. There should be an increased engagement between the Universities, government, students, communities, professional bodies, and Industry stakeholders from the public & private sectors, in an effort to enhance real Workplace knowledge & skills acquisition, promote entrepreneurship, and facilitate the professional development and career progression of students / graduates in the World of work, to promote a knowledge-driven economy and for societal impact. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

44. 44. Rate the level of concern you may have with regard to the Covid-19 Pandemic on the economy, and in terms of the impact it may have on the development and recruitment of capable, knowledgeable, skilled, and competent Geomatics graduates from the DUT. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not concerned at all	◯	◯	◯	◯	◯	◯	◯	Very concerned

45. 45. Do you wish to provide any further feedback pertaining to Work integrated learning (WIL) / Workplace learning; or wish to elaborate on any question above; or have any comments regarding the new Geomatics qualification? If None, state No. *

Thank you for taking the time to participate in this research study. Your contribution to Geomatics Education and Training is greatly appreciated.

Appendix D: WIL – Sample of WIL Student Questionnaire

Geomatics Work Integrated Learning (WIL) / Workplace Learning - DUT Student Questionnaire

Thank you for participating in this Research study.

The Durban University of Technology (DUT) has phased out the National Diploma: Surveying and the B-Tech: Surveying qualifications and introduced a new three academic qualification: Bachelor of The Built Environment (BBE): Geomatics in January 2018. Work Integrated Learning (WIL) / Workplace Learning is not included in the new qualification.

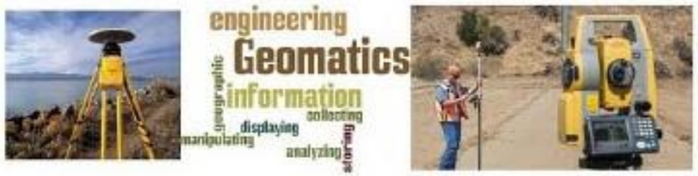
The purpose of this survey is to collect and analyze feed back pertaining to the historical impact of Experiential learning conducted in the National Diploma: Surveying programme, and to evaluate the relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology, through interactions with industry practitioners within the Surveying and Geomatics fraternity in the Kwa-Zulu Natal region.

Participation in this study is voluntary and anonymous. Your response to the following questions will be beneficial to the education and training sectors, and assist in terms of informed decision making and best practices to increase our understanding of industry's and student's perspectives on WIL (Workplace learning). The information will be treated with the utmost confidentiality, and will be used solely for the purpose of this study. The expected time needed to complete the questionnaires is between 8 – 10min which consists of 4 sections.

Note: You are not required to include your name.

Tick the appropriate box for each item below to indicate your response or level of agreement for each of the following:-

*Required



Part A: Informed Consent

Names of Researcher/s: Mr A. Raghubar; Prof D. Allopi

Statement of Agreement to Participate in the Research Study:

1. I hereby confirm that I have been informed by the researcher, Mr A. Raghubar, about the nature, conduct, benefits and risks of this study.
2. I have also received, read and understood the above written information (Participant letter of Information) regarding the study.
3. I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis (if provided) will be anonymously processed into a study report.
4. In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
5. I may, at any stage, without prejudice, withdraw my consent and participation in the study.
6. I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
7. I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

==== ====== ====== ===== ====== ====== ====== ===== ====== ====== ====== ===== ====== ====== ====

I, Mr A. Raghubar herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

AVIDESH RAGHUBAR ____________________ Full Name of Researcher

27 July 2021 ________________ Date

1. 1. I have read and acknowledged the attached Letter of information and the above Statement of agreement, and hereby provide consent to participate in this research study. *

Mark only one oval.

◯ Yes - I provide consent

Part B: General

*Tick the appropriate box for each item below to indicate your response or level of agreement for each of the following:-

2. 2. Please confirm that you are currently, a registered student at DUT or have been a registered student at DUT, studying the BBE: Geomatics qualification. *

Mark only one oval.

◯ Yes, I confirm.

3. 3. Please indicate your current academic level of studies at DUT. *

Mark only one oval.

- ◯ Year 2 of study
- ◯ Year 3 of study
- ◯ Completed qualification

Part C: Work Integrated Learning (BBE: Geomatics)

The new Bachelor of the Built Environment (BBE): Geomatics degree has replaced the National Diploma: Surveying and B-Tech: Surveying qualifications.

The purpose of the BBE: Geomatics programme (3 year academic degree) is for students to assimilate the necessary knowledge, understanding, and skills in Geomatics. This combined with a period of post qualification mentored work experience will enable them to become competent practicing engineering surveying technologists (engineering surveyors), able to apply Geomatics knowledge to make judgment, work independently and responsibly. To contribute to the critical mass of engineering surveyors educated specifically for the World of work and research, and who also play a pivotal role in the infrastructure development of our country, and make a contribution to the economy and national development (Civil Engineering and Geomatics handbook 2021. DUT)

*Tick the appropriate box for each item below to indicate your response or level of agreement for each of the following>

4. 4. Select the option below that confirms and best describes your level of general understanding on the educational practices of Work integrated learning / Workplace learning and Experiential learning (In-service training). *

Mark only one oval.

