University of Cape Town

An exploration of mechanical engineering students' perceptions of the influence of their work placement experiences on their employability

Tiyamike Nyozani Ngonda

Thesis presented for the Degree of

DOCTOR OF PHILOSOPHY

in the Department of Mechanical Engineering

University of Cape Town

January 2020

Supervisor: Dr Corrinne Shaw

Co-Supervisor: Dr Bruce Kloot

DECLARATION

This thesis is submitted to the University of Cape Town in fulfilment of the requirements for the degree of Doctor of Philosophy. It has not been submitted before for any degree or examination at this or any other university. The author confirms that this thesis is based on his own work, save for that which is duly referenced.

Signed by candidate

Tiyamike Nyozani Ngonda

ABSTRACT

Most researchers agree that work placement has a positive influence on students' employability. Despite this consensus, there has been conflicting research on the factors that contribute to this influence. Moreover, the social mechanisms through which this outcome is realised have not been well understood. To address these shortcomings, this study explores how mechanical engineering students' work placement experiences facilitate or hinder the growth of their occupational competency and self-efficacy, two commonly used indicators of student employability. It provides a clear explanation of the factors and social mechanisms that produce employability outcomes and it is hoped that this would enable the implementation of work placement programs in a manner that would promote rather than hinder students' employability.

The study is informed by social cognitive theory's triadic reciprocal causation model, which suggests that student learning arises from interactions of environmental, personal, and behavioural factors. It is further informed by situated cognition, a sociocultural theory that focuses on learning through participation. The study collected qualitative data from a sample of 34 mechanical engineering students from a South African university of technology who were undergoing a year-long work placement. Data were collected using semi-structured interviews as well as document analysis of the students' logbooks and evidence portfolios. Thereafter, a two-phase qualitative analysis comprising thematic analysis and thematic synthesis was conducted.

The thematic analysis produced seven themes: the learning environment, the industry mentor, student performance and participation as learning, quality of work affordances, student characteristics, student's agentic role and student learning

trajectory. These themes represented elements of students' work placement experiences that they considered influential in the growth of their occupational competency and self-efficacy. The thematic synthesis uncovered work placement as a system with emergent outcomes arising from interactions of its variables. These interactions were represented by a qualitative systems dynamics model with negative and positive reinforcing loops. An enabling reinforcing feedback loop explained the growth of the students' occupational competency and self-efficacy, and a constraining reinforcing feedback loop explained how such growth was hindered. This qualitative systems dynamics model may resolve previous studies' explanatory shortcomings by illuminating the processes through which work placements' occupational outcomes are realised.

ACKNOWLEDGEMENTS

This thesis is based on a study that was conducted amongst the 2017 cohort of third-year National Diploma in Mechanical Engineering students at a South African university of technology. I express gratitude to these students for availing themselves to talk to me about their work placement experiences.

I express gratitude to Mr P. Tebele, Mr G. Morris and Prof MAE Kaunda for their assistance.

I acknowledge the moral support and guidance I received from Dr Kant Kanyarusoke.

I acknowledge the financial support that I received from the Cape Peninsula University of Technology (CPUT).

Finally, I thank my supervisors, Drs Corrinne Shaw and Bruce Kloot, for their patience and insightful supervision.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PUBLICATIONS ARISING FROM STUDY

Ngonda, T., Shaw, C. & Kloot, B. 2020. Perceived influence of mechanical engineering students' work placement experiences on their occupational competency and self-efficacy. Accepted on for publication in *International Journal of Mechanical Engineering Education*. DOI: 10.1177/0306419020953117

Ngonda, T., Shaw, C. & Kloot, B. 2020. Mechanical engineering students' perception of the quality of work affordances during work placement. *48th SEFI Annual Conference (SEFI2020).* 20-24 Sept 2020, Enschede, Netherlands: European Society for Engineering Education.

Ngonda, T., Shaw, C. & Kloot, B. 2019. The role of mentors in navigating the paradoxes of industry-based learning. *8th Research in Engineering Education Symposium (REES 2019).* 10–12 July, 2019. Cape Town, South Africa: Research in Engineering Education Symposium. 103-112.

Ngonda, T., Shaw, C. & Kloot, B. 2017. Mechanical engineering students' perceptions of workplace mentoring: A case study at a South African university of technology. *28th Annual Conference of the Australasian Association for Engineering Education (AAEE 2017).* 10-13 December 2017. Sydney, Australia: Australasian Association for Engineering Education. 180-187.

Ngonda, T., Shaw, C. & Kloot, B. 2017. Emerging student-centred perspectives on work placement as a component of mechanical engineering technology education. *Proceedings of the Fourth Biennial Conference of the South African Society for Engineering Education*. 14-15 June 2017. Cape Town, South Africa: South African Society for Engineering Education. 220-231.

LIST OF ABBREVIATIONS AND ACRONYMS

BIng or BEng	Bachelor of Engineering
BSc	Bachelor of Science
CAD	Computer Aided Design
CNC	Computer Numerical Control
DipEng	Diploma in Engineering
DipEngTech	Diploma in Engineering Technology
DHET	Department of Higher Education and Training
DOE	Department of Education
ECSA	Engineering Council of South Africa
HEQSF	Higher Education Qualifications Sub-Framework
HVAC	Heating, ventilation, and air conditioning
NDip	National Diploma
P1	Mechanical Engineering Practice 1
P2	Mechanical Engineering Practice 2
TVET	Technical and Vocational Education and Training
UoT	University of Technology
WIL	Work integrated learning

CHAPTER ONE
INTRODUCTION

1.1 Introduction to the study

In their review of employability literature, Artess, Hooley and Mellors-Bourne (2017) observe that researchers generally agree that work placement is an effective strategy for preparing students for a smooth and structured transition into their chosen professions. Work placement is a structured period of workplace-based learning in which students are attached to an occupationally relevant workplace for the students to gain relevant work experience as part of their qualifications (Smith et al., 2009).

According to Reddan (2016), in most parts of the world, universities implement work placement as a response to growing demands by governments, professional bodies and industry for employable graduates. The term employability, as defined by York and Knight (2006), refers to:

> a set of achievements – skills, understandings and personal attributes – that make graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy. (York & Knight, 2006: 3)

York and Knight's (2006: 3) and Jackson (2014) concur that the aspect of employability relating to 'a set of achievements – skills, understandings and personal attributes' concerns students having occupational competency. In this study, the term 'occupational competency' refers to possessing knowledge, skills and behaviours that are needed to meet the demands of a job (Le Deist & Winterton, 2005). Edwards (2014) contends that besides being perceived to be occupationally competent, the students need to have work self-efficacy – confidence that they

would be able to perform and succeed in their chosen professions. Markauskaite and Patton (2019) concurs and adds that developing these two attributes capabilities is central to preparing students for the workplace. Thus, student employability could be considered in terms of occupational competency and work self-efficacy.

1.2 The evolution of South African engineering education and the resulting changes in work placement learning

In South African engineering education, the practice of work placement has been influenced by policy changes arising from the evolution of engineering education. Therefore, to understand how work placement is practised by UoTs, there is a need to trace how they and engineering education have evolved since the apprenticeship period. This section summarises the changes that occurred in engineering education from 1884 to 2018 with an emphasis on those that have affected UoTs. The section also summarises the policy changes that have influenced the regulation of engineering practice and the accreditation of engineering programmes.

It is not surprising that the evolution of engineering education in South Africa, a Commonwealth country, has been similar to that of the United Kingdom. Before the 20th century, engineers were trained through apprenticeship, technical college education and university education (Erasmus, 2008; Kloot & Rouvrais, 2017). Erasmus (2008) explains that initially, training through apprenticeships only was available; Natal Government Railways established the first formalised apprenticeships in 1884. Cape Government Railways soon followed and established its apprenticeship programme in 1890. After the discovery of gold, technical education developed rapidly so that by 1923, Natal Technical College and Cape Technical College were declared places of higher education (Erasmus, 2008).

Despite their changed status, these technical colleges continued to provide tuition in support of the apprenticeship system.

Erasmus (2008) explains that university education in engineering developed at the same time but parallel to technical education. She notes that there were rapid developments in university engineering education during the period up to 1922 when the University of Cape Town and University of the Witwatersrand started to offer bachelor's degrees in engineering. Even though there were these developments, the practice of engineering remained stagnant. The name 'engineer' was not restricted; any person who might be employed in the capacity of an engineer, other than in the mining industry, could use the title. In mining, only engineers who were holders of government-issued certificates of competency were recognised by law and had their responsibilities defined by regulation (Gericke, 1997). Unfortunately, the Mines and Works Act 12 of 1911, which regulated the awarding of certificates of competency, was silent on the qualifications that a certified engineer was required to possess.

Gericke (1997), whose work focused on the history of engineering in South Africa from 1890 to 1968, wrote of contestations between graduate engineers and those trained through technical colleges and apprenticeships. He documented several attempts by graduate engineers to restrict the use of the title `engineer', but all of them were defeated. Other role players felt that it should be left to employers to decide whom they should appoint as engineers. This situation persisted until February 1969 when the Professional Engineers' Act 81 of 1968, came into operation. The Act established the South African Council for Professional Engineers (SACPE) as the body tasked with regulating the work of professional engineers as well as their training. It required graduate engineers to undergo training under experienced engineers for a minimum of three years before being eligible for

registration. Engineering education was left to the universities, with its quality assured by accreditation. In his 1974 Presidential Address to the South African Institute of Civil Engineers, Harris (1974) stressed the importance of vacation work for engineering students. He recommended that his Institute support this practice, particularly since (in some cases) recently-graduated engineers were appointed as Resident Engineers for major projects owing to skills shortages.

From 1968 to 1991, the status, education and professional registration of South African engineers did not change much. During this period, most developments were aimed at strengthening the functions and instruments of the SACPE (Kruger, 1991). From its inception, the SACPE made it difficult for engineers other than graduates to register as Professional Engineers. However, it did not ban them outright. They could register if they had enough experience as working engineers and if they had passed a qualifying examination. These developments led to the need for the provision of registration of other engineering categories. Consequently, the Professional Engineers' Act was amended in 1979 to create two Boards of Control, one for registration of engineers and the other for engineering technicians (Kruger, 1991).

It is clear from the above developments that the occupational category of technicians began to separate from that of engineers from 1968. Diplomas in engineering which were offered by Colleges of Advanced Technical Education (CATEs), were structurally different from the engineering degrees offered by universities. The diplomas were offered in a cooperative education format for four years, with alternating six-month periods at college and work (Kruger, 1991). Furthermore, their course content was vocationally oriented and, in some cases, aligned with the needs of specific employers (Kruger, 1991).

Raju (2004) records that in 1979, the Advanced Technical Education Act 40 of 1967 which had established CATEs was amended to declare them to be 'technikons'. Three years later, in 1982, the technikons introduced a three-year diploma in technology for a new category of engineering para-professionals called engineering 'technologists'. Kruger (1991) explains that the SACPE was unhappy about this qualification because of a concern that the role of an engineering technologist would be confused with that of an engineer. He notes that these matters were partially resolved in 1985 when a new Board of Control for Professional Technologists (Engineering) was formed. However, the existence of separate registration boards for engineers and technologists did not last: in 1990, the three Boards of Control were replaced by a single entity, the Engineering Council of South Africa (ECSA), created by the Engineering Professions of South Africa Act 114 of 1990.

Erasmus (2008) notes that until 1993, the technikons were not qualifications-granting; their qualifications were awarded by a central body called the Certification Council for Technikon Education. In 1993, the Technikons Act 125 of 1993, allowed technikons to grant degrees. This newly-found status led to the revision of their academic offerings. The technikons reformed the –curriculum of their four-year diplomas in engineering to a three-year National Diploma (NDip). D'Almaine, Manhire and Atteh (1997) explain that the NDip comprised four semesters of theoretical studies over two years, followed by two semesters of experiential training in the course of a year at a cooperating company (D'Almaine, Manhire & Atteh, 1997). For those students who wanted to continue with further studies, the technikons replaced their three-year diploma in technology with a one-year Bachelor of Technology (BTech) degree. Holders of the NDip registered with SACPE as

engineering technicians whereas holders of the BTech registered as engineering technologists.

D'Almaine, Manhire and Atteh (1997) maintain that although technikons became degree-granting institutions in 1993, they were considered to be nominally equal to research-led universities as members of the South African higher education landscape. In 1995, the promulgation of the South African Qualifications Authority Act 58 of 1995, positioned technikon qualifications, like those of research-led universities, in the higher education and training band of the National Qualifications Framework (NQF). Two years later, their standing within higher education was reaffirmed by the Higher Education Act 101of 1997, which repealed the Technikons Act 125 of 1993, and Universities Act 61 of 1955. The Higher Education Act ended the separate regulation of the functioning of universities and technikons. Its passing marked the beginning of rapid changes in the South Africa higher education landscape, including mergers and the renaming of some of the higher education institutions. By 2004, South Africa's 36 higher educational institutions had been consolidated into seven universities of technology, two comprehensive universities and 14 research-led universities.

As higher education was going through these changes, engineering practice was also undergoing significant modifications. In 2000, the Engineering Professions of South Africa Act 114 of 1990 was replaced by the Engineering Profession Act 46 of 2000 (hereafter referred to as the ECSA Act). The ECSA Act mandated ECSA with accrediting engineering education programmes of higher education institutions, registration of persons as engineering professionals and regulation of the practice of registered professionals. In terms of this Act, ECSA registers engineering professionals in four categories: Professional Engineers (Pr Eng), Professional

Engineering Technologists (Pr Tech Eng), Professional Engineering Technicians (Pr Techni Eng) and Professional Certificated Engineers (Pr Cert Eng). Note that Pr Cert Eng is not restricted to holders of a specific engineering qualification. Any holder of an engineering qualification can be registered as Pr Cert Eng on the acquisition of a government-issued certificate of competency (ECSA, 2009). The Pr Cert Eng certifies its holder to perform certain functions in manufacturing, mining and merchant shipping.

The educational requirements for registration are as follows: Pr Eng requires a BSc (Eng) or a BEng degree, Pr Tech Eng requires a BTech degree and Pr Techni Eng requires an NDip. South African BSc (Eng) and BEng qualifications have remained relatively unchanged. In contrast, the BTech and NDip have changed regularly; de Koker (2016) notes that they have gone through significant modifications almost every 10 to 15 years (De Koker, 2016).

According to Report 151 of South Africa's Department of Education (DOE), the NDip in Engineering focused on preparing students for a specific or vocational career as an engineering technician (DOE, 1997). Its structure of instruction and content was, to a large extent, determined by the structure of the actual practice of engineering technicians. To preserve alignment with engineering technician practice, the subject content of the NDip was divided into three categories:

A-type subject content: practice and mastery of manual skills or crafts required for the performance of an occupation;
B-type subject content: mastery of the application of existing knowledge and technology that is relevant to an occupation;
C-type subject content: basic theoretical substructure and principles of scientific thought and method.

The NDip in Engineering comprised four semesters of coursework at university and two semesters of work placement at accredited industry companies. The coursework included lectures, laboratory practice, workshop practice and projects. The DOE (1997) indicates that the taught component of the NDip was required to contain up to 20% A-type content, 60% to 80% B-type content and up to 20% C-type content. The DOE (1997) also indicates that work placement is required to comprise 50% type A-content and 50% type B- content. This distribution of subject content confirms the assertion by Du Pre (20060 and Erasmus (2008) that work placement is crucial in maintaining the occupational-specific nature of the diploma, assisting students in acquiring occupationally relevant skills and dispositions (Smith et al., 2009).

For the NDip in Mechanical Engineering, work placement is divided into two six-month sections: Mechanical Engineering Practice 1 (P1) and Mechanical Engineering Practice 2 (P2). P1 and P2 differ in focus: during P1, students familiarise themselves with their workplaces and acquire type A skills, and during P2, students undertake a project under the supervision of a company-appointed mentor to facilitate the acquisition of type B skills.

In 2007, the South African Government promulgated the Higher Education Qualifications Framework (HEQF) which revised the NQF (South Africa, 2007). The HEQF marked the beginning of a unitary higher education system for South Africa, as envisaged in the Higher Education Act 101 of 1997. The HEQF replaced the NATED 151 and 152 reports that governed the qualifications of UoTs, and the NATED 116 report that dealt with qualifications of universities (South Africa, 2007).

A further revision occurred in 2013 when the HEQF was amended in Higher Education Qualifications Sub- Framework (HEQSF) (South Africa, 2013). The amendment, the HEQSF, especially affected the qualifications offered by UoTs. The

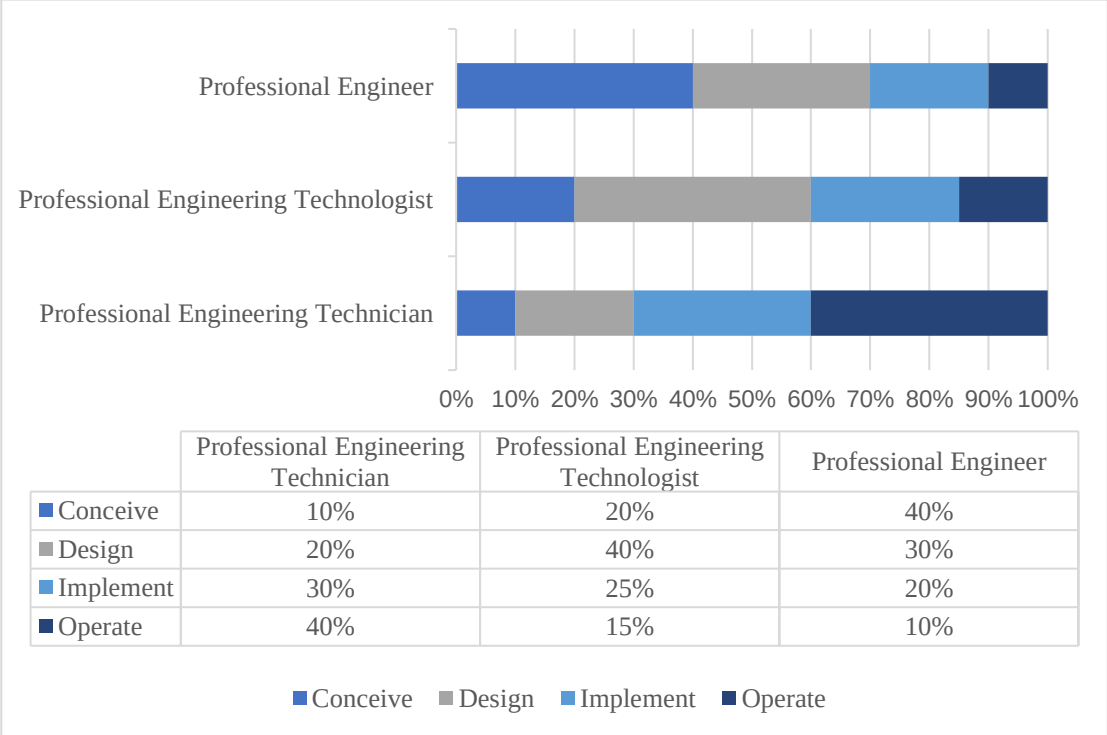
UoTs were forced to reform their qualifications to align them with the HEQSF. The most significant impact on the qualifications of UoTs was the following policy direction from the HEQSF that affected work placement:

> Where the entire WIL component or any part of it takes the form of workplace-based learning, it is the responsibility of institutions that offer programmes requiring credits for such learning to place students into appropriate workplaces. Such workplace-based learning must be appropriately structured, properly supervised and assessed (South Africa, 2013: 11).

The UoTs feared that they would be unable to meet the requirements of this directive under the existing work placement arrangements for their NDip. For this reason, they sought to move away from work placement to other forms of WIL which the HEQSF positioned as achieving the same outcomes as work placement. These include pedagogical practices such as `simulated learning, work-directed theoretical learning, problem-based learning, project-based learning' (DOE, 2013: 11). Since then, South African researchers such as Mutereko and Wedekind (2015) and Reinhard Pogrzeba and Townsend (2016) have discounted the positive outcomes of work placement, arguing that its positive outcomes might not be present in the South African context. At the same time, there were spirited protests from industry bodies against the possibility of having a new diploma that had no work placement component. De Koker (2016) notes the opposition voiced by the civil engineering industry:

> Many people in industry still maintain that the practical or industry component is essential for technology qualifications, distinguishing it as the hallmark of technology training and that graduates would not be able to function in industry without it. This view hails from the time when the technology qualifications were introduced in the late fifties and early sixties as the so-called 'sandwich courses,' with the student doing alternate academic and practical semesters. (p. 68)

De Koker (2016) bases his argument on the fact that engineering is a three-tier profession consisting of engineers, engineering technologists and engineering technicians (called 'engineering associates' in Australia). He argues that civil engineering technicians, whose occupational focus is approximated in Figure 1.1, require a different education from civil engineers; they need pre-qualification exposure to professional practice. Figure 1.1 estimates that civil engineering technicians spend seventy percent of their time implementing and operating, whereas civil engineers spend as much time conceiving and designing civil engineering artefacts.



	Professional Engineering Technician	Professional Engineering Technologist	Professional Engineer
Conceive	10%	20%	40%
Design	20%	40%	30%
Implement	30%	25%	20%
Operate	40%	15%	10%

Figure 1.1: Optimum application of civil engineering professionals in practice (De Koker, 2016: 68)

De Koker (2016) further argues that the training of various categories must align with their occupational role within this three-tier profession. Occupationally, a technician fits mid-way between an engineer and an artisan. A technologist fits between a technician and an engineer. Technicians and technologists are expected to possess manual skills as well as a working knowledge of engineering science. Technicians,

technologists and engineers are professionally oriented, whereas artisans are vocationally oriented. He concluded by suggesting that other branches of engineering have similar concerns as they have the same occupational differentiation.

Despite the opposition from industry, a new engineering qualification structure that aligns with the HEQSF was proposed by ECSA in 2013. Table 1.1 shows this HEQSF-aligned structure of engineering qualifications. It includes two diplomas in engineering: a 360 credit Diploma in Engineering (DipEng) that includes work placement and a 280 credit Diploma in Engineering Technology (DipEngTech) that does not include work placement. ECSA (2016) requires DipEngTech graduates to acquire 120 credits through coursework or monitored work experience before continuing with further studies and registering as candidate engineering technicians.

Table 1.1: The HEQSF-aligned engineering and engineering technology qualifications (adapted from ECSA, 2019a)

Qualification type	**HEQSF level at exit**						
	SAQA credits	**5**	**6**	**7**	**8**	**9**	**10**
HCertEng	120						
AdvCertEng	120						
DipEngTech	280						
DipEng	360						
AdvDip (EngTech)	140						
BEngTech	420						
PgDip (Eng)	120						
BEngTech (Hons)	120						
BEng	560						
MSc (Eng)/MEng	180						
PhD/DEng	360						

Artisans

Technicians

Technologists

To enable access to MEng

Engineers

The two diplomas were developed to accommodate the conflicting demands of UoTs and industry. Those who conceived of the DipEngTech expected that it would address the logistical and student-related challenges reported by some UoTs since students would no longer be required to include work placement. In contrast, they expected the DipEng to address the concerns of industry as outlined by De Koker (2016) concerning the work readiness of diploma graduates. Additionally, the DipEng is expected to facilitate the transition from high school science to engineering science and practice through additional instruction in natural sciences, Physics and Chemistry, at year one (Ziegler, Chipanga & Magoda, 2020).