- ◯ Yes, I have a good understanding.
- ◯ Yes, I have a fair / moderate understanding.
- ◯ Yes, I have some basic understanding.

5. 5. As a student, were you aware that the BBE: Geomatics qualification did not have a Work integrated learning (WIL) / Workplace learning component? *

Mark only one oval.

- ◯ Yes
- ◯ No

6. 6. Do you agree with the exclusion of Work integrated learning (WIL) / Workplace learning in the BBE: Geomatics qualification? *

Mark only one oval.

- ◯ Yes
- ◯ No

7. 7. The lack of Work integrated learning (WIL) / Workplace learning in the BBE: Geomatics degree may be regarded as a valid concern as theoretical (classroom-based) learning and campus Survey practical's alone, may be insufficient for Industry requirements and employment opportunities. *

Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly disagree

8. 8. The lack of Work integrated learning (WIL) / Workplace learning in the BBE: Geomatics degree is not of critical concern and will not affect the student's employability, as graduates will have to obtain post qualification work experience to enable them to become competent skilled practicing Engineering Survey Technologists. *

Mark only one oval.

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ Strongly disagree

9. 9. Work integrated learning (WIL) / Workplace learning is regarded as an essential component of a professional career focused education, and a means of obtaining 'Real-world' Industry practical, technical & employability skills, and should be considered for introduction in the BBE: Geomatics degree. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

10. 10. The absence of Work integrated learning (WIL) in the BBE: Geomatics degree, may have a significant impact on the type and quality of graduate entering the employment sector, due to the lack of actual Workplace learning in the academic programme. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

11. 11. The absence of Work integrated learning (WIL) / Workplace learning in the BBE: Geomatics degree may disadvantage students and may be considered as a barrier to personal and professional development, while also impacting on job prospects and employment opportunities of those entering the work sector. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

12. 12. The absence of Work integrated learning (WIL) / Workplace learning in the BBE: Geomatics degree, may possibly lead to an unexpected and indirect increase in the unemployment rate amongst University graduates, as potential Employers may perceive graduates to be lacking discipline specific skills, employability skills and key competencies required for the World of work. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

13. 13. Work integrated learning (WIL) / Workplace learning may be relevant in the degree to:- Develop responsible, productive, ethical & accountable graduates, Increase work readiness & student competence, Improve problem solving abilities, critical thinking & decision making; and Improve technical knowledge, skills and individual capabilities for the competitive work sector. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

14. 14. The absence of Work integrated learning (WIL) in the BBE: Geomatics degree may disrupt the student's ability to link and integrate theoretical (classroom-based) knowledge with professional practice-based knowledge gained through Workplace learning, thereby possibly affecting the full value of the learning experience. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

15. 15. As a student / graduate, I feel confident in my personal capability of adapting to the requirements and expectations of the Industry environment, even without any Work integrated learning (WIL) / Workplace learning experience. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

16. 16. As a student / graduate, I believe that we are adequately prepared with an appropriate level of hands-on practical training and technical skills, achieved during on-campus Survey practical sessions & demonstrations, to confidently venture out into Geomatics World of work. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

17. 17. Work integrated learning (WIL) / Workplace learning may be beneficial to students in terms of improved academic performance, positive attitude, motivation to learn, professionalism, work ethic and improved work-related capabilities, after exposure to the Workplace, and obtaining greater clarity into the specifics of the Geomatics profession. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

18. 18. Rate the level of importance and relevance you believe, that Work integrated learning (WIL) has in developing 'Employability skills' such as:- Responsibility & reliability; Professionalism; Problem solving abilities & Critical thinking; Decision making; Self-management; Teamwork & collaboration; Leadership; Time management skills; Communication skills and literacy; Interpersonal skills; Organizational skills; Information Technology (IT) skills, Ethics, Application of modern tools, instrumentation & technology; Entrepreneurship, Business awareness etc. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not important at all								Very important

19. 19. A greater emphasis on core academic knowledge and theoretical content in the BBE: Geomatics curriculum in order to reinforce key concepts is preferred, instead of a period of actual Industry Workplace learning, to better prepare and equip students / graduates for the World of work. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

20. 20. The establishment of a 2 to 3 week Geomatics practical Survey camp conducted annually, through a University-Industry collaborative partnership to increase student's practical & technical capabilities; should be considered in the absence of Workplace learning and in preparation for the World of work. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

21. 21. Problem based learning (PBL) in the Geomatics curriculum, through work simulation at the University involving Industry oriented problem-based activities, tasks & assignments, to improve critical thinking skills and problem solving abilities, should be considered as a possible creative alternative to Work place learning to prepare students / graduates for the World of work. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