Ziegler, Chipanga and Magoda (2020) note that this additional instruction in natural sciences necessitated a reduction in the duration of work placement learning from one year to six months. In considering ECSA's 2015 and 2019 qualification standards for DIpEng, it becomes clear that work placement learning is no longer mandatory (ECSA, 2015, 2019b). In the 2019 qualification standard, ECSA makes it clear that for the DipEng, a "simulated environment" could replace actual placement in industry as meeting its requirements of work integrated learning (ECSA, 2019b: 15). Despite these changes, a review of literature on student employability strategies by Winberg et al. (2020) found that work placement remains one of the most effective ways of assisting students to develop complex professional skills that are essential for employability.

1.3 Background to the research problem

According to Akins (2005), Hermann Schneider, who started the first cooperative education program at the University of Cincinnati in 1906, was the first to study the outcomes of work placement. Schneider studied the early careers of his students

and found that those who worked during their studies showed better engineering skills than those who did not combine their studies with working.

> [Schneider] researched the records of other Lehigh graduates and found that most of those who had shown marked ability in engineering during the early years after graduation had combined industry practice with education through part-time jobs, summer jobs or simply by dropping out of school to work periodically. [He] concluded that the educational value of working [during university education] exceeded [its] monetary gains. (Akins, 2005: 63)

Since that time, many researchers have confirmed Schneider's findings and reported numerous benefits of work placement. Silva (2017) found that work placement provides students with work experience that gives them an advantage when seeking their first job. Yorke and Knight (2006) report that work placement increases students' confidence, self-efficacy and communication skills. Lock, Bullock, Gould and Hejmadi (2009) report several benefits that accrued for mechanical engineering students: increased belief in their abilities, confidence in their capacity to secure appropriate jobs after graduation and increased aptitude for learning. A South African study by Jacobs (2015) found that employers prefer to employ students who have had some form of work experience during their studies. These studies strengthen the case for the inclusion of work placement in higher education.

Some studies, such as Wilton (2012), Thompson and Bates (2016), Jackson and Collings (2018) and Irwin, Nordmann and Simms (2019) have focused on the structure and duration of work placement. Other studies, such as Jacobs (2015), Lock et al. (2009) and Lewis, Holtzhausen and Taylor (2010) have focused on perspectives of various stakeholders such as students, industry mentors and academic coordinators. While these studies have produced valuable insights, it appears that what, how and from whom work placement students learn is not fully

understood. Such an understanding could inform improvements in how work placement is conducted.

Moreover, some previous studies produced inconsistent results. Operationally similar studies by Reddan (2016) and by Bates, Thompson and Bates (2013) produced conflicting results; one found that work placement increases students' work self-efficacy whereas the other found that it decreases students' work self-efficacy. In his study, Wilton (2012) struggles to explain why his findings showed that in some but not all measures of employability, non-work placement students fared better than their work placement counterparts. He surmises that there could be internal factors mediating the relationship between work placement and its outcomes. His study did not establish what these mediating factors were. Another study by Irwin, Nordmann and Simms (2019) also alludes to the influence of mediating factors on student employability. Similarly, their study was unable to explain convincingly why work placement appeared not to have considerable influence on student employability.

Snowden (2018) explains that to understand the impact of work placement, one should go beyond evaluating the outcomes of work placement. There is a need to consider what, how, and from whom students learn during work placements. To interrogate this process, some researchers consider work placement experiences as being made up of several constituent elements (Deketelaere, Kelchtermans, Strutf and De Leyn, 2006; Almoayad, 2015; Joubert, 2017; Kramer-Simpson, 2018). For example, Tessaro, Brewer and Cantalini-Williams (2014) found that students' work placement experiences comprised professional growth, cultural and community connectedness, awareness of opportunities and practical considerations. They referred to these constituent elements of students' work placement experiences as dimensions.

In other disciplines such as teacher education and medical education, researchers have studied aspects of work placement experiences that contribute to employability. In teacher education, a study on work placement by Tessaro, Brewer and Cantalini-Williams (2014) found that students' experiences have four elements: professional growth, cultural and community connectedness, awareness of opportunities and practical considerations which they argue influence work placement outcomes. In medical education, Deketelaere et al. (2006) found that work placement experiences comprise dimensions: agenda of the internship, supervisor attitude, culture of the training environment, intern's learning attitude and nature of the learning process.

These studies have highlighted several factors that could be considered for influence on work placement outcomes for mechanical engineering students. It is worth noting that the knowledge required, practices and context for mechanical engineering students are different from work placements for medical or education students. Mechanical engineering is practised in a range of industries and within multi-disciplinary environments. Moreover, the boundaries between the roles of various categories of mechanical engineering practitioners are fuzzy. Therefore, it is not known whether similar elements to those in teaching or medical placements would be influential for mechanical engineering work placements.

1.4 Statement of the problem

There are still gaps in literature on the processes through which students' work placement employability outcomes are realised. Eames and Cates (2011) point out that this shortcoming contributes to the perception that work placement is a peripheral academic endeavour that is of questionable educational value. To remedy this shortcoming, Eames and Cates (2011) and Snowden (2018) recommend further studies on work placement learning that are underpinned by learning theory and that

explain the processes through which the academic and occupational outcomes of work placements are realised.

Cope, Cuthbertson and Stoddart (2000), Linn (2004) and Eames and Cates (2011) concede that theoretically-informed work placement research has been limited by the absence of an acceptable framework that comprehensively deals with the technical, social and cognitive aspects of work placement. The frameworks that were previously used addressed a single aspect of students' work placement experiences (Cantalini-Williams, 2015). As a result, these studies did not provide a full picture of how learning happens during work placement, given that work placement experiences are 'complex social and cognitive experience[s]' (Cope, Cuthbertson and Stoddart, 2000: 850; Eames and Cates, 2011). To reach a clearer picture of how the employability outcomes of work placement are produced, there is a need to adopt a framework that enables us to holistically investigate the social, cognitive and contextual aspects of learning in the workplace. Also, the contextual nature of learning in the workplace makes it unlikely that findings from studies in disciplines other than mechanical engineering would be transferable to the mechanical engineering workplace (Brown, Collins an& Duguid, 1989).

1.5 The aim of the study

This study aims to explore how work placement experiences of mechanical engineering students influence their employability as indicated by their occupational competency and self-efficacy.

1.6 Research questions

Three research questions guided this study:

1. What are mechanical engineering students' perceptions of the quality of their work placement experience?
2. What aspects of the work placement experience contribute to students' growth in occupational competency and self-efficacy?
3. How do social mechanisms within work placement environments operate to facilitate or hinder growth in students' occupational competency and self-efficacy?

1.7 Significance of the study

The study focuses on contributing to knowledge on work placement rather than seeking to influence South African policy on work placement. It took notice of Silverman's (2016) warning that aspirations to change policy are rarely realised because policy decisions are usually not made based on academic research, as policymakers often commission studies to confirm their policy positions. Because of this, the study accepts that changes to the structure and status of work placement as a result of aligning engineering qualifications from South African universities of technology with the Higher Education Qualifications Sub-Framework (HEQSF) are unlikely to occur in the short to medium term.

The study makes two significant contributions to the understanding of how work placement experiences promote or hinder growth in students' occupational competency and self-efficacy. The first contribution is that this study refines the elements of students' work placement experiences that were previously found to have focused on the employability outcomes of work placement. Additionally, it

refines what is known about the influence that these elements have on students' employability outcomes by considering how they interact with one another. The second contribution is that the study demonstrates how combining social cognitive and situated cognition theories makes it possible to account for social, cognitive and contextual aspects of learning in work placement experiences. The use of a two-theory framework enables this study to build a more detailed and realistic picture of student experiences during work placement.

1.8 Outline of the chapters

This thesis is divided into eight chapters. The current chapter has provided the background to this study and outlined the evolution of engineering education in South Africa, focusing on the role that work placement has played at various times in the development of engineering education. After that, it highlighted the gaps in the present understanding of work placement in engineering education both globally and within the South African context.

Chapter Two positions this study of work placement learning in general and within engineering education. It outlines the current understanding of learning that is relevant to engineering practice. It outlines the past studies, current debates and state of understanding of the role, structure and influence of work placement on student learning in engineering education.

Chapter Three provides the theoretical framework for the study. The study was informed by two theories of learning, namely social cognitive theory and situated cognition theory. The chapter discusses how the triadic reciprocal causation model, an aspect of social cognitive theory has the potential to facilitate understanding of the processes through which students' work placement experiences influence their employability. After that, it discusses cognitive apprenticeship and legitimate

peripheral participation, an aspect of situated cognition theory, and how the two concepts outline learning through guided performance and learning through participation.

Chapter Four discusses the research design and research methods of the study, which adopted a qualitative multi-case study methodology. The participants were selected from the 2017 cohort of mechanical engineering practice students from a South African university of technology. Individual students served as units of analysis. The study collected qualitative data from the participants through semi-structured interviews and from their logbooks and evidence portfolios. The collected data were analysed using thematic analysis and thematic synthesis. The chapter ends by discussing the steps that were taken to ensure ethical compliance and to promote trustworthiness and rigour.

Chapter Five describes the work placement experiences of four students who served as examples of the study's thirty-four participants. The descriptions are presented without recourse to explicit analysis other than through categorisation. These descriptions provide an answer to the first research question, 'What are mechanical engineering students' perceptions of the quality of their work placement experience?'

Chapter Six presents the findings from the thematic data analysis that was conducted with the assistance of NVivo software. This chapter addresses the study's last two research questions. The first part of the chapter presents the seven themes that emerged from the thematic analysis. These answered the question, 'What aspects of the work placement experience contribute to students' growth in occupational competency and self-efficacy?' The second part of the chapter presents findings from the thematic synthesis. These answered the research question `How

do social mechanisms within work placement environments operate to facilitate or hinder growth in students' occupational competency and self-efficacy?'

Chapter Seven discusses findings from the thematic analysis and the thematic synthesis considering what is known from previous studies and outlines the contribution this study makes considering the theoretical frameworks employed. The chapter concludes by discussing the significance of the study's findings to literature on work placement learning in mechanical engineering education.

Chapter Eight starts by summarising the significant findings from the study. It then shows how these findings answer the three research questions of the study. It discusses the implications of the findings of the study to the practice of work placement learning and ends with recommendations for further research.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature that is relevant to the aim of the study: exploring how mechanical engineering students' work placement experiences influence their learning for employability. The chapter begins by discussing behaviourist and cognitivist approaches to studying learning. After that, it discusses forms of professional knowledge that are produced and used in an educational setting and at work. Afterwards, it discusses the re-emergence of the workplace as a learning site and the implications of this for the evolution of engineering education in South Africa. The chapter closes by discussing previous evaluative and interpretive studies of work placement learning, focusing on those studies that investigated matters related to students' employability outcomes.

2.2 Behaviourist and cognitivist approaches to studying learning

Pritchard (2009) advises that it is vital in any research that seeks to understand learning processes to acknowledge the centrality of conceptualisations of learning and knowledge. Jarvis and Parker (2005) explain that this is because learning is a complex cognitive and societal endeavour. They assert that this perceived complexity is the reason for the limited commonality in how researchers conceptualise learning. Some researchers regard learning as either behavioural or cognitive, whereas others view it as a combination of the two. Therefore, it is not surprising that definitions of learning reflect these diverse viewpoints.

According to Jarvis, Holford and Griffin (2003: 24), behaviourists define learning as 'any more or less permanent change in behaviour, which is the result of experience'.

They focus on measurable and observable outcomes of learning rather than on intervening processes such as the acquisition of knowledge, attitudes and beliefs. This approach to studying learning is often criticised based on the claim that it ignores the role of cognitive processes and the agency of the student (for example, Jarvis, Holford and Griffin (2003)). During the period 1960 to1970, some researchers such as Julian B Rotter and Albert Bandura realised that behaviourism could not explain some forms of learning such as learning through imitation or vicarious learning (Gibson, 2004; Ormrod, 2012). To remedy this shortcoming, Bandura (1977) developed social learning theory which will be discussed in more detail in Chapter Three.

This study concurs with the assertion by Illeris (2007) that when combined with other scholarly approaches, a behaviourist approach to studying learning is necessary to arrive at an adequate understanding of learning.

As behaviourism was developing in the USA, European researchers such as Jean Piaget and Lev Vygotsky were developing cognitivist approaches to studying learning. Cognitivism focuses on the mental processes involved in learning and on the nature of knowledge. Therefore, cognitivists define learning as ‘a long-term change in mental representations or associations as a result of experience’ (Ormrod, 2016: 4). Some cognitivist theories, which are termed constructivist, portray learning as the construction of new knowledge rather than its acquisition from the environment. Others focus on the influence of context on learning; such theories are termed sociocultural theories. Both approaches share the following assumptions (Ormrod, 2012):

- Some types of learning are limited to humans.
- Not all learning turns into observable behavioural change.

- Students are not passive recipients of environmental stimuli. They are actively involved in their learning.
- It is possible to infer unobservable mental processes of learning from scientifically structured observation of behaviour.
- People's knowledge, beliefs and attitude are directly or indirectly connected.

Recently, there has been an acknowledgement that learning can be both behavioural and cognitive (Ormrod, 2016). To account for this shift in understanding, Schunk (2012) defines learning in a manner that aligns with its cognitive and behavioural aspects. He defines it as 'an enduring change in behaviour or in the capacity to behave in a given fashion, which results from practice or other forms of experience' (Schunk, 2012: 3). It is worth noting that, according to Schunk's definition, not all changes in behaviour occur because of learning. For learning to have occurred, there must be enduring change, and this change must occur because of experience or practice. In this context, change refers to 'acquiring and modifying knowledge, skills, strategies, beliefs, attitudes and behaviours' (Schunk, 2012: 2). The process of change can be deliberate or unintentional but excludes temporary changes in behaviours caused by factors such as drugs or permanent changes in behaviour resulting from maturation.

Hodkinson (2010) argues that in modern societies, learning has become a lifelong exercise that encompasses all sites of living: home, school, work and the broader community. Each of these sites has its unique contextual structure which influences the learning that takes place in them. Learning that takes places in schools is governed by the laws of schooling and that which takes place in the society is governed by the laws of learning. Inevitably, the dominant forms of knowledge that are produced in each context are also different.

2.3 Knowledge forms in educational settings and at work

Kolb (1993: 153) declares that 'to understand learning, we must understand the nature and forms of human knowledge and the processes whereby this knowledge is created'. This study concurs with Kolb and outlines various conceptualisations of knowledge before describing student learning in the workplace. Although knowledge is a difficult concept to define, for this study, the definition offered by Regoczei and Hirst (1992) definition is sufficient. They define knowledge as 'a metaphoric substance that people possess that enables them to perform at expert levels' (Regoczei & Hirst, 1992: 14-15). This definition positions knowledge as a requirement for expert performance. Ryle (1945:8) highlights two forms of knowledge that define performance: *knowing that*: knowing propositions, theories and rules, and *knowing how:* knowing `how to do things of a certain sort'. Other researchers have used the terms shown in Table 2.1 to refer to the two forms of knowledge. There are slight differences in the meanings of the terms that are used by various researchers for the different forms of knowledge. For convenience, this study will use the terms 'declarative knowledge' and 'procedural knowledge'.

Table 2.1: Terms used by various researchers to refer to knowing that and knowing how

Researcher	**Form of knowledge**	
Ryle (1945)	*knowing that*	*knowing how*
Anderson (1981, 1987), Ormrod (2016)	Declarative knowledge	Procedural knowledge
Pollock and Cruz (1999), Billett (1996)	Propositional knowledge	Procedural knowledge
Bernstein (1999)	Vertical knowledge	Horizontal knowledge
Eraut (2004a)	Codified knowledge	Personal knowledge

There is a growing body of research that supports the view that learning is contextual, that is, it is inseparably situated in the physical and social contexts

(Brown, Collins and Duguid, 1989; Lave and Wenger, 1991; Engeström, Miettinen and Punamäki-Gitai, 1999; Engeström, 2001). Collins, Brown and Newman (1987) expand this view and state that both the form of knowledge and the efficiency of its production are inevitably linked to the context. They note that schooling has been relatively successful in conveying declarative knowledge, whereas procedural knowledge is better gained through practice.

Notwithstanding whether the knowledge to be acquired is declarative or procedural, it can be learnt through formal, informal or incidental learning. Eraut (2000) explains that formal education consists of structured, institutionally-sponsored learning activities that are designed to meet specific learning outcomes. Although formal learning usually occurs in educational institutions, it can also happen outside these institutions. A crucial requirement for formal learning is that a designated teacher or trainer facilitates learning activities. Furthermore, the learning activities of formal learning contribute towards a qualification. However, the outcomes of formal learning are not confined to declarative knowledge; students can also acquire procedural knowledge through formal education.

Colley, Hodkinson and Malcom (2003) explain that informal learning is different from formal learning in that it is predominantly unstructured but can be planned or unintentional. They further explain that there is confusion over the boundary between formal and informal learning because there are elements of informality and formality in all learning activities. Marsick and Watkins (2015) categorise incidental learning as a subset of informal learning. Learning is categorised as incidental when it is a by-product of some other activity. This type of learning happens through socialisation in the community, participation at work, personal experience or even during formal learning.

2.3.1 Declarative knowledge as a component of professional knowledge base

Winch (2014) states that declarative knowledge forms an essential part of the professional knowledge base. It includes classifications, principles, generalisations, theories, models and structures and their interlinked associations (Anderson et al., 2001). It also includes knowledge of past experiences and of work procedures that are outlined in manuals and workbooks. Although declarative knowledge provides people with propositions of what to do in an actual situation, it does not equip a person with the capacity required for competent performance. To illustrate this limitation, Eraut (2000b) gave an example of riding a bicycle. He said that knowing all the steps that are needed to ride a bicycle does not mean that a person would able to ride one.

This form of knowledge is explicit and systematically organised. Thus, principles and theories that share the same disciplinary domain are grouped into a coherent whole (Young & Gamble, 2006). For example, knowledge related to conveying, pumping or storing water is sometimes grouped as fluid mechanics. In addition to being explicit, declarative knowledge is capable of being codified. Once codified, it can be either accessible to the public or can be private. Publicly available declarative knowledge is found in journal articles, catalogues, standards and technical magazines. In contrast, private declarative knowledge comprises organisation-specific information such as records, correspondence, operation manuals and work plans (Eraut, 2004a).

Since declarative knowledge can be codified and articulated, it is capable of being taught through verbal or written instruction. Thus, it can be elicited from subject experts when they verbalise or write down their understanding of various concepts (Glaser, 1989). Young and Gamble (2006) state that to successfully acquire propositional knowledge, students need long-term and constant engagement with it

to enable them to develop cognitive schemata that are necessary for advanced understanding. Also, it can be learnt at home, in the community and at work. Although declarative knowledge can be acquired wherever experts articulate their knowledge, Collins, Brown and Newman (1987) maintain that schooling has been largely successful in developing propositional knowledge.

There are strict distributive rules that regulate access to declarative knowledge (Bernstein, 1999; Eraut, 2000). In the public space, subject experts act as gatekeepers by selecting from what is available and regulating access to it. In the broader academic space, editors and peer reviewers regulate available codified knowledge by deciding what is published. Within the university, staff monitor what is taught. Within the workplace, access to private declarative knowledge is controlled by company policies.

2.3.2 Procedural knowledge as a component of professional knowledge base

Procedural knowledge refers to knowledge that enables a person to know what to do in a situation as it arises (Pollock & Cruz, 1999); it is knowledge in action. Gordon (1992), Eraut (1994) and Jarvis and Parker (2005) assert that there is a direct association between procedural knowledge and occupational competency. They attribute novices' inability to execute tasks accurately and promptly to their reliance on declarative knowledge. In contrast, experts' well-developed procedural knowledge enables them to perform cognitive tasks and physical tasks promptly and without errors. Markauskaite and Patton (2019: 228) refers to this as having adaptive actionable knowledge, "that is, knowledge that is needed to have a job done".

Wasonga and Murphy (2006) concur and indicate that procedural knowledge has a technical dimension and a cognitive dimension. The technical dimension encompasses knowledge of domain-specific skills, algorithms, techniques and

methods of doing things. In contrast, the cognitive dimension relates to the awareness of the conditions under which various actions are required (Ormrod, 2016). This cognitive dimension involves highly subjective insights, intuitions and hunches on what should be done in any situation (Pollock & Cruz, 1999). In most cases, expert practitioners implicitly perform cognitive procedures that are needed to execute their tasks. Therefore, they are often unable to articulate the processes they followed in performing tasks.

Gordon (1992) explains that as people become more competent, they use more procedural knowledge than declarative knowledge. The use of procedural knowledge is not an automatic response to repeated opportunities to practise a skill; instead, it is a result of dynamic interactions between the individual and the environment. Unlike declarative knowledge, the development of procedural knowledge requires sustained practice. Anderson (1983, 1987) theorises that the development of procedural knowledge that leads to occupational competency is a three-step process. As presented in Figure 2.1, the development of competence starts with the acquisition of declarative knowledge in what is called the cognitive stage. During this stage, students can perform tasks, but they are slow and error-prone. As they repetitively perform functions within a work domain, their declarative knowledge develops into domain-specific procedural knowledge through proceduralisation/routinisation (Eraut, 2004b).