22. 22. Project based learning (PJBL) in the Geomatics curriculum, through a University-industry collaborative partnership involving Real-world projects (e.g. Industry & community projects) in an Industry controlled environment, should be considered as a possible creative alternative to Workplace learning; as a means of preparing students / graduates for the employment sector, and assist in the transfer of Real-world knowledge and skills. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

23. 23. The introduction of the Geomatics practical Survey camp, Problem based learning (PBL) and Project based learning (PJBL) may not have the same level of desired impact and potential benefit compared to a period (e.g. 3 - 12 months) of actual structured and monitored professional practice Industry Workplace learning. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

24. 24. If it is established that Work integrated learning (WIL) should be included in the Geomatics degree, In your view, what period of Workplace learning will be appropriate, considering that the essential theoretical & academic content, must also be achieved as part of the new qualification to produce an all round graduate? *

Mark only one oval.

- 3 months
- 6 months
- 9 months
- 12 months

25. 25. If it is established that Work integrated learning (WIL) should be included in the Geomatics degree, In what year of study should the Workplace learning ideally take place? *

Mark only one oval.

- Year 2 - semester 1
- Year 2 - semester 2
- Year 3 - semester 1
- Year 3 - semester 2

26. 26. There should be an increased engagement between the Universities, government, students, communities, professional bodies and Industry partners / stakeholders from the public & private sectors, to improve real Workplace knowledge & skills, promote entrepreneurship, and encourage the professional development and career progression of students / graduates in the World of work, which will be beneficial to civil society and the national economy. *

Mark only one oval.

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly Disagree

27. 27. Rate the level of concern you may have with regard to the impact of the Covid-19 Pandemic on the economy, in terms of the challenges that you may face in securing suitable employment upon graduation. *

Mark only one oval.

	1	2	3	4	5	6	7	
Not concerned at all								Very concerned

28. 28. Do you wish to provide any further feedback regarding Work integrated learning (WIL) / Workplace learning; or wish to elaborate on any question above or have any comments regarding Geomatics practical's / Project work in the new qualification? If none, state No. *

Thank you for taking the time to participate in this research study. Your contribution to Geomatics Education and Training is greatly appreciated.

Appendix E: Sample of blank Diploma ET4 and ET5 report forms

ET4

Confidential

DUT DURBAN UNIVERSITY OF TECHNOLOGY

Department of Civil Engineering and Surveying

Experiential Learning

Summary, Evaluation and Certification by the Employer and Technikon

Surname						Initials	
Student Number			Identity Number				
Qualification	N A T I O N A L D I P L O M A : S U R V E Y I N G						
Experiential Training Period	1	2	3	4	5	6	
Training Period - From				To			
Employer				Telephone No.			
Contact Person				Fax No.			

***** Evaluation of Student's Experiential Training Tasks by Employer *****

Summary of Tasks and Assignments	Time Days	Evaluation			Supervisor's Signature
		1	2	3	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					

Evaluation Scale : 1 = unsatisfactory; 2 = satisfactory; 3 = excellent

****** Certification of Student's Competency by the Company Representative ******

Competency of student	Unsatisfactory	Satisfactory	Excellent

Signature : .... Date : ....

Name and Title : ....

Official Company Stamp

Confidential

****Evaluation of Student's Personal Skills by Supervisor****	
Evaluation Scale for Supervisor	1 = Poor (Below 60%) 2 = Satisfactory (60% - 79%) 3 = Excellent (80% - 100%)

	Factors	Evaluation			
		N/A	1	2	3
1	Responsibility and Reliability				
2	Initiative and Problem Solving Ability				
3	Human Relations				
4	Written Communication Skills				
5	Oral Communication Skills				
6	Occupation Safety				

Comments: ....
....
....
....

The information contained in this report may/may not be disclosed to the student
(Delete whichever is not applicable)

Signature: .... Date: ....

Name: .... Position: ....

****** This section to be completed by Experiential Learning Co-Ordinator ******					
****** Certification of student's experiential learning by the University ******					
Student's report *(ET5)* attached to ET4		Yes		No	
Interview needed		Yes		No	
Interview with student	Interviewed by				
	Rank				
	Signature:		Date:		
Acceptable number of weeks / days			Cumulative total acceptable weeks / days		
Unacceptable number of weeks / days					

Signature: .... Date: ....
Experiential Learning Co-ordinator

Signature: .... Date: ....
Head of Department *(if not EL Co-Ordinator)*

Captured by Departmental Secretary

Signature: .... Date: ....