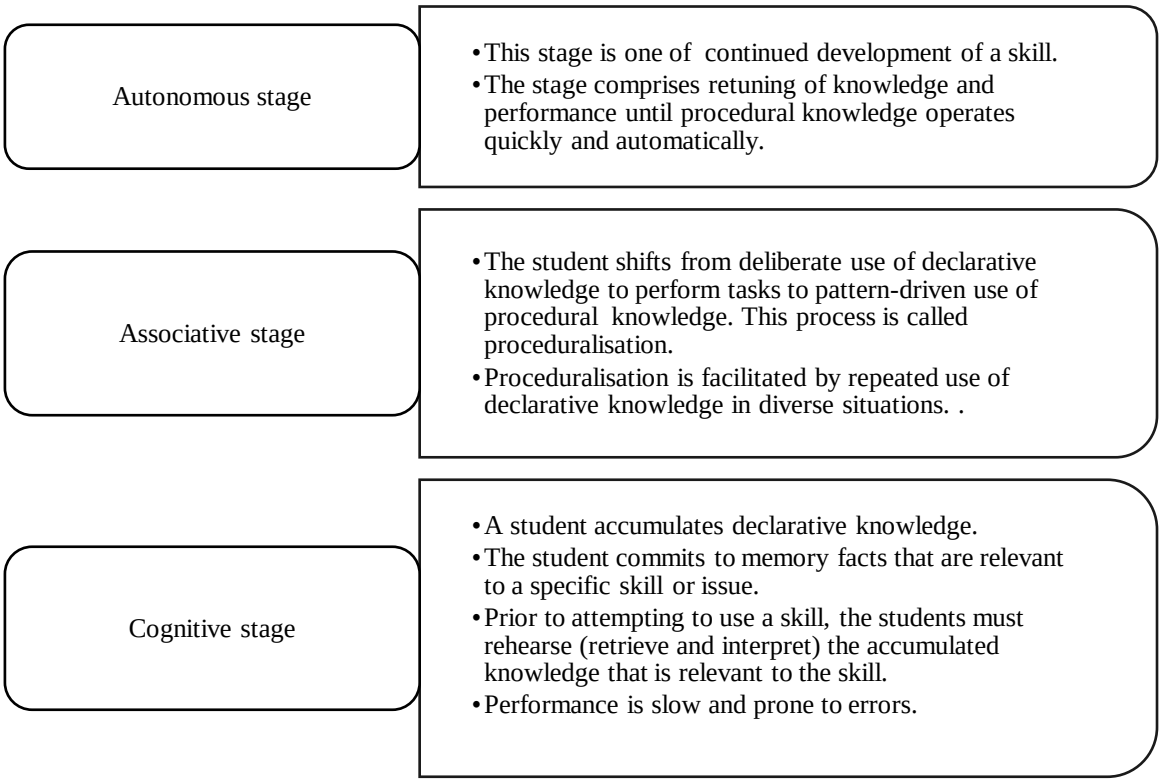


Figure 2.1: Anderson's three-stage model of skill acquisition (Eraut, 2004a)

Gordon (1992) further explains that in the latter stages of skill acquisition, declarative and procedural knowledge develop concurrently. However, as the student's competence grows, there is a more implicit and automatic application of procedural knowledge. For example, a person who can ride a bicycle responds to changes in the environment without having to draw on their declarative knowledge. For instance, a person might apply brakes to slow down a bicycle without knowing the exact speed at which the bicycle is travelling. This braking process is almost automatic in seasoned bicycle riders. The same cannot be said of novice riders.

Since it is tacit and cannot be elicited directly from experts through verbalisation, Cianciolo, Matthew, Sternberg and Wagner (2006) explain that procedural knowledge is developed through socialisation and practice. During socialisation, experts can convert implicit aspects of their procedural knowledge to become explicit through a process which Wasonga and Murphy (2006) call externalisation.

Externalisation occurs when expert practitioners share their knowledge through dialogue and collective reflection. For this to happen, students need to have close interaction with experts, observe the experts in action and participate in work activities with them. The concept of externalisation is similar to the idea of bringing the process of 'cognitive processes into the open' of cognitive apprenticeship (Collins & Kapur, 2014: 110). The concept of cognitive apprenticeship will be discussed in detail in section 3.3.1 in the next chapter.

2.4 The re-emergence of the workplace as a learning space

Having discussed forms of knowledge, learning and types of learning processes, this section focuses on literature on learning in the workplace. Learning in the workplace is not a new concept (Harvey, Geall & Moon, 1998). Keleher, Patil and Harreveld (2011) explain that before the Industrial Revolution, learning occurred in the workplace or societal structures such as the home. People learnt trades through participating in communities or through apprenticeship (Collins, Brown & Newman, 1987). It was only after the Industrial Revolution that the link between practice (doing) and education (knowing) faded. This delinking was mostly due to the expansion of schooling.

There is growing realisation and acceptance that educational institution-based activities alone are not enough to prepare students to smooth entry into their selected occupations. Researchers provide two reasons for this realisation and acceptance. The first reason, as explained by Ryle (1945), Anderson (1981, 1987) and Gordon (1992), is that competent work performance depends on the application of procedural knowledge. Given the nature of procedural knowledge, Collins, Brown and Newman (1987) doubt whether classroom instruction is the only way to prepare students to acquire this procedural knowledge. They argue that while classroom

instruction has been relatively successful in organising and conveying large bodies of declarative knowledge, it has not been as successful in imparting procedural knowledge. Anderson, Reder and Simon (1996) warn that this, however, does not mean that classroom instruction is of little use. Collins, Brown and Newman (1987) further argue that classroom tasks, which are set in classroom culture, can fail to provide contextual features of authentic tasks. This argument emphasises that in an educational programme that seeks to develop professional competence, the context-dependency of knowledge, particularly of procedural knowledge, cannot be ignored (Collins, Brown & Newman, 1987; Anderson, Reder & Simon, 1996).

The second reason is rooted in the competence approach to the training of people in vocationally- or professionally-oriented occupations. This reason is evident in the work of Walther, Kellam, Sochacka and Radcliffe (2011) on the evolution of engineering education in Australia and the United States. They mention that in these countries, engineering education has shifted towards developing students' occupational competency, particularly the acquisition of accidental and incidental competencies that result from participation in professional practice and socialisation rather than from direct instruction. This approach to engineering education is consistent with the assertion of Illeris (2010) that since industry has first-hand knowledge and experience of required occupational competencies, it is better placed to impart them to students. Illeris (2010) further contends that as users of the skills and knowledge of graduates, the demand of industry for participation in the training of its potential new entrants is reasonable. However, he warns that this does not mean that education for the professions should be left to industry because, if it were, training would become narrow and short-sighted.

Collins, Brown and Newman (1987) explain that after schooling became entrenched, practice followed education, but the two no longer happened concurrently. Over time, this disconnect became prevalent, and workplaces lost their place as formal learning spaces. When universities were established, they tended to focus on liberal education at the expense of practical skills. The disconnect between higher education and learning through practice remained until Herman Schneider recognised that he and others who had worked through college showed marked ability in engineering practice upon graduation (Akins, 2005). He concluded that those who worked during their studies had supplemented learning in the classroom with learning in the workplace. Cooper, Orrell and Bowden (2010) concur and attribute this difference in capabilities between those who work while studying and those who only study to variation in the way in which learning occurs in the classroom compared to how it happens in the industrial context.

With this realisation, Schneider established the first engineering cooperative education programme after he joined the University of Cincinnati. He founded the cooperative education programme to facilitate the development of competent occupational competency of his students (Akins, 2005). For competent performance, Lave and Wenger (1991) argue that procedural knowledge (mostly acquired in the workplace) is required in addition to conceptual knowledge (mainly acquired during classroom instruction). Akins (2005) explains that Schneider recognised this, long before it was formalised through learning theories. Schneider's cooperative education took advantage of the uniqueness of university learning and workplace learning to maximise the learning of both declarative and procedural knowledge (Akins, 2005).

Cooperative education began as a structured method of combining classroom learning with workplace experience; students alternated periods of attendance at university with periods of employment in industry as part of the curriculum (Haddara & Skanes, 2007). It was a partnership comprising three entities: the student, the employer and the university. Over time, cooperative education became globally accepted and various derivatives emerged. As other methods of combining learning through practice with classroom learning emerged, the term `cooperative education' became inadequate to describe the new breed of practice-classroom initiatives. To address this, the World Association for Cooperative Education (WACE) coined the term 'work integrated learning' as an encompassing term to describe pedagogical practices that expose students to real or simulated work for learning (Coll et al., 2009). The practices of cooperative education, work placement, sandwich placement, in-service training apprenticeship, project-based learning, vacation work and work directed at theoretical learning now fall under the umbrella term 'work integrated learning' (WIL).

Table 2.2 provides a typology of curricula practices that fall under the term WIL.

Table 2.2: Curricular practices that fall under the umbrella term WIL (CHE, 2011)

Term	Description and key feature	Context
Problem-based learning	Problems rather than academic subjects are the organising structure of the curriculum. Few programmes (none in South Africa) adopt it in its purest form.	University-based
Project-based learning	This practice entails learning through projects. The projects are generally not simulated but involve learning through practice in a work context.	University-/Industry-based
Work-directed theoretical learning	Academic subjects or components are aligned with or have practice-based elements. Examples include guest lectures by practitioners, use of authentic examples and case studies.	University-based
Work placement learning or industry-based WIL	Students are placed in work environments for learning. Examples include sandwich programmes in the United Kingdom, cooperative education in the United States, work placement in Australia/New Zealand and experiential training in South Africa	University-/Industry-based

Cooper, Orrell and Bowden (2010) outline requirements that must be met for work experience to be considered work-integrated learning. Firstly, there must be some form of participation in real or simulated work that is similar to the work that professionals perform. Secondly, participation must facilitate the integration of theory and practice. The process of integration involves the application of theory in dealing with real-world problems, thereby developing strategic knowledge that enables students to act responsibly and knowledgeably in future situations. The integration occurs at individual and group level mainly through interactions between the student, industry mentors and co-workers. Thirdly, there must be a practice curriculum, intended learning outcomes, teaching and learning activities that are aligned to the intended learning outcomes, assessment activities and the actual assessment. Lastly, there must be learning that is relevant to a student's studies. Ad hoc work

undertaken by students to earn an income, for interest's sake or unrelated to their studies does not qualify as WIL (Harvey, Geall & Moon, 1998).

2.5 Previous studies on work placement learning

Considering the aim of this study, this section presents a conceptual review of work placement literature that investigated the influence of work placement on student employability. The section highlights the current understanding of the key themes and concepts that relate to students' work placement experiences and their employability. It categorises the literature into evaluative studies, focusing on the viability of work placement learning as an employability-enhancing strategy, and interpretive studies, focusing on understanding the influence of students' work placement experiences on their employability.

2.5.1 Evaluative studies of work placement learning

Akins (2005) states that since the founding of cooperative education in 1906, many studies on work placement have been evaluative, focusing on verifying the outcomes of work placement. The outcomes have been extensively studied from the perspectives of various stakeholders such as students, university lecturers and industry mentors. Eames and Cates (2011) state that these evaluative studies have deepened understanding of what constitutes successful work placement. It is now generally accepted that work placement is an effective employability strategy because most of these studies reported positive occupational outcomes for students who participated in work placements.

There are numerous examples in literature of the positive employability outcomes of work placement which are typified by the literature presented in this section. For instance, Little and Harvey (2006), Edwards (2014) and Brooks and Youngson (2016) report that work placement has a positive impact on actual graduate

employment. They posit that employers prefer to employ students who have had some work experience during their studies. Brooks and Youngson (2016) explain that this is because work placement students can demonstrate that they have competencies as opposed to those whose ability can be inferred from academic credentials. Further to this, the Council for Higher Education (CHE, 2011), Berg and Broekhuizen (2012), Mncayi (2016) and Mncayi and Dunga (2016) argue that work placement provides structured pathways to employment and are particularly valuable to students from disadvantaged backgrounds who might not have social networks to exploit for employment. This positive outcome was corroborated by a South African study which also found that employers prefer to employ students who have had some form of work experience during their studies: Jacobs (2015) found that more than fifty percent of work placement students who participated in his study were employed by the companies where they undertook their placements.

Other evaluative studies have reported that work placement enhances students' employability. For instance, Jackson (2017) reports that work placement facilitates students' pre-professional identity formation and imbues them with career clarity. Students' socialisation with professionals and participation in occupationally relevant work activities assist students in their transition from being students to become professionals. Jackson further reports that work placement deepens students' understanding of the characteristics, expectations and requirements of their intended professions, thereby enhancing their career clarity. The connection to the core aspects of their professions that students develop during work placement enables them to look for occupationally relevant jobs upon graduation. Therefore, it is not surprising that researchers argue that work placement students are more likely to secure occupationally relevant jobs than non-work placement students.

The evaluative studies have also reported positive developmental outcomes of work placement. Little and Harvey (2006) found that work placement develops students' interpersonal skills such as oral and written communication, dealing with clients and networking skills. Other researchers found that it increases students' personal skills such as self-confidence (Lock et al., 2009), work self-efficacy (Reddan, 2016), maturity and responsibility (Kopsidas, Pampaka & Knowles, 2013) and adaptability (Little & Harvey, 2006; Varghese et al., 2012).

Not all evaluated studies found positive outcomes; some evaluative studies suggest that work-positive outcomes of work placement might not be available in all countries. Reinhard et al. (2016) note that there are challenges in implementing work placement, particularly in developing countries. Mutereko and Wedekind (2015) and Reinhard et al. (2016) concur that in South Africa, there are challenges of access and quality of work placement opportunities. As observed by Lewis, Holtzhausen and Taylor (2010) and Agwa-Ejon and Pradhan (2017), these challenges arise because South African universities of technology struggle to attract enough employers to participate in their work placement programmes. As a result, Mutereko and Wedekind (2015) cite failure to find work placement as one of the reasons for students' delay in completing their studies.

The nation-wide study in Australia by Patrick et al. (2008) indicates that the implementation and operational challenges of work placement are not limited to universities in developing countries. Agwa-Ejon and Pradhan (2017) concur with Patrick et al. (2008) that some universities have difficulties in finding appropriate work placement that meets the learning outcomes of WIL. They report that some employers offer token work placements that benefit them more than students. According to Peters, Sattler and Kelland (2014), these token placements do more

harm to students than any good that might accrue from the resulting work experiences. Considering this, it is not surprising that Patrick et al. (2008) warn universities to ensure that their work placement host companies provide their students with meaningful and worthwhile work placement experiences that contribute to the enhancement of their functional capabilities.

Universities face an additional challenge of administering work placements. University staff expend increasing effort, time and money maintaining industry contacts to sustain work placement opportunities. The additional administrative load arises because of the massification of higher education which results in an ever-increasing number of students having to be placed, monitored and assessed. In the case of South Africa, statistics reveal a 24.4% increase in public higher education enrolments in slightly more than a decade, from 744 488 in 2004 to 985 212 in 2015 (DOE, 2005; DHET, 2015). This massification in higher education is not unique to South Africa; other countries such as Australia have experienced similar growth. Vis a vis Australia, Rook (2017) observes that the increase in students requiring work placement has come at a time when government funding of universities has been decreasing.

In closing, evaluative studies have reported the unenthusiastic perceptions that some role players, particularly university staff, have towards work placement. Edwards et al. (2015) identify the general lack of value that academics place on work placement as an obstacle to introducing and/or maintaining work placement at many universities. The disposition of academics toward work placement is crucial as it is an expensive teaching method which can be sustained only if there is commitment amongst all role players. In a South African study by Lewis, Holtzhausen and Taylor (2010) at the University of Johannesburg, it was found that academic staff supported

the reduction of the duration of work placement for the National Diploma in Town and Regional Planning to six months, whereas both students and employers wanted to retain 12 months of work placement. In the same study, 87% of employers were in support of work placement. An equal number thought that work placement effectively prepares students for industry. Even though many employees support work placement, Edwards et al. (2015) note that they believe that universities do not sufficiently recognise their efforts, in both time and expense, in providing opportunities and supervising their work placement students.

Given the negative outcomes reported above, some researchers such as Mutereko and Wedekind (2015) suggest the elimination of work placement from the engineering curricula of UoTs. This is a minority viewpoint: studies from several countries – Wilson (2012) and Artess, Hooley and Mellors-Bourne (2017) from the UK, Franz (2008) from Australia, Pons (2013) from New Zealand and Lewis, Holtzhausen and Taylor (2010), Samadi (2013) and Jacobs (2015) from South Africa – indicate that eliminating work placement might not be a good idea. They concur that work placement is crucial in promoting graduate employability and narrowing the competency gap. According to Martin, Maytham, Case and Fraser (2005) and Jonck (2014), South African graduates themselves think that they lack practical experience and non-technical skills that are needed to succeed in the workplace.

Consequently, elimination of work placement from UoT curricula is not viable in the long term because it shifts the problem to employers who, according to De Koker (2016) remain opposed to it. Du Pre (2013) avers that current employment trends show that employers require work-ready graduates. Harvey, Geall and Moon (1998) explain that in the past, most graduates were employed by large companies that had graduate training programmes. These companies often employed graduates in

advance of their immediate operational needs. This situation is no longer the case since a more substantial proportion of graduates is now employed by small enterprises which might not have resources to provide on-job training for new employees (Harvey, Geall and Moon, 1998). Moreover, Du Pre (2013) notes that small enterprises employ staff to address their current operational needs; therefore, their new employees are often required to be work-ready from the start (Du Pre, 2013).

2.5.2 Interpretive studies on work placement learning

Eames and Cates (2011) point out that while extensive evaluative work placement research has been done, it appears there is a lack of interpretive studies that would enhance understanding of the processes through which work placement is realised. They assert that most of the previous interpretive studies were not theory-informed. They argue that this constrained the growth of work placement research and the acceptance of work placement as a legitimate educational practice. They suggest that more theory-informed interpretive studies, particularly those that are informed by learning theories, should be carried out to remedy the perception that work placement is either a peripheral academic endeavour or a training strategy.

Since Eames and Cates (2011) first made the call for more interpretive workplace research, there have been several interpretive studies that investigated the processes through which work placement students' experiences produce student employability outcomes. These studies were conducted in clinical practice (Deketelaere et al., 2006), business and engineering (Zehr, 2016) and electrical engineering (Kopsidas, Pampaka & Knowles, 2013). They were mostly qualitative as opposed to evaluative studies that were primarily quantitative (Coll & Kalnins, 2009). They collected data from students using focus groups, interviews, observations and

document analysis. Furthermore, they tended to focus on developing themes that represent factors or dimensions of students' work placement experiences. These studies provide valuable insights into what students learn during their work placement, how they learn and from whom they learn.

An example of an interpretive study is the work of Deketelaere et al. (2006) who studied students' experiences during eight-month internships that occurred in the sixth year of a seven-year medical degree at the University of Leuven in Belgium. The researcher observed and interviewed four students and four work supervisors at each of the two hospitals at which the study was conducted. It was found that students' employability outcomes are the dominant agenda at the work placement site and in the culture of the workplace, the learning attitude of the intern and the nature of the learning process.

Another example of an interpretive study is the work of Zehr (2016), who compared the experiences of business and engineering students placed at start-up companies with those placed at established companies. The study, which followed a sequential mixed-methods approach, recruited participants from six public or State universities in the USA. The study started with the administration of an online survey focusing on the work environment, type of work done, interactions with co-workers and nature of support received. One hundred and seventy-one students participated in the survey, and from these, twenty-one students from five universities participated in the qualitative phase.

The study by Zehr (2016) shows that the work placement context and elements of students' experiences influence students' employability outcomes. The quantitative phase of the study, which focused on the influence of context, showed that the work placement context influences the elements of students' work placement experiences.

The qualitative phase extended this finding and showed that: (1) students learned through practice (working alone); (2) social interactions increased access to learning opportunities; (3) students learned through observation and direct guidance; (4) students at start-ups learnt to be more proactive than those at established companies; (5) start-ups provided students with more responsibility; and (6) a flat hierarchy and relaxed culture were conducive to student learning.

A further example of an interpretive study is the work of Kopsidas, Pampaka and Knowles (2013) who investigated student experiences during a year-long work placement that was part of four-year engineering degrees in Electrical and Electronic Engineering and Electronic Engineering and Mechatronic Engineering at the University of Manchester. There, only students who had achieved an average of 55% or higher were eligible for work placement, which was undertaken either after the second year or after the third year. Kopsidas, Pampaka and Knowles (2013) used a qualitative approach to explore students' perspectives on how their work placement experiences influenced their integration of theory and practice, the development of their transferable skills, the achievement of career clarity and the enhancement of their employability. They interviewed eight students who had completed their year-long work placement.

The findings of their study were most descriptive, and they tried to use the students' own words as much as possible; their deliberate limited-detail thematic analysis gave a voice to their participants. They found that the students believed that their work placement experiences developed their employability by enhancing their technical skills, facilitating career clarity and increasing their motivation, self-efficacy and communication skills.

It appears that few researchers on work self-efficacy or occupational competency of work placement students heeded Eames and Cates (2011) call for more theoretically-informed studies on work placement. However, there are some insightful theory-informed studies, such as Snowden (2018), Almoayad (2015) and Difrancesco (2011), on academic outcomes of work placement.

An exception to the above is the work of Cope, Cuthbertson and Stoddart (2000). Their work is an example of theory-informed research, underpinned by situated learning theory, on the employability outcomes of work placement. The three researchers explored the work placement experiences of nursing students at the University of Stirling in Scotland. They collected qualitative data from two cohorts of nursing students using semi-structured interviews. The collected data were analysed using thematic analysis.

They found that learning during work placement occurred mostly through participation; that demonstrations of occupational competency enhanced that participation; and that mentors were crucial to the success of work placement. The researchers also found that the students' work placement experiences facilitated their realisation of the contextualisation of knowledge. During the initial days of their work placements, the students failed to see the relationships between theory and practice. Practice appeared to be inconsistent with theory. This period was followed by `incremental construction and contextualization of knowledge... which could be emphasised by both the college and the practice community' (Cope, Cuthbertson & Stoddart, 2000: 854). To achieve this, the students required support, mainly from their mentors. In cases where work placement had positive outcomes, the mentors provided appropriate but progressively reduced support. As the students'

competency grew, the mentors reduced the support they provided and shifted responsibility for performing work assignments to the students.

2.6 Conclusion

In this chapter, a review was provided of literature related to behaviourist and cognitivist conceptions of learning and forms of professional knowledge; work placement as a learning practice; and policy changes that have impacted how work placement is practised in South Africa. This review showed that in studies investigating how outcomes of pedagogical practices such as work placement are produced, it is vital to understand the contextual nature and the processes of knowledge acquisition.

The literature that is reviewed in this chapter, suggests that the purpose of many previous studies on self-efficacy and occupational competency of work placement student were pragmatic and therefore not informed by theory. This shortcoming needs to be addressed because it influences how work placement learning is perceived. To address this shortcoming, theoretically-informed interpretive studies need to be done to uncover the processes through which employability outcomes are produced. This study is one such study as it uses theory to explore how mechanical engineering students' work placement experiences influence their employability.

The social cognitive and situated learning theories that inform this study will be discussed in detail in the next chapter.

CHAPTER THREE
THEORETICAL FRAMEWORK

3.1 Introduction

This chapter presents the two-theory framework, comprising social cognitive and situated cognition theories, that informed this study's research design.

The chapter starts by presenting the structure and rationale for adopting a two-theory framework. After that, it discusses social cognitive theory, focusing on the triadic reciprocal causation model and the various concepts that govern the operation of the model. The chapter closes with a discussion of situated cognition theory, focusing on how its concepts of cognitive apprenticeship and legitimate peripheral participation may be applied in a study of work placement learning.

3.2 Structure and rationale for the theoretical framework

Maxwell (2013: 39) defines a theoretical framework as 'the system of concepts, assumptions, expectations, beliefs, and theories that supports and informs your research'. He explains that it tentatively presents what is occurring vis a vis the phenomenon that is being studied. Furthermore, he indicates that it is an essential part of research design as it facilitates development, assessment and refinement of the research goals and questions of a study, the selection of research methods to be used and the identification of validity threats to a study. Given Maxwell's (2013) elucidation of its importance, this study includes a theoretical framework as a crucial component of its research design (see in the next chapter). When considered in conjunction with the research goals and questions of this study, it is clear that the theoretical framework of this study should tentatively explain individual and group-centred processes of student learning during work placement.

Zehr (2016) laments that although hundreds of learning theories have been developed for work placement learning, none fully accounts for its cognitive and social aspects. To comprehensively account for both aspects, researchers such as Kerka (1997), Burke, Marks-Maran, Ooms, Webb and Cooper(2009), Cooper, Orrell and Bowden (2010) and Zehr (2016) opted to integrate by using several theories to form multi-theory theoretical frameworks. For example, Cooper, Orrell and Bowden (2010) used experiential learning theory (Kolb, 2015) and situated learning theory (Lave and Wenger, 1991) to conceptualise student learning in the workplace. This use of multiple theories is consistent with recommendations made by Eames and Cates (2011) and the Higher Education Quality Council of Ontario (2016) which proposed several learning theories that could be used individually or as combinations. Table 3.1 summarises the learning theories that could inform research into work placement learning.

Table 3.1: Learning theories that, according to Eames and Cates (2011) and the Higher Education Quality Council of Ontario (2016), could be used in research on work placement learning

Learning theory that is applicable to work placement	**Literature where theory is presented**
Situated learning theory (Lave and Wenger, 1991)	Lave and Wenger (1991)
Social learning theory	Bandura (1977a, 1997)
Cognitive development theory	The theory was developed by Jean Piaget whose writings are in French. Hergenhahn and Olson (2001) summarise the main aspects of Piaget's theory.
Pedagogy of the workplace	Billett (2002)
Action and active learning	Bonwell and Eison (1991)
Transformative learning	Mezirow (1991)
Turning experience into learning frameworks	Boud, Keogh and Walker (1985)
Experiential learning theory	Kolb (2015)
Action theory and boundary crossing	Guile and Griffiths (2001)
Cultural-historical activity theory	Engestrom (2014)

As indicated earlier, learning in the workplace is both an individual endeavour, with cognitive and psychodynamic aspects, and group endeavour, with social aspects. The theory/theories selected for this study needed to address all aspects of learning in the workplace. This study selected social cognitive and situated cognition theories as most appropriate to address individual and group learning processes that occur during work placement. Additionally, several concepts of social cognitive theory such as self-efficacy, agency and self-regulation have received widespread acceptance as determinants and outcomes of learning in work placement literature (Zehr, 2016). In this study, the social cognitive theory, which does not adequately address group aspects of learning in work placement, is integrated with situated cognition theory, a sociocultural learning theory that focuses on learning through participation in a group, to form the study's theoretical framework.

Miles, Huberman and Saldana (2014:20) explain that a theoretical framework can be presented graphically to highlight the 'presumed interrelationships among' its various components. Considering the above, Figure 3.1 presents the theoretical framework of this study and highlights how the various concepts of social cognitive and situated cognition theories fit together to provide a tentative map of the processes of work placement learning.

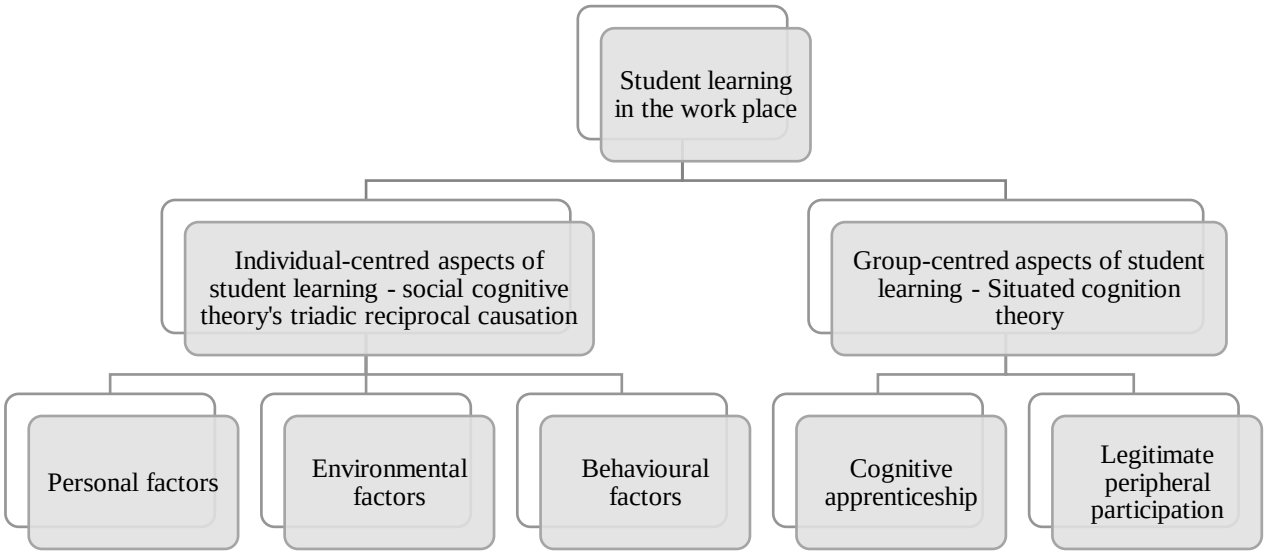


Figure 3.1: A graphical overview of the theoretical framework of this study

3.3 Social cognitive theory

Social cognitive theory is a cognitivist-leaning learning theory that focuses on how individuals learn through social interactions (Jarvis, Holford & Griffin, 2003; Olson & Hergenhahn, 2013). Grusec (1992) explains that the theory was developed in the 1960s and 1970s from the work of Albert Bandura and Robert Sears, who were dissatisfied with the behaviourist theories of that time because they could not explain observational learning and learning through imitation. They developed social learning theory, the first iteration of social cognitive theory to accommodate learning through imitation or observation as ways of learning.

Grusec (1992) explains that as the theory developed, it adopted a more cognitive approach mainly through the work of Albert Bandura of Stanford University and his graduate student, Robert Walters. She further explains that in the early 1980s, Bandura abandoned mechanistic conditioning explanations of observational learning and turned to information processing theories to explain the process of modelling in observation learning. In 1986, Bandura renamed the theory ‘social cognitive theory’ to acknowledge the cognitive stance that the theory had adopted (Snowman,

McCown & Biehler, 2012). As shown in Figure 3.2, the social cognitive theory has been influenced by cognitive psychology and social learning theory, its earlier behaviourist-leaning version.

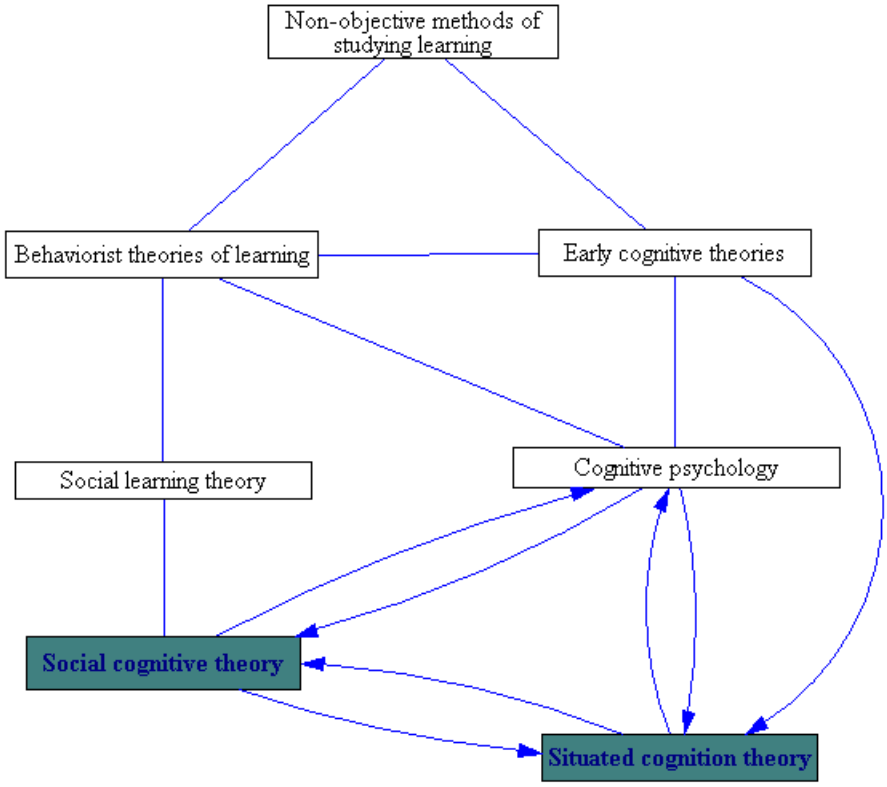


Figure 3.2: Position of social learning theory and situated cognitive theory in the evolution of learning theories (adapted from Ormrod,2012: 8)

3.3.1 Triadic reciprocal causation

The triadic reciprocal causation model (TRCM) of social cognitive theory is especially relevant for this study, owing to its potential to explain individual-centred aspects of students' learning that arise through social interactions. According to the TRCM, learning or change of behaviour arises from interactions among three variables: a person, their environment and their behaviour (Bandura, 1977a). The concept of learning of the TRCM is consistent with Schunk's (2012) definition of learning as a change or potential of behaviour (see section 2.2). According to Bandura (1977), the three variables of the TRCM that produce learning are integrated; none of them can

be understood in isolation from the others as a determiner of social learning. This integration, as well as the reciprocity of the three TRCM variables, is schematized in Figure 3.3.

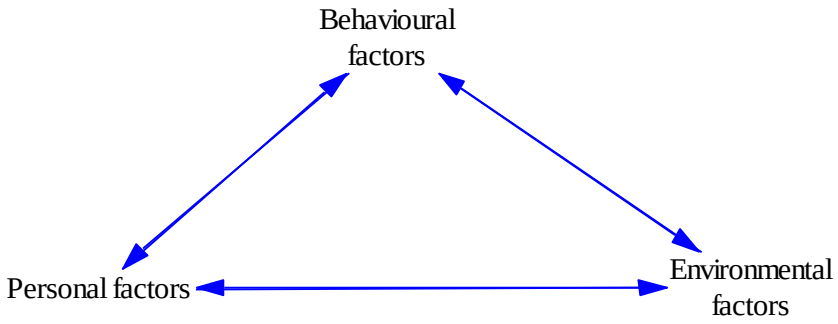


Figure 3.3: Schematisation of Bandura's (1977, 1986) triadic reciprocal causation model

The social-interactive nature of learning envisaged in the TRCM is consistent with Brown, Collins and Duguid (1989) who theorise that learning in the workplace entails students being guided to use practitioner's cognitive and physical tools. Brown, Collins and Duguid (1989) and Bandura (1977a, 1986) present learning as a social process; however, Bandura (1977a, 1986) focuses on interactions between individuals and their environments as illustrated in Figure 3.3. Bandura (1977a; 1986) advises that the interactions of the TRCM should not be seen as presenting an irreducible triad of variables of equal strength but rather a collection of variables of varying relative strength depending on the context. He further explains that the variables do not act simultaneously, and each takes time to exert influence and to activate a reciprocal response from the others.

Personal factors in triadic reciprocal causation model

According to Bandura (1999), personal factors, such as cognitive and affective factors and biological events, are co-participants with behavioural and environmental factors in the TRCM. Although several variables constitute personal factors, this section focuses on agency and self-efficacy because of their association and

potential to contribute to the understanding of the development of students' occupational competencies.

The concept of agency can be used to explain students' actions during work placement that are not prompted by their work environments. According to Bandura (1999), people are not merely destined to respond to environmental events. They choose 'which environmental events will be observed [and] what meaning will be conferred on them', thereby influencing their own experiences (Bandura, 2001: 267). Bandura (2001) refers to this as agency, the capacity to intentionally influence one's behaviour as well as one's physical and social-structural environment as agency. For example, the students choose whom to associate with in their workplaces and how to act, and in so doing, influence their workplace experiences.

According to Bandura (1999), people's agency has more influence on their behaviour than environmental forces. He explains that behaviour is influenced by intentionality, forethought, self-reactiveness and self-reflectiveness, which he refers to as the four expressions of agency. Table 3.2 describes how these four expressions of agency produce and regulate behaviour. He further explains that the four expressions of agency have mutual influence. For example, forethought can produce intentionality in that it influences how the students act in the present: work placement students might motivate themselves to act in a particular way to increase their chances of employment with their host companies.

Table 3.2: Social cognitive theory's four core features of agency

Feature of human agency	Description
Intentionality	Intentionality includes proactive commitment to bring one's plans to fruition and determination to perform certain activities (Bandura, 1986; Feist & Feist, 2008).
Forethought	Forethought is cognitive representations of possible futures which are brought to the present as anticipated outcomes (Bandura, 2006a). Future events cannot cause present motivation; however, their cognitive representation can. Therefore, visualised futures are brought to the present as guides and motivators of behaviour.
Self-reactiveness	'The metacognitive capability to reflect upon oneself and the adequacy of one's thoughts and actions is the most distinctly human core property of agency' (Bandura, 2006: 165).
Self-reflectiveness	People can examine their functioning, their motivations, their values and goals and the soundness of their thinking and make readjustments where needed (Bandura, 2006a).

Feist and Feist (2008) note that expressions of agency encompass more than self-motivation and self-guidance; individuals also adapt their intentions and actions as they re-evaluate their capabilities or become aware of the resulting consequences. Moreover, individuals re-evaluate their capabilities based on their current performance. For this reason, Bandura (2001) concedes that agency is not independent; social-structural environment can influence it.

Another personal factor, self-efficacy, has the potential to provide the basis for linking students' work placement learning processes and changes in their perceived competence. Bandura (1999, 2001a) explains that self-efficacy refers to one's belief about one's capacity to handle particular tasks. He advises that self-efficacy should not be generic, as is the case with self-confidence, because it is specific to particular competencies. For example, a student might think they can handle any word-

processing task but feel utterly incapable of using a finite element analysis computer program. According to Bandura (2001), low self-efficacy can be debilitating for students as it may influence them to act in ways that might be detrimental to achieving learning outcomes. One such negative result of low self-efficacy is task-avoidance because people tend to avoid tasks which they feel they are incapable of completing. Conversely, he explains that high self-efficacy can enhance a student's potential to achieve learning outcomes as students with high self-efficacy tend to be proactive and thrive in performing challenging tasks.

Figure 3.4 shows the processes which, according to Bandura (1994, 1997a), produce self-efficacy. The first and most influential source of self-efficacy is mastery experiences, which entail offering students opportunities to perform authentic activities of practitioners (Bandura, 2006b). According to this concept, if work placement students are offered and perform authentic and meaningful tasks, it enables them to become assured of their occupational competency. This assurance manifests as increased self-efficacy. Feist and Feist(2008) explain that people attain a sense of whether they are capable of successfully executing a task by thinking about how well they have performed related tasks in the past.

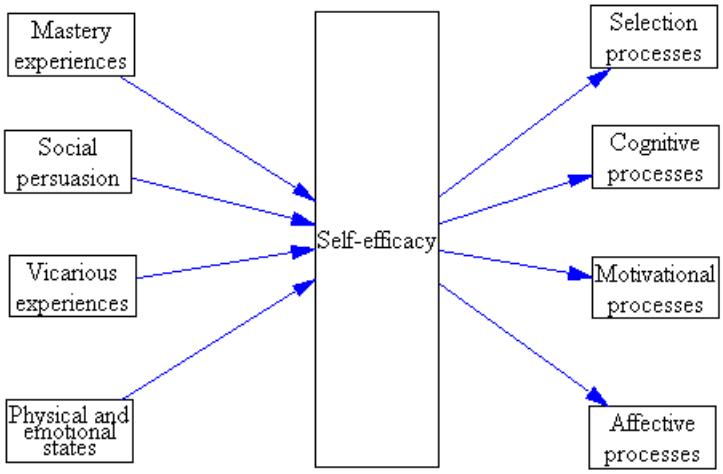


Figure 3.4: Self-efficacy as a link between learning processes and processes through which agency is exercised

Secondly, as illustrated in Figure 3.4, Bandura (1982) explains that students can be socially persuaded to believe that they have the occupational competency they need to be employable. For example, during work placement, social persuasion can take the form of comments made to students by industry mentors and others on the quality of the students' work. He further explains that although the influence of social persuasion is limited, it can act as a reinforcement to those who already have high self-efficacy.

Thirdly, students' self-efficacy can be influenced by observing the successes or failures of others whom the students perceive to have similar abilities to themselves (Ormrod, 2012; Snowman, McCown and Biehler, 2012). Ormrod (2016) explains that students benefit more from observing other students or those that they consider to be novices perform tasks, than seeing proficient practitioners perform those tasks. Unfortunately, this process of enhancing self-efficacy is a challenge for work placement because, in most cases, students are placed alone in host companies. Despite this, Snowman, McCown and Biehler (2012) add that people generally judge their capabilities in comparison with others. Consequently, work placement students

can gauge their capabilities by observing practitioners perform similar work (Snowman, McCown & Biehler, 2012). If students believe that they perform work at proficiency levels similar to those of experienced practitioners, it enhances their self-efficacy. Therefore, having ready access to skilled practitioners, as is the case during work placement, assists students in building competencies for dealing with both work and interpersonal situations and strengthens their belief in their capability.

Lastly, Bandura (1977b) states that physical and emotional states such as fear-provoking thoughts and feelings of vulnerability influence self-efficacy as individuals are more likely to avoid actions that they associate with these negative states. He explains that 'by conjuring up fear-provoking thoughts about their ineptitude, individuals can rouse themselves to elevated levels of anxiety' that may cause them to misjudge their capabilities (Bandura, 1977b: 199). In the case of work placement students, the perceived intimidating nature of workplaces might compound the anxiety. According to Bandura (1977b), students' fear-provoking thoughts might be reduced by vicarious experiences, such as exposing them to other students who have completed similar assignments. Additionally, he suggests that negative emotions could be eliminated by providing students with mastery experiences; as the students are exposed to mastery experiences, they begin to feel better about their chances of completing future work successfully.

As illustrated in Figure 3.4, Bandura (1990) argues that self-efficacy influences individuals' behaviour and functioning through selection, cognitive, motivational and affective processes. Bandura (1997b) contends that self-efficacy influences the goals and activities that individuals choose to pursue. He expands this by stating that 'the stronger the perceived self-efficacy, the higher the goal aspirations people adopt and the firmer their commitment to them' (Bandura et al, 2001: 189). This expression of

self-efficacy has far-reaching consequences in that by choosing to engage in one activity and not another; different competencies can be cultivated to foster a particular career trajectory.

In addition to influencing selection processes, Bandura (1990) and Snowman, McCown and Biehler (2012) concur that self-efficacy enhances or undermines performance by influencing an individual's cognitive processes. They explain that those with high self-efficacy tend to visualise positive outcomes of their course of action and this galvanises them to act. On the other hand, those with low self-efficacy often envision failure and are plagued by self-doubt; consequently; they tend to procrastinate in acting. According to Snowman, McCown and Biehler (2012), self-doubt also causes them to become increasingly erratic in their thinking, lowers their goals and sometimes allows them to give up without accomplishing their goals.

Besides, Bandura (1997a) contends that self-efficacy influences how a person responds to challenging situations. He explains that when faced with a challenging task, those with high self-efficacy exercise better control over their anxiety. He argues that high self-efficacy individuals are likely to experience excitement and eagerness to get started rather than anxiety about their capacity to complete the task. Conversely, when faced with similar challenging tasks, those with low self-efficacy focus on their coping deficiencies and worry about things that rarely happen, thereby impairing their current functioning.

Behavioural factors in the triadic reciprocal causation model

The TRC conceptualises behaviour as the link between cognitive and environmental determinants of learning. According to Bandura (2001), aspects of an environment that are available to individuals depend on their behaviour; at the same time, their environment influences their behaviour, albeit indirectly, through their cognitive

processes. These two determinants influence each other as represented in a clockwise manner in the TRCM representation in Figure 3.2. Bandura (1997) argues that neither the environment nor cognitive factors are the sole determinants of changes in behaviour. It must be noted that Bandura (2001) distinguishes between behaviour and behavioural change: he presents behaviour as a consequence of personal factors, as illustrated in Figure 3.5, and behavioural change as a product of both cognitive and environmental determinants. He concurs with Schunk (2012) in defining learning as behavioural change).

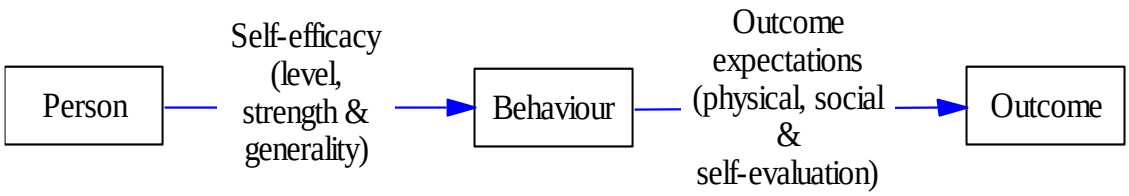


Figure 3.5: Conditional relationship between self-efficacy, behaviour and outcomes (Bandura, 1997a: 22)

Bandura (1997) observes that among the cognitive factors that influence the interaction between the environment, behaviour and behavioural change, self-efficacy is central because it influences how a person conceptualises the environment. For example, if a work placement student who has low-self-efficacy is asked to use a different model of a CNC machine from that which they were exposed to at university, they might feel threatened because of the possibility of making work errors as a result of unfamiliarity with the machine. The student might hold back from using the machine and wait for guidance or training. If confronted with a comparable situation, a high self-efficacy person might work proactively, believing that he could handle any challenge that might arise because of the model differences. According

to Bandura (1997a) this association, which he represents as in Figure 3.5, links personal factors with behaviour, and links behaviour with outcome expectations.

The differences between behaviour and behaviour change in the TRCM can be illustrated using the following example: work placement students who procrastinate (a personal factor) are likely to complete tasks late (behaviour). This late completion of work might influence their mentors to assign them student non-priority work (personal factor influencing the environment). However, if the students notice that their co-workers start executing their tasks as soon as the tasks are assigned to them (environment), they might learn to associate an early start to work with being assigned priority work. They might also start their assigned work early (change in behaviour) in the hope that this might result in being assigned priority work. Of course, this can only happen if the students want to be assigned priority work (cognitive regulation of the influence of an environment determinant). Bandura (1994, 1997a) refers to this learning from observing the outcomes others attain from their behaviour as vicarious learning. He indicates that apart from vicarious experiences, the environment provides two other mechanisms through which it influences the change of behaviour: mastery experiences and social persuasion. In the example, priority work provides the students with mastery experiences.

Environment factors in the triadic reciprocal causation model

The positioning of the environment with the TRCM has the potential to facilitate understanding of the processes through which the environment and work placement students jointly influence student learning. It was established in the previous sections that TRCM presents cognitive factors as the link between environmental influences and behavioural change. Bandura (2001a) explains that the environment that is referred to in the TRCM is not merely a physical environment; it encompasses the

social, cultural and political environment. He further explains that cognitive factors determine ‘which environmental events will be observed, what meaning will be conferred on them, whether they leave any lasting effects’ (Bandura, 2001a: 267). By influencing the selection of what to observe, cognitive factors influence which aspects of an individual's environment have the most influence on their behavioural change. By cognitively selecting aspects of the environment to observe or experience, a person isolates a subset of the environment that participates in the TRCM.