ET5

Confidential

DURBAN UNIVERSITY OF TECHNOLOGY

Department of Civil Engineering and Surveying

Three Monthly Report : Experiential Learning

Three Monthly Report : Experiential Learning	Report Number	

Employer Information	**Student Information**
Name:	Name: Initials:
Postal Address:	Student Number:
Code:	Identity Number:
Telephone:	Experiential Training Period:
Fax:	From:
Contact Person:	To:

***** Brief Description of tasks completed by student during period of report *****

Comments : Employer	Comments : Student

Performance appraisal (scale 1 - 10) (to be completed by supervisor)		Comments : University
Quality of work		
Productivity		
Responsibility / Reliability		
Theoretical Knowledge		
Practical Skills		
Motivation		
Communication Skills		
Human Relations		
Punctuality		
Initiative / Problem Solving		
Report Writing		

****** Signatures ******

Student: .... Date: ....

Employer: .... Date: ....

Name: ....

Position: .... Official Company Stamp

Telephone: ....

....

Experiential Learning Co-ordinator Date

Comments: ....

....

Appendix F: Sample of template for experiential training record data

DUT NATIONAL DIPLOMA: SURVEYING EXPERIENTIAL TRAINING RECORD DATA (2010 - 2020)

					FIRST SIX MONTHS - (TIME 1)																
					ET4 FORM REPORT DATA PERSONAL SKILLS APPRAISAL						ET5 FORM REPORT DATA PERFORMANCE APPRAISAL										
No:	NAME:	STUDENT NO:	COMPANY:	TRAINING PERIOD:	Responsibility & Reliability	Initiative & Problem solving ability	Human Relations	Written Communication Skills	Oral Communication Skills	Occupational Safety	Quality of work	Productivity	Responsibility & Reliability	Theoretical knowledge	Practical skills	Motivation	Communication Skills	Human Relations	Punctuality	Initiative & Problem solving	Report Writing
MAXIMUM SCORES					3	3	3	3	3	3	10	10	10	10	10	10	10	10	10	10	10
1																					
2																					
3																					
4																					
5																					
6																					
7																					
8																					
9																					
10																					
11																					
12																					
13																					
14																					
15																					
16																					
17																					
18																					
19																					
20																					

	SECOND SIX MONTHS - (TIME 2)																	
	ET4 FORM REPORT DATA PERSONAL SKILLS APPRAISAL						ET5 FORM REPORT DATA PERFORMANCE APPRAISAL											SUMMARY OF EMPLOYER COMMENTS (OPTIONAL)
No:	Responsibility & Reliability	Initiative & Problem solving ability	Human Relations	Written Communication Skills	Oral Communication Skills	Occupational Safety	Quality of work	Productivity	Responsibility & Reliability	Theoretical knowledge	Practical skills	Motivation	Communication Skills	Human Relations	Punctuality	Initiative & Problem solving	Report Writing	
MAXIMUM SCORES	3	3	3	3	3	3	10	10	10	10	10	10	10	10	10	10	10	
1																		
2																		
3																		
4																		
5																		
6																		
7																		
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11																		
12																		
13																		
14																		
15																		
16																		
17																		
18																		
19																		
20																		

ET4 REPORT KEY	
Blank	Not applicable
1	Poor (Below 60%)
2	Satisfactory (60% - 79%)
3	Excellent (80% - 100%)

ET5 REPORT KEY	
1 - 4	Poor
5 - 6	Average
7 - 8	Good
9 - 10	Excellent
Blank	Not applicable

Appendix G: Gatekeeper letter of permission for SAGI

Department of Civil Engineering & Geomatics
Steve Biko Campus - cnr Botanic Gardens & Mansfield Roads, Berea. P.O. Box 1334, Durban, 4000
Tel: 031-373-2224 Fax: 031-373-2816.

South African Geomatics Institute (SAGI)
P O Box 201446
Durban North
4016

Tel: 031 563 9481
Fax: 086 684 1353
E-mail: admin.officer@sagi.co.za
E-mail: president@sagi.co.za

Attention: SAGI President – Mr Peter Newmarch

21 June 2021

PERMISSION TO CONDUCT RESEARCH STUDY:

Relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology.

Dear Mr Newmarch,

Greetings,

Trust you are keeping well.

My name is Avidesh Raghubar and I am conducting research for a Masters of the Built Environment (MBE): Geomatics degree at the Durban University of Technology (DUT), with Prof Dhiren Allopi, in the Department of Civil Engineering & Geomatics, and Faculty of Engineering & the Built Environment.

The Durban University of Technology (DUT) has phased out the National Diploma: Surveying and the B-Tech: Surveying qualifications and introduced a new qualification: Bachelor of The Built Environment (BBE): Geomatics in January 2018.

Work Integrated learning (WIL) has become an integral part of the teaching and learning pedagogy within the Surveying profession at a National Diploma level across many of the Technikons and Universities of Technology's (UoTs) nationally over the years, including the DUT. It has been widely recognized as the cornerstone of student development and their interactions with industry has led students to understand the mechanisms of real work place learning and the dynamics of a professional working environment. However, Work Integrated Learning (WIL) has now been excluded in the new BBE: Geomatics qualification.

The aim of this study is to investigate and evaluate the historical impact of Experiential learning (Work Integrated Learning) in terms of the impact on the student's overall personal and professional development, as conducted in the National Diploma: Surveying programme, and to evaluate the relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology, through interactions with industry practitioners within the Surveying and Geomatics fraternity, in the Kwa-Zulu Natal region.

The key objectives of the research are:-

- to determine whether the absence of WIL, will influence the type and quality of graduate entering the industry sector and if they will be perceived to be lacking substantive practical knowledge, skills and technical expertise to cope with the industry expectations.
- to establish whether the absence of WIL, will create a vacuum of knowledgeable, skilled, and competent technicians/technologists in industry thereby affecting industry productivity, workflow, output and economic growth.
- to determine whether the absence of WIL, is perceived as an inhibitor to student's personal growth and professional development.
- to determine whether it will affect the employability skills, graduate attributes, employment opportunities and job prospects of the graduates.

The study will seek to increase our understanding of industry's perspectives on WIL (Workplace learning), assist in terms of informed decision making and best practices, establish whether WIL is relevant in the BBE: Geomatics program and to possibly further establish if WIL could be effectively integrated into the new qualification, in accordance with industry and institutional requirements, to produce responsible, skilled, knowledgeable, ethical and competent practitioners, in an effort to maintain a high standard of professional conduct, work ethic and integrity, as stipulated in the Geomatics Profession Act (GPA) of 2013, for the country's workforce and the built environment industries that we serve. This study will therefore be beneficial to all stakeholders including the University, employers, government, communities and students, through means of increased collaboration.

Kindly grant me the necessary consent in the form of a letter of approval in order to proceed with the study, and the distribution of the electronic questionnaire survey via email to the SAGI KZN branch members.

Your assistance and corporation in this essential study would be most greatly appreciated.

Yours faithfully

....

Avidesh Raghubar
(Lecturer / Researcher)

Department of Civil Engineering & Geomatics
Faculty of Engineering & the Built Environment
Durban University of Technology
Tel. 031-373 2095
Fax. 031-373 2020
Email: avi@dut.ac.za

Appendix H: Gatekeeper letter of permission for DUT

DUT DURBAN UNIVERSITY OF TECHNOLOGY | FACULTY OF ENGINEERING & THE BUILT ENVIRONMENT | DEPARTMENT OF CIVIL ENGINEERING & GEOMATICS

Department of Civil Engineering & Geomatics
Steve Biko Campus - cnr Botanic Gardens & Mansfield Roads, Berea. P.O. Box 1334, Durban, 4000
Tel: 031-373-2224 Fax: 031-373-2816.

Dr Linganiso: Director Research and Postgraduate Support
Department of Research & Postgraduate Support
Durban University of Technology
P O Box 1334
Durban
4000

Tel: 031-373 2576 / 2577
Fax: 031-373 2946
E-mail: researchdirector@dut.ac.za.

02 June 2021

PERMISSION TO CONDUCT RESEARCH STUDY:

Relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology.

Dear Madam,

Greetings,

Trust you are keeping well.

My name is Avidesh Raghubar and I am conducting research for a Masters of the Built Environment (MBE): Geomatics degree at the Durban University of Technology (DUT), with Prof Dhiren Allopi, in the Department of Civil Engineering & Geomatics, and Faculty of Engineering & the Built Environment.

The Durban University of Technology (DUT) has phased out the National Diploma: Surveying and the B-Tech: Surveying qualifications and introduced a new qualification: Bachelor of The Built Environment (BBE): Geomatics in January 2018.

Work Integrated learning (WIL) has become an integral part of the teaching and learning pedagogy within the Surveying profession at a National Diploma level across many of the Technikons and Universities of Technology's (UoTs) nationally over the years, including the DUT. It has been widely recognized as the cornerstone of student development and their interactions with industry has led students to understand the mechanisms of real work place learning and the dynamics of a professional working environment. However, Work Integrated Learning (WIL) has now been excluded in the new BBE: Geomatics qualification.

The aim of this study is to investigate and evaluate the historical impact of Experiential learning (Work Integrated Learning) in terms of the impact on the student's overall personal and professional development, as conducted in the National Diploma: Surveying programme, and to evaluate the relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology, through interactions with industry practitioners within the Surveying and Geomatics fraternity, in the Kwa-Zulu Natal region.

The key objectives of the research are:-

- to determine whether the absence of WIL, will influence the type and quality of graduate entering the industry sector and if they will be perceived to be lacking substantive practical knowledge, skills and technical expertise to cope with the industry expectations.
- to establish whether the absence of WIL, will create a vacuum of knowledgeable, skilled, and competent technicians/technologists in industry thereby affecting industry productivity, workflow, output and economic growth.
- to determine whether the absence of WIL, is perceived as an inhibitor to student's personal growth and professional development.
- to determine whether it will affect the employability skills, graduate attributes, employment opportunities and job prospects of the graduates.