Bandura (2001b) accounts for this selective participation of the environment in the TRCM by distinguishing three operative environments: imposed, selected and experienced environments. He defines the imposed environment as one that is present when a person first encounters a new environment. In a work context, the newcomer might be a newly recruited employee or a work placement student who experiences a social, physical and political environment that predates their arrival in the workplace. According to Bandura (2006a), this environment is imposed on them because in most cases, the newcomers do not immediately have control over this environment. However, the newcomers select their experienced environments through their agentic actions, such as choice of work associates, union membership and activities they participate in. For example, new employees that are hardworking and proactive are more likely to be invited to participate in priority activities than those who are passive and less hardworking.

According to the TRCM, newcomers are not the sole determinants of their experienced environments because, as argued by Bandura (1999: 24), their ‘agency operates within a broad network of socio-structural influences’. Bandura (1999) contends that the prevailing social structure imposes constraints or provides

opportunities for the exercise of agency by the newcomer. For example, in some organisations, there are limited interactions between people occupying various levels in the hierarchy. In such instances, it is difficult for newcomers to articulate their work preferences to people who can affect the necessary change. Bandura (1999) recommends that agency and social structures should be treated as unified causal determinants of experienced environments.

3.3.2 Strength and limitations of social cognitive theory

The primary strength of the social cognitive theory is that it has endured over time. Many empirical investigations in various disciplines supported its propositions. Middleton, Hall and Raeside (2018) refer to the use of social cognitive theory by researchers in health education, information systems, organisational studies, media and communication studies and several other disciplines. Gibson (2004) notes that social cognitive theory is uniquely suited to workplace learning research as it is a synthesis of behaviour and cognitive views of learning. Other researchers such as Middleton, Hall and Raeside (2018) and Eames and Cates (2011) concur with this assertion.

Social cognitive theory is not without its critics. Several researchers find fault with the theory for being too broad and for supposedly failing to address issues of causation of behaviour (Olson & Hergenhahn, 2013). A criticism by Phillips and Orton (1983) is especially relevant to this study. They argue that the pattern of modelling causation, especially the reciprocity amongst the personal, environmental and behavioural factors, is misleading and vague. They argue that if, for example, behaviour influences the environment and reciprocally the environment influences behaviour, it becomes impossible to determine causation. Bandura (1983) responds by clarifying that the reciprocal interaction does not happen simultaneously. He comments:

> The production of a reciprocal effect takes time. Because reciprocity is traditionally defined as a back-and-forth interchange, to conceptualise it as a process in which the interactants are influencers and influenced at the same instant in time would constitute a contradiction in terms. Successive happenings cannot be simultaneous. (Bandura, 1983: 167)

Staddon (1984) considered criticism by Phillips and Orton (1983) and Bandura's (1983) response. He accepted that when the reciprocal response is considered as a timeline, the concept of reciprocal interaction is consistent with other research. However, he warned that internal and intervening variables operating between the interacting determinants could not be ignored. Tittle (2004: 716) argues that 'the real test of a theory is whether the causal structure it specifies holds up empirically and does so across many domains.' If we accept the test for the validity of a theory that is suggested by Tittle (2004), then we must accept that the triadic reciprocal causation model has passed the test, as it has been empirically validated in many disciplines over the past forty years.

3.4 Situated cognition theory

Situated cognition theory, which is sometimes called situated learning theory, is a group of theoretical positions that share the assumption that knowledge, learning and cognition are inextricably situated in their sociocultural contexts of production and use. The theory shifts from the cognitivists' conception of learning as a mental process, conceptualising it as a product of social activity. Situated cognition theory postulates that students learn through guided performance of work assignments (Brown, Collins & Duguid, 1989) and through participating in workplace activities (Lave & Wenger, 1991).

Learning through guided performance, a concept that was developed by Brown, Collins and Duguid (1989), is premised on the notion that doing is the most effective

way of developing expertise. Brown, Collins and Duguid (1989) indicate that to develop expertise, students need to use the same tools that practitioners use, and they need to use these tools in the same contexts that experts use them. They recognise that students might initially not be competent enough to use the practitioners' cognitive and physical tools by themselves. Therefore, they proposed a type of guided performance which they called `cognitive apprenticeship'. Cognitive apprenticeship is a teaching approach that provides students with apprenticeship-like experiences by giving them opportunities to use practitioners' tools to perform authentic tasks while providing them with close guidance and immediate support (Collins, Brown & Newman, 1987; Brown, Collins & Duguid, 1989). The concept of cognitive apprenticeship is discussed in detail in section 3.4.1.

While Brown, Collins and Duguid (1989) focused on the interactions between students and their teachers, Lave and Wenger (1991) focused on the social process that makes this possible within what they referred to as 'a community of practice'. A community of practice is a group of 'people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis' (Wenger, McDermott & Snyder, 2002: 4). According to Li et al. (2009), a community of practice is a type of learning community and may exist within a school, home or workplace. For example, a group of technicians in a machine shop can coalesce into a community of practice when they share knowledge of machining techniques and identify themselves as members of the group. Within a community, members define their identity through their roles within the community and their interactions with other members. Each community of practice has core members, old-timers who are the custodians of the community's shared knowledge repository (Karalis, 2010). Lave and Wenger (1991) explain that

the old-timers guide newcomers to become active members of the community of practice through a process that is referred to as `legitimate peripheral participation'. The concept of legitimate peripheral participation is discussed in section 3.4.2.

3.4.1 Cognitive apprenticeship

Cognitive apprenticeship has some similarities with traditional apprenticeship in that both approaches focus on teaching students to understand and use processes that experts employ to solve real-world (authentic) problems. However, these two approaches focus on different things. Traditional apprenticeship focuses on teaching physical skills, such as welding or machining, that are externally available for observation, correction and refinement (Collins & Kapur, 2014). On the other hand, cognitive apprenticeship focuses on teaching students cognitive and metacognitive skills and processes that experts use to perform their work and solve problems. Since these skills are mind-based, cognitive apprenticeship is designed to bring cognitive processes that experts use into the open to enable students to observe and practise them. Collins, Brown and Holum (1991) refer to this process as `making thinking visible'.

Cognitive and traditional apprenticeship also differ in agenda. Traditional apprenticeship arises from workplace demands. In traditional apprenticeship, the apprentice observes the expert demonstrating how to perform a portion of the task. The expert hands over that portion to the apprentice and coaches the apprentice to perform it. This back and forth continues until the apprentice can perform the whole task. Thus, traditional apprenticeship involves an interplay between modelling, coaching, scaffolding and increasing independence (Collins, Brown & Holum, 1991).

In contrast, cognitive apprenticeship arises from teaching and learning concerns. It is designed to introduce students to cognitive skills and processes that experts use and

to enable them to develop their expertise. This process was operationalised by Collins, Brown and Holum (1991) who presented it as four interconnected dimensions of learning, as shown in Table 3.3. It is clear that if a skill to be learnt is cognitive, such as mathematical problem solving, the processes of traditional apprenticeship are lacking. In this case, modelling involves making visible to students the problem-solving heuristics (rules of thumb) that the experts use. Collins, Brown and Holum (1991: 13) indicate that this involves 'externalisation of usually internal processes and activities; specifically, the heuristics and control processes by which experts apply their basic conceptual and procedural knowledge'.

Table 3.3: Four interconnected dimensions of learning that constitute a cognitive apprenticeship environment

Item	Description
Content	Knowledge and thinking strategies required for expertise. These include propositional and procedural knowledge, and heuristic and control strategies that experts use to accomplish tasks and to direct their solution process.
Method	Teaching strategies for developing expertise: modelling, coaching, scaffolding, articulation, reflection and exploration. The first three teaching strategies are as described in traditional apprenticeship. The last three teaching strategies are unique to cognitive apprenticeship: articulation – students verbalise their knowledge and thinking, reflection – students compare their performance with that of others, and exploration – students choose and solve their problems.
Sequencing	How learning tasks should be organised and presented to promote the development of expertise. Learning tasks should be provided to students in increasing complexity, increasing diversity and transferring focus from global to local.
Sociology	Cognitive apprenticeship acknowledges that learning is situated in a social context. It is influenced by the student's interactions with members of the community of practice (CoP) and the student's intrinsic motivation to learn. Since learning is considered a social activity, cooperation between the student and members of the CoP is key to meaningful participation.

3.4.2 Legitimate peripheral participation

Legitimate peripheral participation shifts the focus away from relationships between students and their teachers to students and the entire community of practice.

Legitimate peripheral participation refers to the process through which newcomers become old-timers. The process is premised on the community practice accepting the newcomers as one of its members. This acceptance is required before the newcomers can be granted access to a shared repository of resources such as experiences, stories, cognitive and physical tools and ways of solving problems. In work placement learning, the students are newcomers to the workplace community.

It is the community's acceptance that gives the newcomer authority to enter the community. If the community of practice does not accept a person, he or she might render a service or receive service from the community but will remain an outsider or a transactional participant (Karalis, 2010). Lave and Wenger (1991) state that the term `legitimate' defines belonging, indicating that unlike a transactional participant, the legitimate peripheral participant is identified by the community as one of its members. They further state that learning through participation entails changing location within the community, changing power dynamics and developing identity.

In 1991, Lave and Wenger indicated that participation would be peripheral, full or central participation. Karalis (2010) explains that in later work, Wenger added more detail to the concept of level of participation. Table 3.4 describes the five levels of participation that newcomers go through as they develop into old-timers (Wenger, 1998; Karalis, 2010).

Table 3.4: A description of levels of participation within a community of practice

Increasing participation	Level of participation	Description
	Transactional participation	These are people who interact with the workplace community but are not members. They receive or provide a service to the community. Newcomers who are transaction participants feel as if they are not welcome
	Peripheral participants	These are newcomers to the workplace community. They feel accepted by the community
	Occasional participants	These members of the community of practice only participate in a specific topic of interest in some aspects of the work of the community, such as a project
	Active participants	These are full members of the community. They are recognised as practitioners
	Core participants	These are a small group within the community who energise and nurture the community. This group is the leaders of the community.

Holland and Lave (2009) add that participation in the community of practice is not neutral, it is influenced by political-economical and cultural-historical factors. They suggest that newcomers belong to some cultural or social-economic groups or with life histories would find it easier to participate in workplace communities than others. Furthermore, they perceived the workplace as a contested space, contested between imperatives of the newcomers between and within-company power relations.

Holland and Lave (2009) concur with Lave and Wenger (1991) that as new members of a community of practice become competent, their involvement in the socio-cultural practices of the community increase. Holland and Lave (2009) contend that the use of artefacts that are common to the community also facilitates the integration of the newcomers. As this happens, the newcomers move from peripheral to active or occasional participation. Thus, learning is increasing engagement in communities of practice and complexity of the tasks in which a student co-participates. In this conception of learning, it is more than doing, more than experiential knowledge.

Thus, learning concerns the whole person acting in the world rather than cognitive processes that reside in the mind (Lave & Wenger, 1991).

3.5 Synthesis of social cognitive and situated cognition theories

Jarvis and Parker (2005) explain that learning is a complex process as it is both cognitive and social. This view is shared by Johri and Olds (2011) who indicate that learning occurs through acquisition as well as through participation in activities that are situated in the social and material context. Unfortunately, “no single theory explains everything researchers have discovered about learning” (Ormrod, 2016:10). Theories tend to focus on either the cognitive or social aspects of learning. Eames and Cates (2011) suggest the use of multiple theories to account for both cognitive and social aspects of learning. To account for the cognitive and social aspects of learning, this study uses social cognitive theory which is based on cognitive psychology and situated learning theory which is based on sociology.

The social cognitive theory is used to conceptualise the acquisition aspect of learning in the workplace by drawing on the concepts of mastery experiences and triadic reciprocal causation model (Bandura, 1977a, 1986). On the other hand, situated cognition theory is used to conceptualise the participation aspect of learning by drawing on the concept of legitimate peripheral participation (Brown, Collins & Duguid, 1989; Lave & Wenger, 1991).

The two theories complement each other to present a conceptualisation of learning in the workplace as simultaneously a group and an individual process. Additionally, the two theories complement each in conceptualising the outcomes of work placement learning in the workplace. Social cognitive theory focuses on the cognitive outcomes of learning in the workplace such as self-efficacy and agency (Bandura,

1986). Situated learning theory conceptually occupational competency is reflected in the changing identity of the newcomer shown by acceptance of the newcomer by the workplace community (Lave & Wenger, 1991). This enables the study to account for how participation influences the growth of occupational competency and self-efficacy as well as how self-efficacy influences the trajectory of participation in a community of practice.

3.6 Conclusion

This chapter presented social cognitive theory and situated cognition theory, two learning theories that formed the theoretical framework for this study.

The social cognitive theory developed from behaviourist theories of learning. However, it shifted from its behaviourist roots, mostly through the work of Albert Bandura. The theory has developed several concepts that are valuable in understanding individual-centred aspects of student learning during work placement. These include self-efficacy, agency, self-regulation and the triadic reciprocal causation model. The triadic reciprocal causation model explains how students learn through interactions among themselves, their learning environments and their behaviour.

In recognition of the situatedness and the group aspects of work placement learning, the theoretical framework of the study includes two concepts that fall under the group of theories that are collectively referred to as situated cognition theory. The first one, cognitive apprenticeship, focuses on student learning through guided performance. The second concept; legitimate peripheral participation, focuses on student learning through participation. When considered collectively, triadic reciprocal causation model, cognitive apprenticeship and legitimate peripheral participation provide a

framework for understanding the development of student employability during work placement.

The following chapter discusses the research methods that were used in this study: the preparations that were done, including negotiating for access, preparing documents for ethical approval and conducting a pilot study. The pilot study comprised interviewing 5 mechanical engineering students about their work placement experiences. The chapter also discusses the data collection and data analysis methods that were used in the study, as well as measures that were taken to promote trustworthiness and rigour.

CHAPTER FOUR
RESEARCH DESIGN AND METHODS

4.1 Introduction

This chapter presents the interactive model of research design that was followed to conduct the study.

The chapter starts by discussing the qualitative multi-case design of the study, the research philosophy that underpins it and its suitability for the study. Next, it discusses the preparations that were done, the pilot study, the research setting and participant selection processes. Later, it discusses the research methods used in the study, data collection, thematic analysis and the thematic synthesis. The chapter closes by discussing measures that were taken to adhere to principles of good ethical practice.

4.2 Research philosophy

Before presenting the research design that was followed in the study, it is vital to outline the research philosophy that underpins the assumptions and choices that were made in this study. Easterby-Smith, Thorpe and Jackson (2015: 46–47) explain that a philosophical foundation of a study comprises its ontology – 'assumptions about the nature of reality', and epistemology – 'assumption about ways of inquiring into the nature of the world'. They further explain that there are two main contrasting ontological positions: one that views reality as concrete and external (realism) and the other that views it as 'socially constructed that is, there… there are multiple realities, or interpretations, of a single event' (relativism) (Merriam & Tisdell, 2016: 9).

These two ontologies lend themselves to positivist or interpretive epistemologies. The key idea of positivism is that a single reality exists and that its properties can be measured through objective methods (Easterby-Smith, Thorpe & Jackson, 2015). In contrast, interpretivism, also referred to as social constructivism, the researcher's goal is to appreciate and understand the different constructions and meanings people place on their experience.

The study adopted a social constructivism philosophy because it is consistent with the aim of this study, exploring how mechanical engineering students perceive their work placement experience. According to Easterby-Smith, Thorpe and Jackson (2015), the two epistemologies are suited to different types of studies. As is the case in this study, they suggest that social constructivism is suited to studies that seek to understand the different experiences that people have. On the contrary, they suggest that positivism is suited to studies that seek to explain and predict behaviour through uncovering fundamental laws relate human action with external stimuli.

4.3 Research design

This study followed a qualitative research design in which qualitative data was collected to explore the mechanical engineering students' work placement experiences. Silverman's (2014: 34) advice that researchers should use a qualitative research design if they are 'concerned with exploring people's life-histories or everyday behaviour' applies to this study. In addition, this study acknowledges that the centrality of the research questions in research design, as illustrated in the interactive model of research design, derived from Maxwell (2013), as shown in Figure 4.1.

Inspection of the research questions of this study reveals that they are process questions, which, according to Maxwell (2013), favour a qualitative design. Maxwell

(2013: 82) defines process questions as those which 'focus on how things happen' as opposed to variance questions, which focus on 'whether there is a particular relationship or how much it is explained by other variables'.

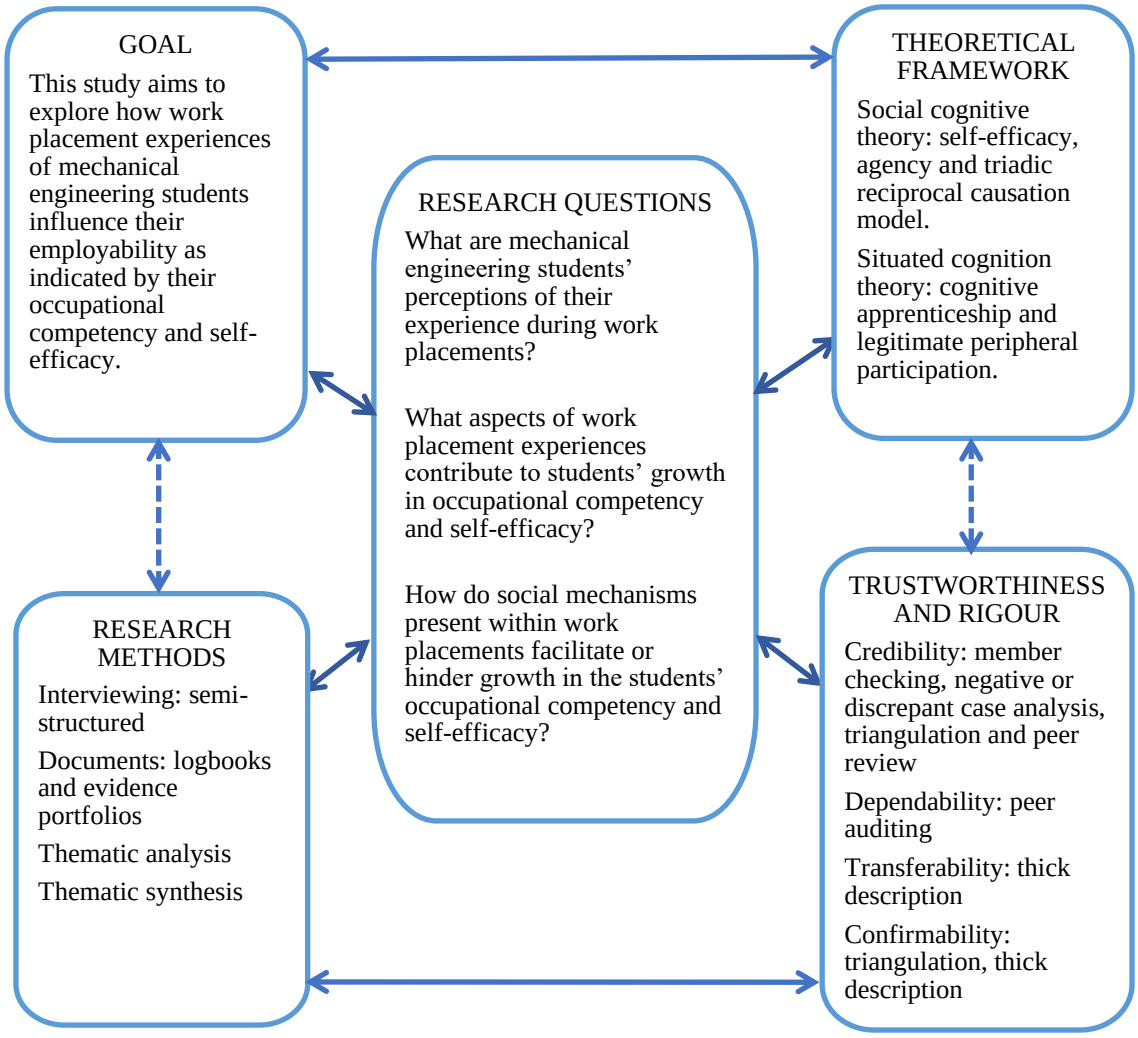


Figure 4.1: An interactive model of research design (adapted from Maxwell, 2013)

The interactive model of research design, shown in Figure 4.1, is central to this study. Figure 4.1 presents how various elements of the interactive model of research design used in the study fit together. These elements are discussed in this and chapters One and Three. This chapter presents the research methods and measures that were taken to ensure trustworthiness and rigour. Chapter One presents the goal and the study's research questions, which are aligned as both are concerned with

uncovering the social processes that produce employability outcomes. Chapter Three presents the study's theoretical framework.

4.4 Research methodology

This study followed a multiple case study methodology because, according to Yin (2018), this methodology is appropriate for studies such as this which focus on the processes through which outcomes of intrinsically bounded activities are realised. In addition to this, Stake (2005:445) advises that multiple case study methodology is preferable in instances that focus on the developing 'insight into an issue', with the cases being of secondary interest. The term 'case' refers to the bounded system that is the subject of 'an in-depth description and analysis' (Merriam, 2009: 40). In this study, the case is the work placement experiences of a mechanical engineering student since it is the experience that is the subject of the study (Bazeley, 2013). As indicated earlier, the processes within these experiences which enhance student employability are of interest. Therefore, according to Merriam's advice, individual cases will be chosen based on their potential to advance understanding of the activities of interest: that is, employability enhancing processes.

4.4.1 The pilot case study

The study followed Yin's (2018) advice and conducted a pilot case study to refine data collection plans, facilitate developing relevant lines of questions for the semi-structured interviews of the main study and familiarise oneself with the data analysis tools. Sinkovics and Alfoldi (2012: 824) called this 'progressive focusing', that is, being 'strongly open to the possibility of significant modifications to [a study], driven by emic questions arising from the field'. The design of the pilot case study comprised participant selection, data collection and data analysis.

Five participants were chosen for the pilot study based on convenience of geographic proximity, as they had all been placed with organisations in the Cape Town Metro. One student had been placed in an engineering consultancy firm, another in a research institution and three had been placed in manufacturing companies. Data collection for the pilot case study was through semi-structured interviews that were conducted with the participants in the researcher's office during February 2017. The interview data were transcribed by the researcher and imported into NVivo for analysis. The data analysis comprised first-cycle coding and second cycle pattern coding for themes (Miles, Huberman & Saldana, 2014).

4.4.2 Research setting and participant selection

Polit and Beck (2017) suggest that to support the transferability of their findings, research studies should provide descriptions of their research settings. The term `research setting' refers to the physical, social and cultural environment from which data are collected. The research setting for this study was primarily the Western Cape Province in South Africa, except for two participants who were placed outside the Western Cape. The interviews were conducted in the researcher's office in Bellville, Cape Town. Furthermore, they were conducted when the participants came to the university on one errand or another to minimise inconvenience to the participants.