The study will seek to increase our understanding of industry's perspectives on WIL (Workplace learning), assist in terms of informed decision making and best practices, establish whether WIL is relevant in the BBE: Geomatics program and to possibly further establish if WIL could be effectively integrated into the new qualification, in accordance with industry and institutional requirements, to produce responsible, skilled, knowledgeable, ethical and competent practitioners, in an effort to maintain a high standard of professional conduct, work ethic and integrity, as stipulated in the Geomatics Profession Act (GPA) of 2013, for the country's workforce and the built environment industries that we serve. This study will therefore be beneficial to all stakeholders including the University, employers, government, communities and students, through means of increased collaboration.

Kindly grant me the necessary consent in the form of a letter of approval in order to proceed with the study, and the distribution of the electronic questionnaire survey via email to the DUT Geomatics students.

Your assistance and corporation in this essential study would be most greatly appreciated.

Yours faithfully

....

Avidesh Raghubar
(Lecturer / Researcher)

Department of Civil Engineering & Geomatics
Faculty of Engineering & the Built Environment
Durban University of Technology
Tel. 031-373 2095
Fax. 031-373 2020
Email: avi@dut.ac.za

Appendix I: Gatekeeper letter of approval from SAGI

Office of the President:
Mr Peter Newmarch
Ph: +27 (0) 31 5642856
president@sagi.co.za

South African Geomatics Institute

Office of the Secretariat:
Mrs Marylynn Grant
Ph: +27 (0) 31 5639481
admin.officer@sagi.co.za
P O Box 201446
Durban North
4016

23 June 2021

Mr Avidesh Raghubar
Durban University of Technology
P O Box 1334
Durban
4000

Dear Mr Raghubar

Research Survey: Relevance of Work Integrated Learning (WIL) in the Geomatics programme at DUT

SAGI President, Mr Peter Newmarch has agreed to SAGI distributing your Research Study Survey to SAGI KZN Members.

Please ensure that any personal data collated be kept strictly confidential.

Should you wish the survey to go to members in all provinces, please advise.

We wish you all success
With regards

Mrs Marylynn Grant
Administration & Finance Officer
South African Geomatics Institute

Appendix J: Gatekeeper letter of approval from DUT

Directorate for Research and Postgraduate Support
Durban University of Technology
Tromso Annexe, Steve Biko Campus
P.O. Box 1334, Durban 4000
Tel.: 031-3732576/7
Fax: 031-3732946

30th June 2021
Mr Avidesh Raghubar
c/o Department of Engineering and Geomatics
Faculty of Engineering and Built Environment
Durban University of Technology

Dear Mr Raghubar

PERMISSION TO CONDUCT RESEARCH AT THE DUT

Your email correspondence in respect of the above refers. I am pleased to inform you that the Institutional Research and Innovation Committee (IRIC) has granted **Gatekeeper Permission** for you to conduct your research "Relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology." at the Durban University of Technology. **Kindly note that this letter must be issued to the IREC for approval before you commence data collection.**

The DUT may impose any other condition it deems appropriate in the circumstances having regard to nature and extent of access to and use of information requested.

We would be grateful if a summary of your key research findings would be submitted to the IRIC on completion of your studies.

Kindest regards.
Yours sincerely

____
DR LINDA ZIKHONA LINGANISO
DIRECTOR: RESEARCH AND POSTGRADUATE SUPPORT DIRECTORATE

Appendix K: Sample of email invitation correspondence to SAGI members

INVITATION TO PARTICIPATE IN RESEARCH STUDY: GEOMATICS WORK INTEGRATED LEARNING (WIL) - EMPLOYER INDUSTRY QUESTIONAIRE SURVEY

Dear Industry participant,

Greetings Sir / Madam,

Trust you are keeping well.

My name is Avidesh Raghubar and I am conducting research for a Masters of the Built Environment (MBE): Geomatics degree at the Durban University of Technology (DUT), with Prof Dhiren Allopi, in the Department of Civil Engineering & Geomatics, and Faculty of Engineering & the Built Environment.

You are kindly invited to participate in this research study titled:-

"Relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology"

Link to Online Industry / Employer Questionnaire Survey:
https://forms.gle/CTbih3hzNzkrww37A

Preferably use Microsoft Edge, Google Chrome or FireFox Internet browser. Alternatively you may also use a Smart phone or Mobile device to access the survey.

The Durban University of Technology (DUT) has phased out the National Diploma: Surveying and the B-Tech: Surveying qualifications and introduced a new qualification: Bachelor of The Built Environment (BBE): Geomatics in January 2018.

Experiential Training and Work Integrated learning (WIL) have become an integral part of the teaching and learning instruction within the Surveying profession at a National Diploma level across many of the Technikons and Universities of Technology's (UoTs) nationally over the years, including the DUT. Work Integrated Learning (WIL) has now been excluded in the new BBE: Geomatics qualification.

The aim of this study is to investigate and evaluate the historical impact of Experiential learning (Work Integrated Learning) in terms of the impact on the student's overall personal and professional development, as conducted in the National Diploma: Surveying programme, and to evaluate the relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology, through interactions with industry practitioners within the Surveying and Geomatics fraternity, in the Kwa-Zulu Natal region.

The study will seek to increase our understanding of industry's and student's perspectives on WIL (Workplace learning), assist in terms of informed decision making and best practices, establish whether WIL is relevant in the BBE: Geomatics program and to possibly further establish if WIL could be integrated into the new qualification, in accordance with industry and institutional requirements, to produce responsible, knowledgeable, skilled, ethical and competent practitioners, for the country's workforce and the built environment industries that they serve. This study will therefore be beneficial to all stakeholders including the University, employers, students, government, professional bodies and communities, and society through means of increased collaboration.

Participation in this study is voluntary and anonymous. The information will be treated with the utmost confidentiality and will be used solely for the purpose of this study. The expected time needed to complete the questionnaires is between 10 – 15min.

Note: You are not required to include your name.

The supporting letter of information and informed consent is attached for your perusal. **The Informed consent is also embedded in the online Google electronic form Survey questionnaire for convenience.**

KINDLY CLICK ON THE LINK TO PARTICIPATE IN THE ONLINE INDUSTRY / EMPLOYER QUESTIONNAIRE SURVEY: **https://forms.gle/CTbih3hzNzkrww37A**

Your participation and assistance in contributing to Geomatics Education and Training is greatly appreciated.

Thanking you in advance for your time and contribution.

Kind Regards

Avidesh Raghubar
(Lecturer / Researcher)

Appendix L: Sample of email invitation correspondence to DUT students

INVITATION TO PARTICIPATE IN RESEARCH STUDY: GEOMATICS WORK INTEGRATED LEARNING (WIL) – STUDENT QUESTIONAIRE SURVEY

Dear Student participant,

Greetings Sir / Madam,

Trust you are keeping well.

My name is Avidesh Raghubar and I am conducting research for a Masters of the Built Environment (MBE): Geomatics degree at the Durban University of Technology (DUT), with Prof Dhiren Allopi, in the Department of Civil Engineering & Geomatics, and Faculty of Engineering & the Built Environment.

You are kindly invited to participate in this research study titled:-

"Relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology"

Link to Online Student Questionnaire Survey: **https://forms.gle/hW6aXkgUqvDVPYvL9**

Preferably use Microsoft Edge, Google Chrome or FireFox Internet browser. Alternatively you may also use a Smart phone or Mobile device to access the survey.

The Durban University of Technology (DUT) has phased out the National Diploma: Surveying and the B-Tech: Surveying qualifications and introduced a new qualification: Bachelor of The Built Environment (BBE): Geomatics in January 2018.

Experiential Training and Work Integrated learning (WIL) have become an integral part of the teaching and learning instruction within the Surveying profession at a National Diploma level across many of the Technikons and Universities of Technology's (UoTs) nationally over the years, including the DUT. Work Integrated Learning (WIL) has now been excluded in the new BBE: Geomatics qualification.

The aim of this study is to investigate and evaluate the historical impact of Experiential learning (Work Integrated Learning) in terms of the impact on the student's overall personal and professional development, as conducted in the National Diploma: Surveying programme, and to evaluate the relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology, through interactions with industry practitioners within the Surveying and Geomatics fraternity, in the Kwa-Zulu Natal region.

The study will seek to increase our understanding of industry's and student's perspectives on WIL (Workplace learning), assist in terms of informed decision making and best practices, establish whether WIL is relevant in the BBE: Geomatics program and to possibly further establish if WIL could be integrated into the new qualification, in accordance with industry and institutional requirements, to produce responsible, knowledgeable, skilled, ethical and competent practitioners, for the country's workforce and the built environment industries that they serve. This study will therefore be beneficial to all stakeholders including the University, employers, students, government, professional bodies and communities, and society through means of increased collaboration.

Participation in this study is voluntary and anonymous. The information will be treated with the utmost confidentiality and will be used solely for the purpose of this study. The expected time needed to complete the questionnaires is between 8 – 10min.

Note: You are not required to include your name.

The supporting letter of information and informed consent is attached for your perusal. **The Informed consent is also embedded in the online Google electronic form Survey questionnaire for convenience.**

KINDLY CLICK ON THE LINK TO PARTICIPATE IN THE STUDENT QUESTIONNAIRE SURVEY: https://forms.gle/hW6aXkgUqvDVPYvL9

Your participation and assistance in contributing to Geomatics Education and Training is greatly appreciated.