Yin (2018) advises that once the case has been defined, the next step should be to define its boundaries. In following this advice, this study limited its potential participants to the 2017 cohort of third-year mechanical engineering students from the Cape Peninsula University of Technology (CPUT). This cohort had 302 students who were placed in 150 host companies. Table 4.1 provides a summary of their work placement registrations. Most of the members of this cohort were placed at host

companies within Cape Town Metro. However, a few of them were placed in other provinces of South Africa, and a few international students from Namibia and Angola were placed with host companies in their home countries.

Table 4.1: Mechanical Engineering Practice 1 (P1) and Mechanical Engineering Practice 2 (P2) registrations for the 2017 cohort of National Diploma in Mechanical Engineering students: registrations

Category		**Registered for P1**	**Registered for P2**	**Registered for both P1 and P2**
Gender	Male	148	103	6
	Female	26	25	4
Nationality	South African students	146	115	10
	International students	28	13	0

It was not feasible to invite the entire cohort to participate in the study. The advice of Miles, Huberman and Saldana (2014: 31) that ‘as much as you might want to, you cannot study everyone everywhere doing everything’ is pertinent to this study.

Before semi-structured interviews were due to be held, field observations had been conducted at forty-seven host companies in the Cape Town Metro. Therefore, potential participants were limited to one hundred and two students whose host companies had been visited during field observations. This limitation was essential because the researcher had an emic perspective only for students who were hosted in these forty-seven companies as he was aware of their work placement contexts.

From the potential one hundred and two students, maximum variation purposeful sampling was used to select the participants. Maxwell (2013) explains that in purposeful sampling, sampling parameters are chosen deliberately to provide qualitative data that is relevant to the research questions. In a qualitative study, sampling parameters are usually people, settings, events and processes (Miles, Huberman & Saldana, 2014).

In this study, the participants were selected to encompass a diversity of experiences. This selection strategy was based on Patton's (2015: 283) assertion that ‘any common patterns that emerge from great variation are of particular interest and value in capturing the core experiences and central, shared dimensions of a setting or phenomenon’. Most of the host companies took one work placement student at a time but a few established companies hosted more than five students. The study limited the number of students that were interviewed to three per host company to ensure a diversity of experiences.

Polit and Beck (2017) and Bryman (2016) concur that there are no fixed rules on appropriate sample size in qualitative research. They explain that it is difficult to establish the appropriate sample size at the onset of a study and that the numbers given in literature are indicative. However, Bryman (2016) notes that a sample size of between 12 and 60 with a mean of 30 is generally acceptable for qualitative studies that use in-depth interviews. The sample size should be selected on the understanding that the number of participants may be increased if saturation is not reached. In following this recommendation, the 34 students agreed to participate in the study were considered enough. Of these, 32 participants were placed in host companies within the Cape Town Metro and two students were placed outside the Western Cape, one in Gauteng and another in the North West Province.

Only two of the participants had previous exposure to work experience, one as a sales administrator and the other as an engineering drawing instructor at a TVET college. Table 4.2 shows a list of the participants and the distribution of the industries in which they were placed.

Table 4.2: List of participants, their pseudonyms and engineering fields of their placement companies

Student number	Pseudonym	Industry
Student 1	Johannes	Manufacturing and fabrication, Mechanical engineering consultancy
Student 2	Jaco	Manufacturing and fabrication
Student 3	Nuriya	Manufacturing and fabrication
Student 4	Hlobloblothando	Aquaponics
Student 5	Janet	Research Institute
Student 6	Moyenda	Hydraulics and pneumatics manufacturer, foundry, pharmaceutical products producer
Student 7	Henri	Mechanical and material testing
Student 8	John	Manufacturing and fabrication
Student 9	Raphael	Engineering consultancy and mechanical manufacturer
Student 10	Umdobi	Marine vessel fabrication and repair
Student 11	Lesedi	Automobile component manufacturer
Student 12	Kgabu	Automobile component manufacturer
Student 13	Magda	Automobile component manufacturer
Student 14	Mugisha	Non-alcoholic beverage producer
Student 15	Joseph	Non-alcoholic beverage producer
Student 16	Mantso	Non-alcoholic beverage producer
Student 17	Botumelo	Higher education workshop and research laboratory
Student 18	Hlumelo	Higher education workshop and research laboratory
Student 19	Marianne	Higher education workshop and research laboratory
Student 20	Arsenio	Non-alcoholic beverage producer
Student 21	Katleho	Non-alcoholic beverage producer
Student 22	Thomas	Manufacturing and fabrication
Student 23	Mark	Plastic bottle manufacturer
Student 24	Tabelo	Fibre products manufacturer
Student 25	Tendai	Higher education workshop and research laboratory
Student 26	Andrew	Petroleum products tank manufacturer
Student 27	Adriaan	Manufacturing and fabrication
Student 28	Tumelo	Pressure vessel manufacturer
Student 29	Nqobile	Gold mining and gold waste recovery plant
Student 30	Lerato	Automobile component manufacturer
Student 31	Kagiso	Automobile component manufacturer
Student 32	James	Mechanical engineering consultancy
Student 33	Kenneth	Gold mining
Student 34	Mavuto	Manufacturing and fabrication

4.4.3 Qualitative data collection

The study collected qualitative data from three sources: semi-structured interviews, documents (logbooks and evidence portfolios) and field observations. The qualitative data collected from semi-structured interviews were the primary data for analysis,

whereas the naturally occurring data collected from student logbooks and evidence portfolios were for triangulation purposes (Patton, 2015). Even though observational data were not used in the data analysis, they enhanced awareness of the students' work placement contexts and facilitated a purposeful sampling process.

Qualitative data collection from interviews

Kvale (2007: 7) defines an interview as 'a conversation that has a structure and a purpose determined by one party – the interviewer'. Interviews have many uses, and their structure varies depending on their use (Punch, 2014). According to Merriam and Tisdell (2016), interviews are identifiable as unstructured, structured and semi-structured. Table3 provides descriptions of the three types of qualitative interviews.

Table 4.3: Interview types that are used in qualitative research (adapted from Merriam and Tisdell (2016))

Interview type	Description	Potential use
Structured interview	The wording and structure of questions are predetermined. There is rigid adherence to predetermined questions. It is an oral form of a written survey.	This type of interview is to gather basic sociodemographic data (Merriam & Tisdell, 2016).
Semi-structured interview	The interviewer is guided by an interview schedule that has some default questions that are ordered in a particular way.	This type of interview is used when a researcher is clear at the outset about their exact areas of interest (Easterby-Smith, Thorpe and Jackson, 2015)
Unstructured interview	The interviewer has themes of interest and lets the conversation develop around them. There is no predetermined set of questions.	This type of interview is useful in exploratory research (Merriam and Tisdell, 2016). It can be used to prepare questions for subsequent interviews.

According to Merriam and Tisdell (2016), both semi-structured and unstructured interviews may allow a researcher to `access participants' perspectives and understandings of the world'. However, the semi-structured interview allows a researcher to align an interview with a study's theoretical framework in a manner that is flexible enough to allow the researcher to respond to emerging views of participants. Because of this, the study used semi-structured interviews, which followed the sequence outlined in Figure 4.2.

The semi-structured interviews were conducted between March 2017 and December 2017 using the interview protocol that is presented in Appendix C.

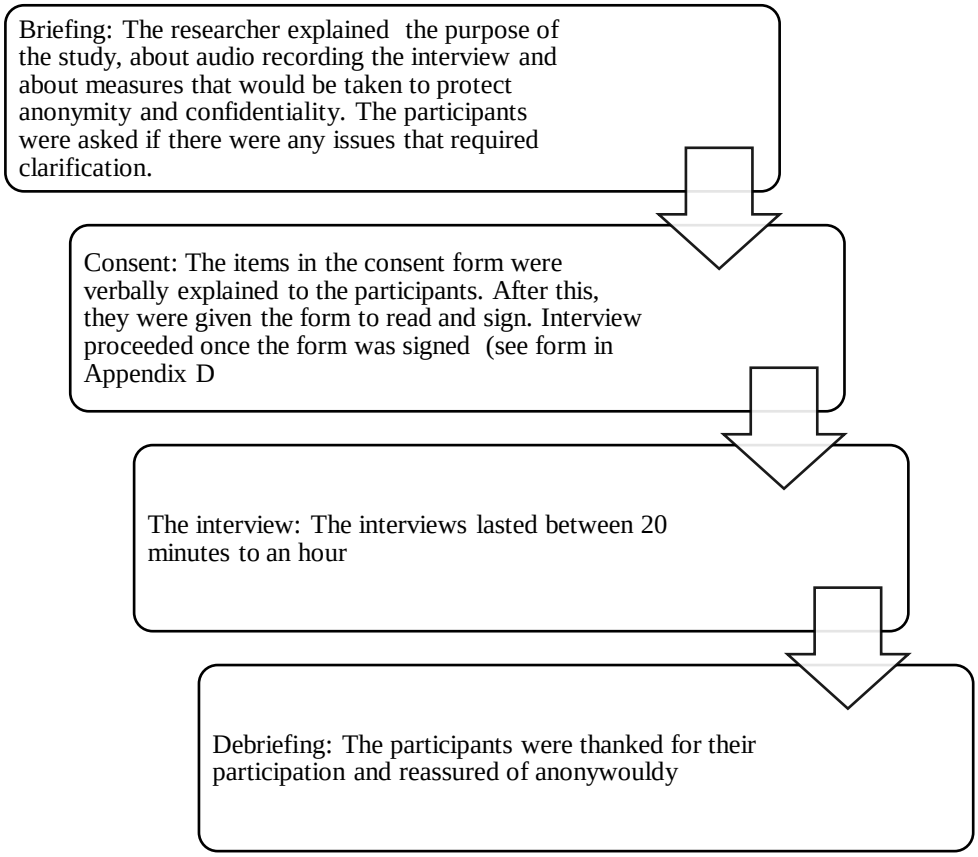


Figure 4.2: Sequence of the semi-structured interviews of this study

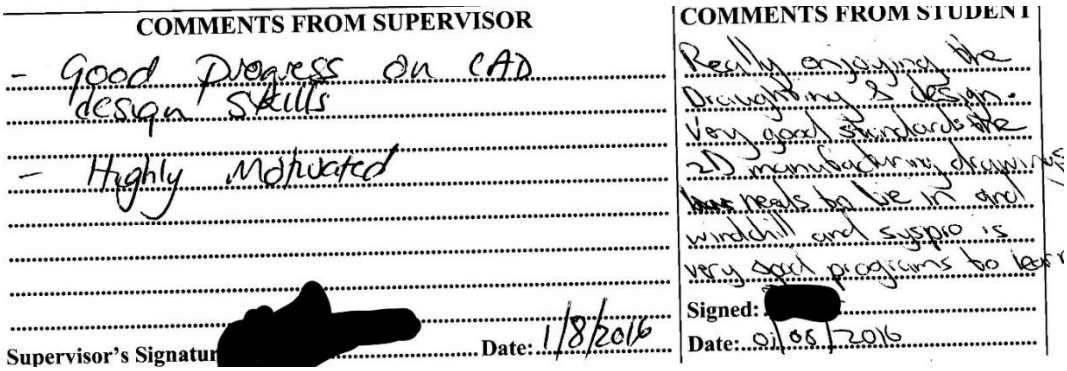
Although the researcher strived to follow these steps, both intentional and unintentional deviations happened. For instance, despite planning to conduct student

interviews in a neutral venue, a boardroom, only five interviews were conducted there. There were too many distractions in the boardroom as it was also used for storage, so remaining interviews were shifted to the researcher's office. Also, despite planning to conduct one-on-one interviews only, two students who were placed at the same company requested a joint interview. The researcher accepted this request but separated their responses during transcribing.

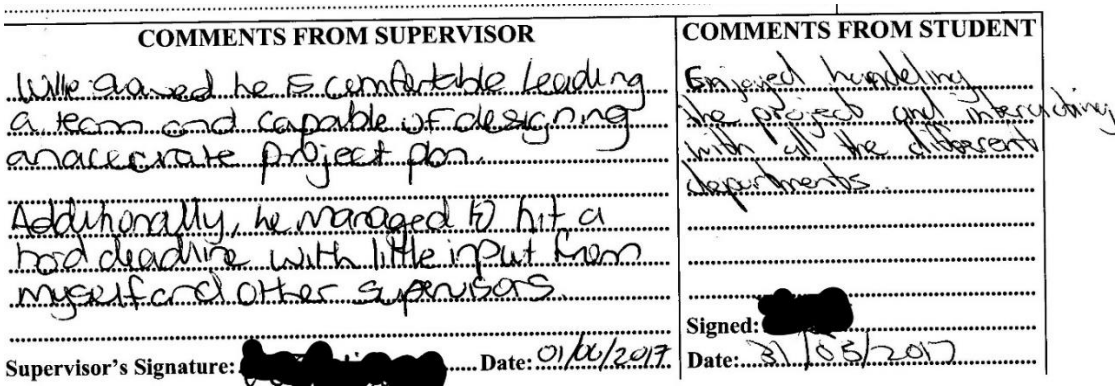
Other deviations were intentional: for instance, to encourage and prompt the participants to talk to elicit detail about aspects of their work placement experiences, the researcher sometimes deviated from the interview protocol (Cook, 2012; Guest, Namey & Mitchell, 2017).

Qualitative data from student logbooks

Patton (2015) explains that triangulation is a useful strategy for enhancing the credibility of a study. He argues that triangulation of qualitative data sources provides for cross-checking the consistency of information collected from the participants. In this study, the students' logbook comments were mostly useful for cross-checking what they said during interviews about the nature of activities performed. For example, the student's and industry supervisor's comments shown in Figure 4.3 indicate that the student's performance improved and that his participation increased in the eight months between (a) and (b). The student had progressed from working in the drawing office to leading a project team. This data is consistent with what the student said during his interview.



(a) Student's and industry mentor's logbook comments



(b) Comments made by the industry mentor and student eight months later

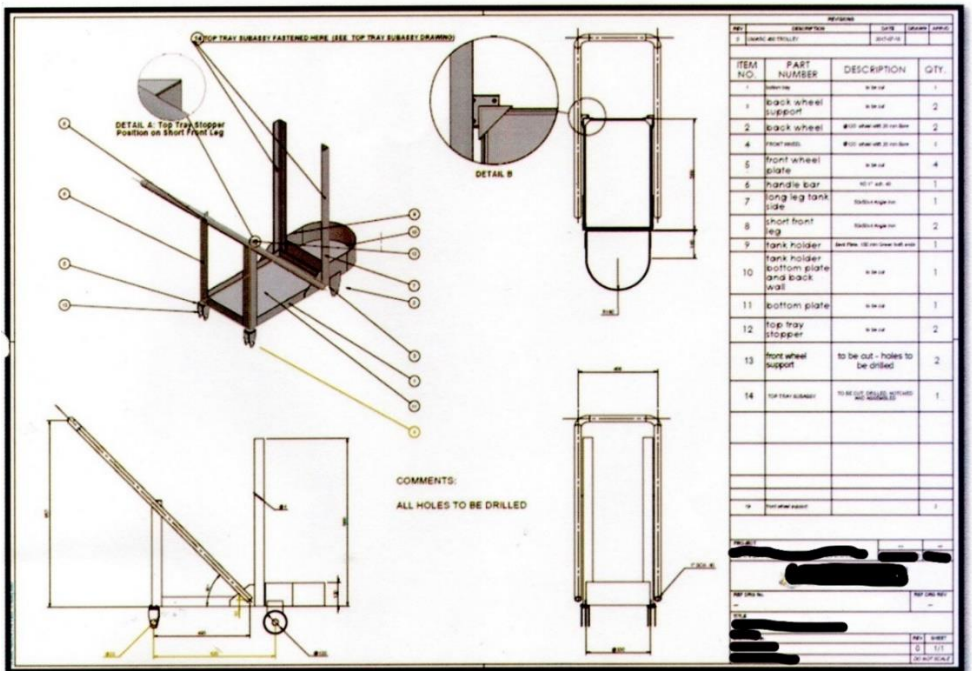
Figure 4.3: Examples of a student's and industry mentor's logbook comments

Other logbook entries showed similar consistency with what students said in their interviews. The logbook entries describe the tasks that students performed and the time that they took to complete them. The data derivable from the logbooks was limited because although the logbooks provided for weekly entries, the participants' logbooks were completed monthly. Moreover, it was noted that the supervisor comment section of the logbooks was not always completed by the same person. The section was completed by the person that the students were working with during a period signed off the logbook sheet.

Qualitative data from students' evidence portfolios

Student evidence portfolios were another source of data that was useful for triangulation. The evidence portfolios provided the researcher with background information on the host companies, pictures of students' artefacts, CAD drawings,

job cards, cost sheets, students' appraisal forms and competency assessments sheets. Figure 4.4 shows an example of a CAD drawing of a trolley that one of the participants designed and a picture of the completed trolley. This data was extracted from the student's evidence portfolio. Evidence portfolio data was also used to cross-check what was said during interviews. In all cases, it was consistent with the interview data.



(a) A CAD drawing of a trolley that one of the participants designed

(b) A picture of the fabricated trolley from one of the participants' evidence portfolio

Figure 4.4: An extract from a student's evidence portfolio showing a CAD drawing of a trolley and the fabricated trolley

Evidence portfolio data was also used to cross-check what was said during interviews. In all cases, it was consistent with the interview data.

Observational data for context familiarisation

Yin (2009: 110) contends that field observations are vital for case study research because of their potential to 'add new dimensions for understanding either the context or the phenomenon being studied'. In addition, Krefting (1991) observes that prolonged exposure to the participants and their contexts enhances the credibility of a study as the participants are more likely to volunteer information that they would initially be too sensitive to disclose. Both objectives were relevant to this study as it sought measures to enhance understanding of the students' work placement environments and to facilitate a shared understanding of contextual elements during the semi-structured interviews.

The researcher conducted direct field observations at 47 host companies between February and March 2017. He was accompanied by a WIL coordinator, an academic staff member who places, monitors and assesses work placement students. The WIL coordinator served as the gatekeeper for the work placement sites. Each field visit lasted between two and three hours. The researcher wrote field notes and conducted conversational interviews with the students, their industry mentors and other co-workers. Also, the students took the researcher around their host companies. The tours yielded valuable information as the students found it easier to talk about their experiences as they showed the researcher the various workstations through which they rotated and the work activities they performed. Furthermore, he sat in on progress meetings between the students, the WIL coordinator, their industry mentor and other host company representatives, which also provided information on the students' experiences.

Although the observational data was not used in the analysis, the first-hand knowledge it provided was essential for the success of the study. The knowledge

gained was used in the purposeful sampling to select potential participants who represented a diversity of experiences. Out of the thirty-four students who were interviewed in this study, 32 were selected on the basis that the observational data suggested that their experiences would aid in answering the research questions of the study.

4.4.4 Qualitative data analysis

The qualitative data analysis process of the study is illustrated in Figure 4.5. This process is a combination of Bryman's (2012) generic thematic analysis approach, the coding procedures developed by Miles, Huberman and Saldana (2014) and theme associations procedures developed by Bazeley and Jackson (2013).

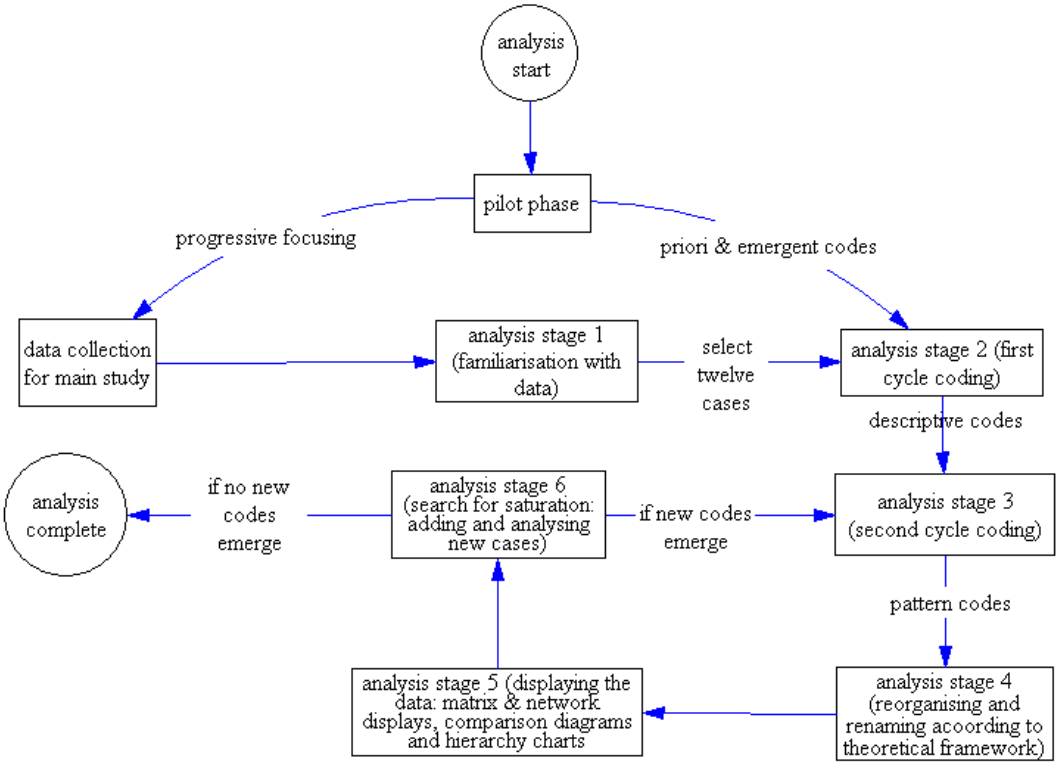


Figure 4.5: Steps that were followed during qualitative data analysis

As indicated earlier, the analysis starts with coding the pilot case study data. Miles state that `codes are labels that assign symbolic meaning to the descriptive or inferential information compiled during a study'. They explain that codes are attached

to portions of data of varying size. The coding process was iterative due to its heuristic nature. The initial codes that were developed were mostly descriptive. These were refined during the second-cycle coding into tentative themes. The code list of the pilot case study was used as a priori list for stage 1 of the analysis. In addition, the pilot case study analysis assisted in refocusing the study, in refining the interview protocol and in developing a theoretically-informed priori code list for the main study (Parlett & Hamilton, 1972; Sinkovics & Alfoldi, 2012; Yin, 2018). After the pilot phase, the study followed the steps below:

Analysis stage 1

Analysis stage 1 was developed based on Bryman's (2012) advice that recommends thorough acquaintance of oneself with data before beginning coding. This step was particularly important because the researcher made use of transcription services. Therefore, the researcher checked the transcripts while listening to the audio recordings of the interviews. Furthermore, the researcher also read the students' logbook' comments and perused their evidence portfolios. After familiarising himself with the data and considering the observational data, the researcher selected 12 cases based on Baker and Edwards' (2012) recommendation of short-duration research studies that are conducted by a single researcher. The researcher then imported the data for these 12 cases into NVivo software to begin analysis.

Analysis stage 2

The coding process in the first cycle was iterative. It started with coding, using the priori codes from the pilot study. This was followed by recoding the data without the priori list. A comparison of the two versions of codes followed, and it led to a revised code list. The researcher coded and recoded the data several times between May

and September 2017, following Krefting's (1991) advice that coding and recoding data improved the dependability of findings, especially if the coding processes were separated by periods of more than two weeks.