Thanking you in advance for your time and contribution.

Kind Regards

Avidesh Raghubar
(Lecturer / Researcher)

Appendix M: IREC approval certificate

Institutional Research Ethics Committee
Research and Postgraduate Support Directorate
2nd Floor, Berwyn Court
Gate 1, Steve Biko Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2375
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

23 July 2021

Mr A Raghubar
Department of Civil Engineering and Geomatics
Steve Biko Campus
Faculty of Engineering and the Built Environment
Durban University of Technology

Dear Mr Raghubar

Relevance of Work Integrated Learning (WIL) in the Geomatics programme at the Durban University of Technology
Ethics Clearance Number: 088/21

The Institutional Research Ethics Committee acknowledges receipt of your final data collection tool for review.

We are pleased to inform you that the data collection tool has been approved. Kindly ensure that participants used for the pilot study are not part of the main study.

In addition, the IREC acknowledges receipt of your gatekeeper permission letters.

Please note that FULL APPROVAL is granted to your research proposal. You may proceed with data collection.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC Standard Operating Procedures (SOP's).

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Yours Sincerely,

Prof J K Adam
Chairperson: IREC

ENVISION2030 transparency • honesty • integrity • respect • accountability
fairness • professionalism • commitment • compassion • excellence

Appendix N: Research ethics online training certificate

TRREE

Zertifikat

Certificado

Certificat

Certificate

Promouvoir les plus hauts standards éthiques dans la protection des participants à la recherche biomédicale
Promoting the highest ethical standards in the protection of biomedical research participants

Clinical Trials Centre
The University of Hong Kong

Certificat de formation - Training Certificate

Ce document atteste que - this document certifies that

Avidesh Raghubar

a complété avec succès - has successfully completed

Introduction to Research Ethics

du programme de formation TRREE en évaluation éthique de la recherche
of the TRREE training programme in research ethics evaluation

Release Date: 2021/06/02
CID : JCRGBO5fMg

Professeur Dominique Sprumont
Coordinateur TRREE Coordinator

FMH Continuing Education Program (5 Credits)
Programme de Formation continue (5 Crédits)

Foederatio Pharmaceutica Helvetiae FPH Programmes de formation continue

Continuing Education Programms
Programmes de formation continue

Ce programme est soutenu par - This program is supported by :
European and Developing Countries Clinical Trials Partnership (EDCTP) (www.edctp.org) - Swiss National Science Foundation (www.snf.ch) - Canadian Institutes of Health Research (http://www.cihr-irsc.gc.ca/e/2891.html) - Swiss Academy of Medical Science (SAMS/ASSM/SAMW) (www.samw.ch) - Commission for Research Partnerships with Developing Countries (www.kfpe.ch)

[REV : 20170310]

Appendix O: Statistician confirmation letter

Gill Hendry B.Sc. (Hons), M.Sc. (Wits), PhD (UKZN)
Mathematical and Statistical Services

Cell: 083 300 9896
Email: gillhendrystats@gmail.com

4 October 2021

Re: Assistance with data analysis

Please be advised that I have assisted Avidesh Raghubar (Student number 20251797), who is currently studying for an MBE at DUT, with the statistical analysis of his data.

Yours sincerely

Dr Gill Hendry
Private Consulting Statistician

Appendix P: English editor certificate

DR RICHARD STEELE
BA HDE MTech(Hom)
HOMEOPATH
Registration No. A07309 HM
Practice No. 0807524
Freelance academic editor
Associate member: Professional Editors' Guild, South Africa

110 Cato Road
Glenwood, Durban 4001
031-201-6508/082-928-6208
Postal: P.O. Box 30043, Mayville 4058
Email: rsteele@vodamail.co.za

EDITING CERTIFICATE

Re: **AVIDESH RAGHUBAR**
Master's dissertation: **RELEVANCE OF WORK INTEGRATED LEARNING (WIL) IN THE GEOMATICS PROGRAMME AT THE DURBAN UNIVERSITY OF TECHNOLOGY**

I confirm that I have edited this dissertation and the references for clarity, language and layout. I returned the document to the author with track changes so correct implementation of the changes and clarifications requested in the text and references is the responsibility of the author. I am a freelance editor specialising in proofreading and editing academic documents. My original tertiary degree which I obtained at the University of Cape Town was a B.A. with English as a major and I went on to complete an H.D.E. (P.G.) Sec. with English as my teaching subject. I obtained a distinction for my M.Tech. dissertation in the Department of Homoeopathy at Technikon Natal in 1999 (now the Durban University of Technology). I was a part-time lecturer in the Department of Homoeopathy at the Durban University of Technology for 13 years and supervised many master's degree dissertations during that period.

Dr Richard Steele
30 December 2021
per email