Analysis stage 3

The first cycle of coding in September 2017 produced 270 codes. After that, a second cycle of coding was undertaken, and this reduced the number of codes to thirty-seven. In the second cycle of coding, categorisation, pattern-seeking and reducing the first-cycle codes into higher-order theoretical constructs were used to develop themes and subthemes. An example of this process is illustrated in Table 4.4. In the table, is it shown that the first-cycle codes (first column), were converted into the second-cycle codes (last column), using the process highlighted in the second column.

Table 4.4: Process of developing of second-cycle codes from first-cycle codes

First-cycle code	**Process of developing second-cycle code**	**Second-cycle code**
Others allocate work Others in the host company guide mentee Others work together with mentee	Categorisation	Supportive co-workers
Under full supervision (1) Responsibility limited (2) Supervision limited (3) Responsibility with approvals (4)	Pattern seeking	Increasing performance (if in a case 1 and/or 2 was present with 3 and/or 4)
Based on the experience that I have learned there, I am ready. I am confident that I can succeed in future employment I believe I am capable at the level of technician I believe I am capable of jobs requiring similar experience I believe I am capable (work ready) but I plan to study further	Reducing data into higher-order theoretical constructs	High self-efficacy

Analysis stage 4

Analysis stage 4 comprised iterative revision and renaming of the second-cycle codes. The second-cycle codes were revised several times between September 2017 and June 2018. As was indicated earlier, Krefting's (1991) advice is that sole researchers benefit from taking breaks between analysis iterations as it enhances their studies' dependability. For this reason, the researcher took a break of a few weeks between categorisation iterations. After that, the revised second-cycle codes were renamed to make them consistent with the theoretical framework of the study. They were then arranged into three categories as in the triadic reciprocal causation model. The reorganisation and renaming were done without using the theoretical framework; instead, NVivo's hierarchy diagrams, cluster diagrams and coding charts were used. A comparison of the outcomes of the two revisions produced three categories that were consistent with the triadic reciprocal causation, and a further four categories more than before. The seven categories became the themes of the study and their sub-categories became sub-themes. Figure 4.6 provides an example of the coded data and themes that were applied.

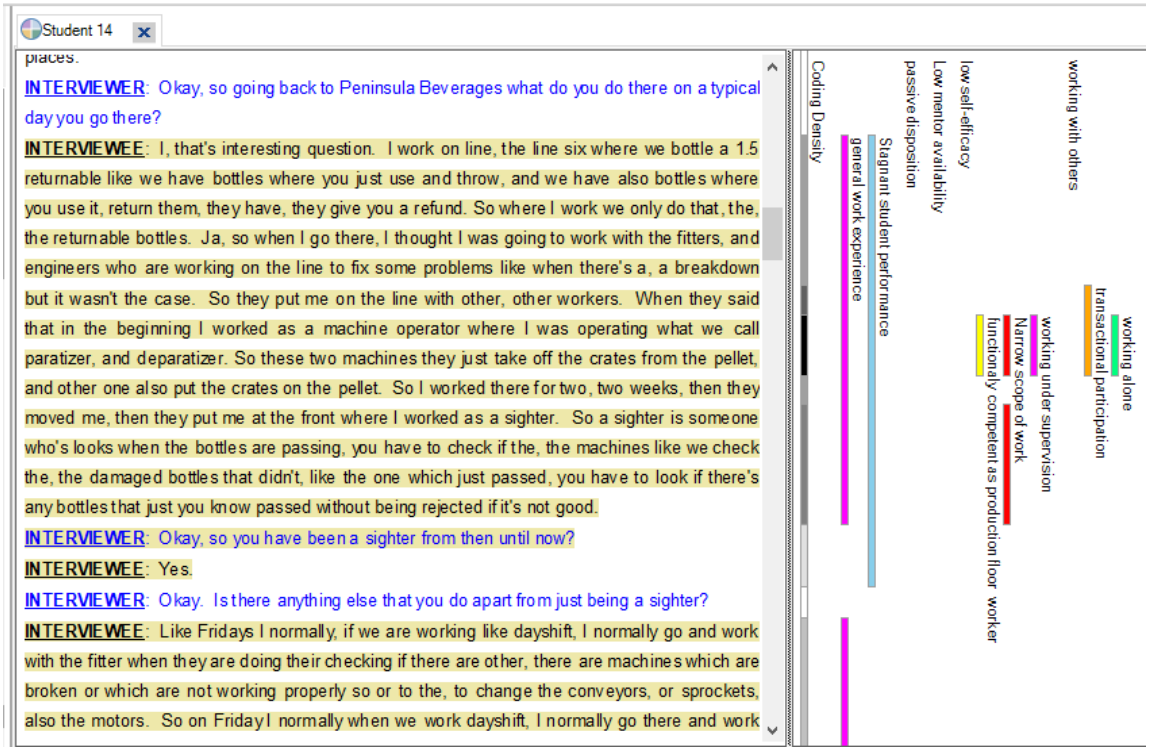


Figure 4.6: An extract of Mugisha's processed interview test showing the coded text and themes that were applicable to it.

Analysis stage 5

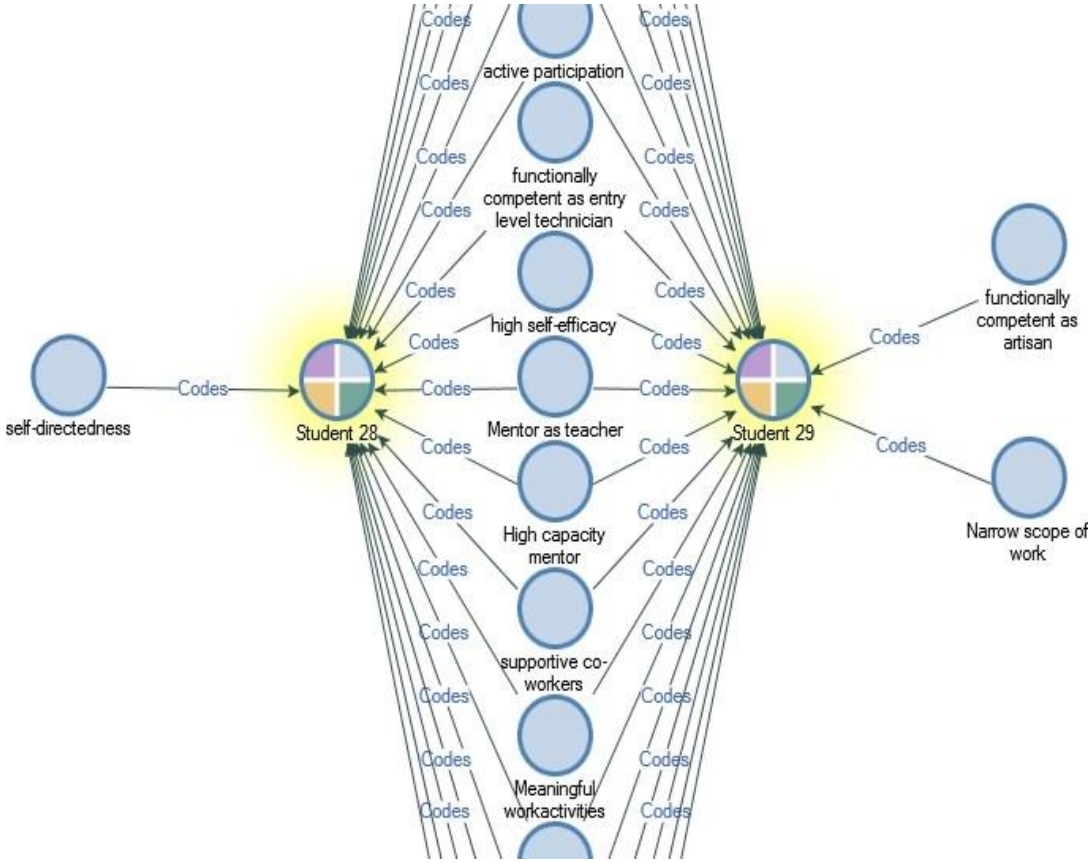
The purpose of analysis stage 5 was to establish associations among cases and subthemes. These associations were developed by making comparisons between cases and between themes. Bazeley (2013) explains that making comparisons enables researchers to move beyond describing themes to theorising about the data. In this study, comparisons were facilitated by data visualisation tools within NVivo. Several visualisation tools assist researchers in discovering patterns and relationships in their data (Bazeley & Jackson, 2013). For instance, matrix coding queries and comparison diagrams were used to visualise possible relationships between codes. Table 4.5 gives an example of a matrix coding that shows associations between subthemes under a constraint learning environment and subthemes under student characteristics. The example shows that limited access to guidance was associated with limited access to work and with student's competency

as ‘still a student’ and limited access to work was associated with student filled an actual position, with student’s passive disposition and with student’s competency as ‘still a student’.

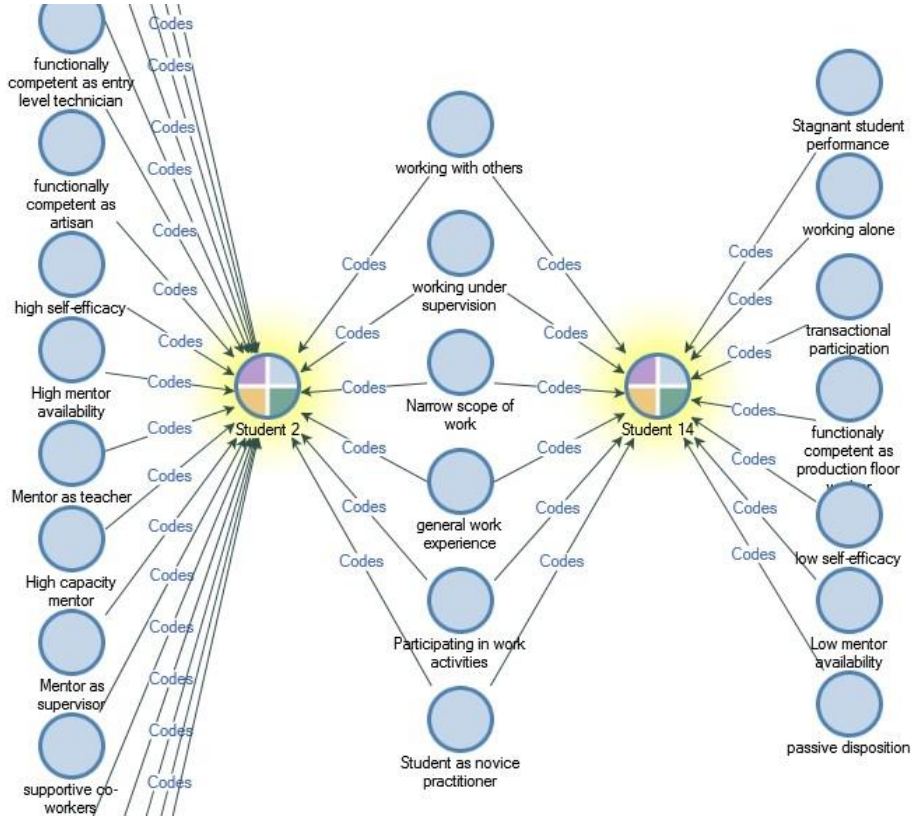
Table 4.5: Example of matrix coding of subthemes under a *constraint learning environment* and subthemes under student characteristics

	limited access to guidance	**limited access to work**	**low tolerance for errors**	**student filled actual position**	**low self-efficacy**	**passive disposition**	**still a student**
limited access to guidance	12	2	0	0	0	0	4
limited access to work	2	19	0	3	0	1	9
low tolerance for errors	0	0	8	0	0	0	0
student filled actual position	0	3	0	9	0	0	6
low self-efficacy	0	0	0	0	9	3	0
passive disposition	0	1	0	0	3	8	0
still a student	4	9	0	6	0	0	42

NVivo’s comparison diagrams were used to cluster cases into groups. The graphic user interface for NVivo is set up in a manner that limited case comparisons to two cases at a time. Figure 4.7 shows examples of case comparisons showing similar cases and dissimilar cases. From the comparisons, two clusters of cases emerged: those that had positive experiences and those that had negative work placement experiences.



(a) Comparison diagram of similar cases (Tumelo and Nqobile)



(b) Comparison diagram of dissimilar cases (Jaco and Mugisha)

Figure 4.7: Examples of case comparisons showings similar cases and dissimilar cases

Analysis stage 6

Saunders et al. (2018: 1894) state that ‘saturation is used in qualitative research as a criterion for discontinuing data collection and/or analysis’. They explain that although the concept developed in grounded theory, it has been accepted in most approaches of qualitative research. They explain that there are two main categories of saturation: theoretical saturation which deals with ending data collection and inductive thematic saturation which signals the end of data analysis as no new codes emerge from the data.

In this study, inductive thematic saturation was applied as presented in analysis stage 6 in Figure 4.6; saturation was reached when the addition of new cases did not produce new themes. In analysis stage 6, new cases were added and coded, one at a time. This stage made use of the descriptive codes from analysis stage 2. The new codes that emerged fitted with identified subthemes, indicating a stable theme, subtheme structure. The emergence of new codes showed that inductive thematic saturation had not been reached with the 12 initial cases. After coding seventeen cases in total (five additional cases), no further new codes emerged from the coding. This indicated that thematic saturation was reached with seventeen cases.

In following the tradition established in other qualitative studies that used semi-structured interviews, such as Niccolai et al. (2016) and Constantinou, Georgiou and Perdikogianni (2017), the addition of cases and their coding continued until the remaining cases had been added and coded.

4.5 Measures taken to promote quality and ensure rigour

Silverman (2013) points out that qualitative research is often criticised for supposedly lacking rigour and for being plagued by anecdotalism. He warns against being dismissive of these criticisms and advises that for qualitative research to achieve the

same acceptance as quantitative research, it must meet the standards for research quality. Unfortunately, the commonly used measures of research quality, reliability and validity, were developed for quantitative research, therefore `carry connotations of measurement' (Bryman, 2012: 389). Merriam and Tisdell (2016) explain that since qualitative research is based on different assumptions and strives to achieve goals, the concepts of validity and reliability are either reinterpreted to align them with qualitative research or alternative quality criteria developed for qualitative research. Some qualitative research such as Mason (2002) advocates reinterpreting the quantitative quality criteria to accommodate qualitative research. Others such as Lincoln and Guba (1985) advocate alternative concepts of credibility, transferability, dependability and conformability to accommodate ontological and epistemological differences between qualitative and quantitative research. Table 4.6 presents a comparison between adapted quality criteria and alternative quality concepts for qualitative research.

Table 4.6: A comparison of quality criteria for quantitative research, adapted criteria to accommodate qualitative research and equivalent alternative quality criteria for qualitative research

Quality criteria for quantitative research	**Adapted quantitative criteria for qualitative research**	**Alternative concepts of quality criteria for qualitative research**
Internal validity: The extent to which a study provides evidence that the independent variable causes the effects of the dependent variables (Newman & Benz, 1998)	Internal validity: The extent of correspondence between a researcher's observations and the theoretical concepts they develop (Bryman, 2016)	Credibility: The assurance that a researcher has accurately represented the constructed realities of the participants and that the researcher has correctly understood the social world (Lincoln & Guba, 1985)
External validity: The extent to which the results of a study can be extended to other populations beyond the study's sample (Newman & Benz, 1998)	External validity: The extent to which findings of a study can be generalised across settings (Bryman, 2016)	Transferability: The extent to which the researcher has presented information that will allow readers to judge the similarity between the sending context and the receiving context (Lincoln & Guba, 1985)
Internal reliability: The extent to which different items of a multi-indicator measure in a research instrument are consistent among themselves (Bryman, 2016)	Internal reliability: The extent to which different researchers would agree about a study's findings and their interpretations (Bryman, 2016)	Dependability: The extent to which the findings of a study `could be determined to be an outcome of a consistent and dependable process' (Lincoln & Guba, 2013: 105)
External reliability: The extent to which results of a measuring instrument are consistent from one use to another (Polit & Beck, 2017)	External reliability: The extent to which a study can be replicated by other researchers (Bryman, 2016)	Confirmability: The extent to which research findings are the result of the experiences and ideas of the informants, rather than the personal values or theoretical inclinations of the researcher – `relative neutrality and freedom from unacknowledged research biases' (Miles, Huberman & Saldana, 2014: 311).

Among the criteria presented in Table 4.6, Lincoln and Guba (1985, 1986), four criteria of trustworthiness have received general acceptance by qualitative researchers. This study concurs with these researchers that it is preferable to use alternative quality criteria to avoid confusing the quality criteria measure of qualitative studies with those of quantitative studies and to accommodate ontological and epistemological differences between qualitative and quantitative research (Lincoln & Guba, 1985; Bryman, 2012). Easterby-Smith, Thorpe and Jackson (2015) explain that quantitative research is grounded in realism, the belief in the existence of a single truth, whereas qualitative research is founded on relativism, the belief that

facts depend on the viewpoint of the observer, or even nominalism, the belief that facts are human constructions. Furthermore, these two research concepts follow different processes of inquiry; quantitative research focuses on using objective methods and deduction to enquire into the physical and social world, whereas qualitative research focuses on ‘understanding how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences’ (Merriam & Tisdell, 2016: 6). Because of these differences, this study concurs with Lincoln and Guba (1985, 1986) that it is preferable for qualitative studies to use alternative concepts for assessing research quality.

According to Walther, Sochacka and Kellam (2013), systematic managing of the research process is essential in ensuring the quality of the outcome. Therefore, they developed a process-oriented framework for managing the quality of making data (data collection) and of handling data (data interpretation and generalisation of knowledge claims, representation and communication of the research). The process-oriented framework was specially developed for ensuring the quality and rigour of qualitative engineering education research. Unfortunately, it uses reinterpreted quality criteria of reliability and validity, which, as discussed, are not favoured for qualitative research. Therefore, to eliminate the potential for confusing validity and reliability with how they are used in quantitative research (Merriam and Tisdell, 2016), this study replaces the concepts with Lincoln and Guba's (1985, 1986) four criteria of trustworthiness. Table 4.7 presents the revised process-oriented framework for ensuring quality of engineering education research as it was used in this study.

Table 4.7: Combination of process-oriented and criteria-oriented frameworks for quality in qualitative research

Internal customer (participants, research team)		**External customer (research team and community, broader public)**	
Making Data		**Handling Data**	
Credibility	**Dependability**	**Transferability**	**Confirmability**
Member checking	Peer auditing	Thick description	Triangulation
Negative or discrepant case analysis		Maximum purposeful variation sampling	Thick description of methods and procedures
Triangulation			
Peer review			

The study followed the strategies presented in Table 4.7 to ensure quality and rigour in the processes for making data and handling data. In making data, credibility and dependability were essential to ensure that the data and the findings represented the work placement realities of students and that the processes that were used to collect and analyse the data were consistent and trustworthy. The next paragraphs in this section describe how each of the strategies presented in Table 4.7 were implemented in the study.

The study used member checking, negative or discrepant case analysis, triangulation and peer review to promote its credibility. For member checking, the researcher provided four participants with copies of the interview transcripts and the code list. They concurred that these represented the essence of what they had said during the interviews. Since Lincoln and Guba (1985) indicate that it is the most crucial technique for establishing the credibility of the findings of a study, the researcher expanded member checking to include one of the WIL coordinators. He corroborated the student interviews, logbooks and evidence portfolios data and

confirmed that the findings that resulted were accurate representations of the students' work placement experiences.

The study used three triangulation strategies for enhancing its credibility: data collected from multiple students using interviews, logbooks and evidence portfolios as well as a theoretical framework that comprised two theories. It did not make use a fourth triangulation method, the use of different investigators, which Lincoln and Guba (1985) claim to be valuable in enhancing the credibility of a study. This method was considered impractical in a doctoral study.

The uniformity of the pattern of findings emerging from the three triangulation methods suggests that the findings were credible. This assessment is consistent with Patton (2015: 662), who notes that 'either consistency in overall patterns of data from different sources or reasonable explanations for differences in data from divergent sources can contribute to the overall credibility of a study's findings. As indicated in Table 4.7, triangulation also contributes to the confirmability of a study.

In addition to the above strategies, this study used negative or discrepant case analysis, 'a systematic and conscientious search for alternative themes, divergent patterns and rival explanations' to enhance its credibility (Patton, 2015: 653). Silverman (2014) and Bryman (2016) concur and note that the search for rival explanations counters one of the biggest threats to the credibility of qualitative research: the suspicion that researchers shape their findings to suit their personal biases and predispositions. In this study, the search for alternative themes was done by constantly comparing results of theoretically informed coding and coding without theory (see analysis stages 2 and 4 in section 4.4.4). As indicated in section 4.4.4, this search for rival explanations produced 4 additional themes besides those aligned to the triadic reciprocal causation model and an alternative explanation for

the role of a mentor in work placement, the participant best placed to manage paradoxes that are inherent in work placement learning.

Finally, the study used peer review to enhance its credibility. Patton (2015) and Merriam and Tisdell (2016) recommend presenting the findings of a study for review by experts such as those available in the review process of journals and peer-reviewed conferences. This also enhances the dependability of a study. This study made use of local and international engineering education conferences for expert review. In the papers developed for these conferences, the researcher provided thick descriptions of the research methods, of themes developed and of students' experiences. This strategy proved useful beyond enhancing the credibility of the studies: the feedback from conferences highlighted themes that were unclear and possible strategies for enhancing clarity. For instance, some conference participants indicated that they were confused by the themes `rigid learning environment' and `flexible learning environment'. These themes were revised, and the study eventually settled on the terms `enabling learning environment' and `constraining learning environment'. This renaming seemingly eliminated confusion because reviewers and participants at subsequent engineering education conferences appeared to understand the themes.

As was indicated in Table 4.7, this study used peer auditing to enhance its dependability. Miles, Huberman and Saldana (2014) explain that the purpose of peer auditing is to verify the consistency and stability of the research process. They advise the facilitation of peer auditing by providing extensive detail of the research design and research processes. The researcher followed their advice and provided details of the research design, the collected data, analysis and interpretation to a work colleague who has extensively published in engineering education the various iterations of the

code list, the NVivo files and the interview transcripts to the peer auditor. The latter corroborated the consistency of the codes with the student interview transcripts.

As was suggested by Lincoln and Guba (1986), the study provided thick descriptions of its research methods, the research context and students' experiences to facilitate its transferability and enhance its confirmability. Lincoln and Guba (1985) explain that for findings to be transferable, the sending context and the receiving context must be similar. However, a researcher cannot know the contexts to which transferability might be required. Merriam and Tisdell (2016: 256) advise that since this is the case, 'the researcher has an obligation to provide enough detailed description of the study's context to enable readers to compare the 'fit' with their situations'. They explain that the concept of transferability differs with generalisation in quantitative studies in the sense that in transferability, the onus is on the reader to decide whether the findings of a study apply to their situation. Furthermore, they confirm that the use in this study of maximum purposeful variation sampling also enhances its transferability as it 'allows for the possibility of a greater range of application by readers or consumers of the research' (Merriam & Tisdell, 2016: 257).

4.6 Measures taken to conduct ethical research

Stake (2005: 459) cautions that '[q]ualitative researchers are guests in the private spaces of the world. Their manners should be good and their code of ethics strict'. He advises that they must exercise care to minimise risks of potential harm to research participants. In this study, the researcher paid considerable attention to ethical issues because the study collected data from students, a situation that raises unique and complex social and ethical issues.

The study recognised the potential negative influence of power dynamics and conflict of interest arising from academic staff members researching in their department. In this study, the researcher was an academic staff member in the department where the participants were students. This created a power differential between the researcher and the participants. This would also create a conflict of interest for both the researcher and the participants. However, in this study, the influence of these factors was minimal as the researcher did not participate in the participants' placement, monitoring and assessment. This was further mitigated by the absence of prior lecturer-student interactions between the researcher and the participants as he lectured in another programme in the department.

However, the most significant mitigating tool was the study's compliance with ethical principles during each step of the research process. The study followed principles of ethical research delineated in Easterby-Smith, Thorpe and Jackson (2015) and Bryman (2012), as presented in Table 4.8. In addition to following the ethical principles outlined in Table 4.8, institutional ethical approval was obtained from the Faculty of Engineering and the Built Environment at UCT (see Appendix A). Additionally, the study followed guidelines from the stakeholders. For instance, the study complied with WIL coordinators in contacting the potential participants and identifying the potential observation sites through them. Furthermore, the researcher was accompanied by a WIL coordinator when visiting the placement companies. The WIL coordinator arranged for the visit and secured the necessary permission from the host company.

Table 4.8: Key principles of research ethics that were followed in the study

Ethical principle	How the study implemented the ethical principle
Protecting the students from potential harm	In-depth interviewing can cause participants to confront issues that make them uncomfortable. Therefore, the participants were told not to answer any question that made them uncomfortable. The study anticipated no long-term problems apart from immediate discomfort in answering some questions.
Participation was voluntary	The participants were invited through e-mail to participate in the study. The invitation e-mails were sent to the 2017 cohort of work placement students through their WIL Coordinators. Communication with the students was handled by a research assistant The students were told that they could withdraw from the study at any point, even after they had been interviewed.
Protection of confidentiality of research data	The study maintained the confidentiality of research records. All data were stored on a password-protected personal computer. Additionally, it ensured that the students and their host were not identified or identifiable in the research reports. Furthermore, the audio data will be destroyed at the end of the study.
Ensuring fully informed consent	Invitation to participate included purpose of study, what the study is about. The students signed a consent form before participating in the study, and they also gave verbal consent at the start of each interview.
Protecting the privacy of research subjects	There was no covert data collection. The students' personal information was not disclosed to third parties.
Avoiding deception about the nature or aims of the research	There was no covert data collection. The nature and aim of the research were disclosed on the consent form and in the invitation to participate.

4.7 Conclusion

This chapter showed that the research questions, measures to promote rigour and principles of ethical research were central to the planning and execution of this study. The study focused on rigour to counter the claim that qualitative studies are unsystematic. The adherence to the principles of ethical research was to protect the students, who were the participants in this study, from potential harm. Lastly, the

centrality of research questions ensured coherence among the various components of the research design.

The study followed a qualitative multi-case study methodology. Qualitative data was collected from participants who were purposefully sampled from the 2017 cohort of third-year mechanical engineering students from a South African university of technology. The collected data was analysed using a six-step thematic analysis process and a thematic synthesis process that was supported by NVivo's data display tools. The descriptions of four examples of participant experiences and outcomes of the thematic analysis and the thematic synthesis of the entire sample are presented in the next two chapters.

CHAPTER FIVE
DESCRIPTIONS OF FOUR EXAMPLES OF STUDENTS' WORK PLACEMENT EXPERIENCES

5.1 Introduction

The purpose of this chapter is to provide the reader with examples of the students' work placement experiences and the context in which they happened.

The chapter describes the work placement experiences of four students, two males and two females, who were selected from the 34 participants (see Table 4.2) to illustrate the diversity of experiences present in this study.

The chapter starts by describing the experience of Johannes[1], a 21-year-old male student. After that, it describes the experiences of Mugisha[1], who at the age of 37, was the oldest among the participants. Mugisha was as a black[2] international student. Afterwards, it describes the experiences of Marianne[1], a 27-year-old white female student. The chapter closes by describing the experiences of Nqobile[1], a 22-year-old black African female student.

5.2 Rationale for choosing the four exemplars

Patton (2015) advises that a few exemplars should be provided in research reports to assist readers to make sense of what was happening in a particular study. This

[1]This is not the student's real name. Pseudonyms have been used throughout the thesis to give anonymity to the participants

[2] The term 'black' in this study refers to those categorised as 'non-white' under the apartheid government. This includes those classified as black African, 'coloured' and Indian. It is acknowledged here that 'race' was used as a construct to institutionalise oppression in South Africa and such references are not intended to entrench racial classifications. However, given the history of South Africa and the nature of this study, it is impossible to avoid the use of these designators

concurs with this view because if all the 34 respondent experiences were described in this chapter, it would be overwhelming and would overshadow the pertinent aspects of those experiences that need to be conveyed. Patton (2015: 23) advises that in such cases, a detailed description of select cases will 'provide depth, detail and individual meaning' that is needed to understand the variation of experiences that are present in this study.

It was not the intention of this study to select the cases so that they are representative of the 34 respondent experiences. The cases were selected to encapsulate the variation of student experiences that is possible during work placement. Therefore, the four exemplars were selected for their variation in two dimensions of interest, demographics and perceived quality of work placement experiences (Polit & Beck, 2017).

5.3 Examples of participant experiences

This section presents four examples of student experiences which, as previously stated, were chosen to offer insights into individual students' placement contexts and experiences.

Some of the students, such as Johannes and Nqobile, believed that their experiences adequately prepared them for work.

Others, such as Mugisha and Marianne, did not consider their experiences to have been adequate. Mugisha thought that his experience was utterly inadequate. Marianne, who had been placed in a university workshop, had mixed feelings about her experience. Although she acknowledged that she had been exposed to a diversity of mechanical engineering work, she believed that her experiences were inadequate and that they lacked authenticity.

5.3.1 Johannes

Johannes is a 22-year-old white male whose father owned a mechanical engineering consulting company. Nevertheless, he chose to be placed in a small engineering fabrication company because he believed it would offer him broad exposure to mechanical engineering practice, covering both factory operations and engineering design. His mentor at his placement company was a mechanical engineering technologist who was the owner/manager of the company and involved in one of the university's industry advisory boards. Johannes worked for this placement company for nine months (with three months of work remaining) before resigning, with permission obtained from his WIL coordinator. He proceeded to finish his work placement at his father's company, which specialised in HVAC and fire suppression systems.

Two interviews were conducted with this student, the former while he was at his first company and the latter while he was at the second company. Both interviews were conducted at the university. In addition, the WIL coordinator provided the researcher with Johannes's WIL logbook and evidence portfolio; the qualitative data from these sources were used for validation of the interview data.

The researcher was familiar with Johannes' first placement company, having conducted field observations at the company. The observations included a tour of the workplace, including an inspection of the wheelchair stairs lift that Johannes had designed and manufactured.

It was evident from the interviews that Johannes loved mechanical engineering but considered hand skills to be inappropriate for engineering graduates. He said that on the factory floor he was exposed to "almost zero engineering work" as he did not consider "grinding and removing splatter from welding, using a heating torch to bend

sheet metal or tack welding" to be real engineering work. When the researcher asked him what he would have preferred to do, he responded:

> I would like to do more engineering work to gain a bit of experience because I spoke to guys outside here [other students], they talk about the nice designs that they do. They are sitting in the office doing nice designs, doing actual engineering work and going to clients. That is the type of work I want to do.

Before his first interview, he had completed two major projects for his first host company. He designed and manufactured a trailer and a foldable house lift for wheelchair users. Furthermore, the company had exposed him to basic mechanical engineering hand skills using grinders, welding tools and metal bending tools. In summarising his experience at the first company, he said:

> The nice thing about [Company 1] is that they have a nice factory. They said to me, in the beginning, you are going to design, you will sit in the office designing stuff, drawing stuff and then you are going to build the stuff in the factory with the workers. It was really nice because you go through the whole process. You start off with the designing, consulting and then you do the drawings. And then, you work with the people in the factory where you can see the part, where you must put in certain tolerances, how stuff is going to be welded. So that helps with design work as well because then you know how it actually is manufactured in the industry. So, it goes from a real design to the factory, now you see this part, how much welding tolerance they need and how the stuff can be built. So, it helped me a lot, I gained a lot of experience. I definitely gained a lot of experience while doing these projects.

The wheelchair lift project was extraordinarily complicated, comprising mechanical and electrical engineering aspects. Johannes faced technical challenges during the design of electrical components, particularly with the selection of electrical components such as limit switches. For this, he solicited help from his father who was unable to assist him but referred him to one of his friends, an electrical engineer who assisted him with the electrical aspects of the project. During this time, he worked mostly from home. He said, "I did my design work at home and over

weekends.” At the time of the first interview, he had resigned from his first placement company after working for nine months. He gave two reasons for resigning: he said that firstly, he was spending most of his working hours on the factory floor as he was no longer assigned design projects which now went to a new student that the company had recruited. He said:

> They have got another student working on the design work and all the engineering work is going to him so that he also can get a lot of exposure to design work. So basically, the next 2 months, I would have been in the factory, grinding.

Secondly, he said that he struggled to adapt to the culture of the factory floor, particularly their lack of tolerance for work errors. He also spoke of instances when there were conflicts due to errors such as misplacing tools and inadequate performance. He said:

> If something is not perfect while I was busy building it, they would scream at me, shout, yell and get angry and stuff.

At his father’s company, he was involved in “draughting and design, site inspections” and liaising with clients. He related what he was exposed to:

> A whole lot of different jobs, mainly I have done fire plans, drafting and design, designing a big wood drying oven that is 18 m by 5 m. I designed a fabric roller. I have done a lot of site visits, measuring air flows, fire plans, warm water systems. So, I have done a wide variety of work in a short time, piping systems. It’s not the same things; it’s a whole lot of different stuff. In the designs, I am using thermodynamics, strength of materials, design, hydraulic machines, basically everything that I studied here. It’s a lot of work. Some you don’t have from varsity, stuff like the fire plans because fire plans are not exactly mechanical engineering, its regulations and rules. It’s not stuff that one would study from a book.

According to him, this type of work was appropriate for him. He indicated that he liked it, mainly because it was aligned with the coursework that he did at university. He said:

> I am actually doing engineering, doing equations, working out stuff. This new job is eighty percent theoretical, and I enjoy this more.

Here, he worked mostly with a junior mechanical engineer with whom he shared an office. He called this junior engineer his `unofficial mentor' as he provided him with most of the guidance that he needed. Additionally, he mentioned that he now interacted with clients more:

> I think my people skills have developed over time. It's hard to explain, but over time, you are not shy to email or to drive there to get a quote. My people skills have definitely improved. I am better now because I have to deal with people directly as I am in charge of my own projects. I have to contact people, I have to get quotes. In the previous job, he gave me a book with prices in there. But now, I have to phone the people, research which price is the lowest, e-mail the people. I drive and collect it myself.

When the researcher asked him whether he thought he was work-ready, the student compared himself to the junior engineer whom he considered to be of almost similar competence. He said:

> Theoretically, I am behind but not too far away. I can do all the stuff that they ask me to do. I can do all that stuff that he does, but I think he has a more theoretical background and a little more experience in the field. But on the practical side, I definitely have more experience.

5.3.2 Mugisha

Mugisha was an African male international student who, at 37 years, was the oldest amongst the interviewed students. He had lived as a refugee in three African countries before coming to South Africa. He was placed in the production department of a non-alcoholic beverage manufacturer. He considered himself lucky that, unlike his fellow international students who had finished coursework but were yet to find a placement, he found placement soon after completing his coursework.

Despite this luck, he considered his placement experiences to be less than adequate – good for graduation purposes but not for work readiness.

A single interview was conducted with this student. The interview was conducted at the university, seven months into his placement. The researcher was familiar with Mugisha's first placement company, having conducted field observations at the company. The observations included a tour of the workplace and sit-ins on progress review meetings between the WIL coordinator, Mugisha and four other students who were placed at the company, and a human resources practitioner from the placement company.

As mentioned already, Mugisha considered himself lucky since, as an international student, his friends "who even finished before [him]" were yet to find work placement. His sentiments corroborated the information that the researcher gleaned from the WIL coordinators, that the university struggled to place international students. They concurred that this challenge was due to administrative and legal constraints. For Mugisha, fortuitous events led to his work placement. He explained:

> I submitted my CV to Mr X and Mr Y and waited for placement. I did not just wait but I also went to the other companies to put my CV there and to see if they can't take me. Another student got a call from Mr Y to say they must go to Company Y. Since he was my friend and I didn't have anything to do, I accompanied him there, right. When we got there, I saw that there was a chance that I could talk to HR, so and I did. Then, she said that some people did not pitch up, so I can bring my CV to see if I can get a place. Then that's what I did. Then she called me, she said you could come.

He explained that despite this initial good fortune, his placement did not turn out as he had expected. He was disappointed that his placement company did not appoint a mentor for him and that it did not allow him to engage in meaningful work. He said:

> When I got there, I thought I was going to work with fitters and engineers who are fixing problems on the line, like when there is a breakdown, but it was not the case. They put

> me on the line with other workers. I worked as a machine operator where I was operating what we call a palletiser.

He said the following about the complexity of the work he did:

> Anybody can operate any machine there if they show you where to press. And most breakdowns that occur there, they just show you what it is and what you do when this happens.

He attributed all the challenges that he faced to his placement company's inability to appoint mentors. He explained what he thought were the consequences for him and the other students who were placed there, of not having a mentor:

> We expected them to appoint mentors for us, at least five students per mentor but that is not the case. They put us on the line and we have to find your ways to learn. There is no one appointed there to look after you or to tell you, 'Okay, I want you maybe after a month to show me what you have done'.

His placement company was keen to derive operational benefits from the students. They arranged that, from Monday to Thursday, the students would be assigned regular work. On Friday, which was set aside for plant maintenance, they would work with the fitters and engineers. When he arrived, he was assigned to work on the night shift, operating a palletiser machine, loading and unloading beverage crates onto pallets. After about two weeks, he was moved to operate a sighting station that was used to physically and electronically check if beverage bottles were filled correctly and for foreign objects. At the time of the interview, ten months later, the student was still working at this station.

During production days, the factory floor was so busy that the student was unable to participate in any activity other than operating the machine. He complained that working on the production line prevented him from benefiting from the learning opportunities that arose in the workplace. He mentioned that he failed to attend

training workshops that were provided to workers as he had no one to stand in for him on his machine. He said, "…if the line is busy, you have to be there". Additionally, he mentioned that working night shift compounded the problem as there were fewer people working during this shift.

On Fridays, which were set aside for maintenance, the student worked the day shift. He explained how he worked with artisans who were undertaking preventative maintenance on the production plant:

> On Fridays, I worked day shifts. I worked with the fitters when they are checking the machines, to see which ones are broken or which ones are not working properly. I also work with them to change the conveyors, or sprockets, motors and so on. Now, I can change sprockets, I can also split the chains and conveyors, and I do it all by myself. When we started, they showed me what to do. Now, they just tell me this is what you're going to do, then they leave me there, and then I just do it. Then they come and see if I did it properly.

Although he thought that he received valuable experience working with the artisans, he did not consider this experience to be adequate. He indicated that he would have preferred to work with engineers undertaking work that required problem-solving skills. He said, "I expected my daily work to be there with engineers, fixing stuff and solving problems." He further explained that his logbook, which was supposed to be completed by an engineer or engineering technician, was completed by his line manager who had only a school-leaving certificate. He complained that the absence of appropriate mentoring had a profound influence on his learning, particularly for his P2. According to him, it was required by the university that he be given an individual project to satisfy the independent learning outcome of his placement, but at the time of the interview, he had not yet been assigned a suitable project.

According to him, there was confusion at his placement company about what work placement students were supposed to be exposed to in comparison to what was available for apprentices from TVET colleges. His managers, who had gone through apprenticeships, thought that the students should be exposed to artisan work. Despite these shortcomings, he thought that he had learnt how to work with people and how to be responsible. He noted:

> Somehow, I learnt how to work with people, something I already knew because when I was studying here, we worked in groups. In addition, I learnt how to handle pressure. I also learnt how to work under rules, you have to be there on time, leave on time and to obey whatever they are telling you. Yes, I learnt to follow the rules.

Unlike other students the researcher interviewed, Mugisha was timid in his approach to resolving the challenges he faced. Although he complained about the lack of meaningfulness in the work tasks that he was assigned, he did not attempt to change his placement company. His only response was to request his line manager for meaningful work, and when the line manager refused, he did not proceed with the matter. His excuse was, “We have to pass through the line manager and the line manager is telling us that this is what you have to do. There is nothing else.” Moreover, he explained that he was hoping to learn just enough to be able to pass the WIL module and graduate. He thought he would resolve his competence challenges once he got a substantive job. He said, “If I go into industry, I have to try to work hard because, at the moment, I am not getting the knowledge that I need….”

5.3.3 Marianne

This subsection describes and analyses the experiences of Marianne, a 27-year-old white female student who was placed in the mechanical engineering workshop of the university. Initially, the student was working on an aquaponics project with a lecturer, but she was later incorporated into the workshop.

A single interview, held at the university, was conducted with this student. Field observations were not done for this student as the researcher was familiar with the mechanical engineering workshop. However, the researcher made use of the student's evidence portfolio and logbook to broaden his understanding of the student's statements and perceptions.

Throughout the interview, the student expressed some regret for not having undertaken her placement at a private company. She doubted if her experience was as authentic or as meaningful as it would have been if she had been placed at a private company.

> I would have gone to an engineering company where they have clients and work on deadlines, things like that to show you what in-service training is all about. I think when you are at a company, you learn how various sections of that company operate and how they are run so that when you go out and work one day, you have been in that environment and know what that environment is about. For me, I have not been there in that environment, but I also learnt a lot which might not have been the case if I went to a company.

Although she expressed these reservations, she did not act to try to rectify the perceived shortcomings. She was content to allow things to continue. When talking about her placement, she said, "I did not really have a direct plan. It just happened." During the initial days of her placement, she was involved in an aquaponics project. In this project, she welded and fabricated various components of the aquaponics units. When the laboratory assistant who was responsible for welding resigned, she was shifted to that position. By moving to the post of a laboratory assistant, she was assigned different responsibilities from the other interns. She contrasted her role and that of an intern:

> I was doing an actual job. I was not just an intern going from section to section, learning by each section, doing little projects here and there like they do in the workshop. I actually had a job description and my job was a lab assistant and that is what I did.

Her job involved conducting demonstrations in arc welding, assisting students with their projects and assisting the technicians in supervising practical welding classes. She said of her role:

> You do not really have that free time[, always busy] and it is, I would say, a monotonous job. It is the same thing day in and day out. It is not doing anything different really.

Not surprisingly, she spoke of developing competence in arc and gas welding, brazing, grinding, milling, lathe machining and other skills. Although having a designated job exposed her to authentic work, it also limited her to the welding section. She was not as exposed to other aspects and sections of workshop practice. Some of these limitations she had were lack of exposure to CNC machining and plasma cutting:

> CNC machines are only used for those who were given the job to use them. So not everyone uses the CNC machines, only those who are specially trained. Because my job description is a lab assistant, I never had the opportunity to work on a CNC machine and the plasma cutter.

Although she indicated an interest in learning how to use these two machines, she conceded that she had not spoken to her mentor about her interest. She claimed to have been too busy:

> We were so busy last year that I really did not have the opportunity to say, “Hey, can I use this or show me how to use this”.

This passive disposition is reflected in how she approached other learning opportunities as well.

She mentioned that English and isiXhosa were the two main languages used in her workplace. English was used for most work-related interactions, whereas isiXhosa was used mostly for socialisation. This arrangement meant that she was included in work-related manners but excluded from non-work-related socialisation. She accepted that language would cause her to be excluded from some interactions but insisted that it was not a barrier as far as work was concerned. She said:

> When they spoke Xhosa, they did not face me because I am not in their conversation. If they want me to be involved, then they spoke English to me, then I knew that I am part of the conversation. I did not get offended about that. Funny enough, they did not do that in meetings. Everybody spoke English in meetings. It is only when they have their side conversations that they spoke Xhosa.

Marianne's mentor, who was a fitter and turner, greatly influenced what she learnt and how she learnt it. According to her, he taught her "gas welding, brazing, how to use the lathe properly and how to use the milling machine". She indicated that her practical knowledge of workshop operations was gained through him. She mentioned that he mostly used two strategies in guiding her. He shared knowledge through stories of his past experiences "even just in conversation, telling [her] about stories from 20 years ago or whenever". She also stated that he preferred to provide guidance in action:

> He is one of those guys that say, you do something, walk past you and he sees that you are doing something wrong, will say you are not doing it right and then explain how it should be done. As I was doing something, he will say, 'No, you should go like this, or like that'; you know, just little things and he would assist me.

In considering the entirety of her work placement experience, she did not think it enhanced her work readiness. She expressed her doubts:

> So, for preparedness for a company, I would not say I am one hundred percent ready, but I feel that I should be able to cope with arc welding. I would say "Yes" for arc welding

> but “No” for TIG. I would have to learn how to do that skilfully to apply for that job. Look, I would say if you get someone who has been at a company, their answer would probably be ‘Yes’. Mine I would still lean towards ‘No’ because I do not think I will be ready… but nobody is ever ready for anything. But when it comes to a job application, I would have to think carefully, and I would have to obviously tell them, straightforward, that this is my experience. I would have to ask if they offer training because a lot of companies do offer training.

5.3.4 Nqobile

Nqobile was a 22-year-old black African female student. She undertook her work placement in the engineering department of a multinational gold recovery processing company that has operations in several African countries. Although the company has several gold mining operations, its South African operations focus on recovering gold from mine waste, using chemical processes.

She mentioned that the first thing she noticed when she arrived there was that she did not fit in. She said:

> What is challenging is that I am a woman and very young compared to the people that I work with. Most of them are white; out of the eighteen or twenty artisans that we have, only one is black…the most challenging thing is that they are older, and they have been doing it for years. So, I’m a new addition into the group and language is a barrier. And they don’t take you seriously.

She considered language to be her most prominent barrier to participation in workplace activities. It led to her missing elements of work instructions and this influenced her performance. For instance, she mentioned cases in which she failed to pass instructions to the artisans who were working under her because the meetings, where these instructions were discussed, were conducted in Afrikaans.

Her mentor, the Engineering Superintendent, was an artisan and an electrician. He had extensive experience in the mining sector and was a member of the company’s

management structure. During her time with her placement company, Nqobile mentioned that she worked with artisans, a foreman, her mentor and the company's Executive Director.

Her experiences illustrate the importance of a proactive disposition to workplace learning. During the early days of her placement, she worked on peripheral tasks which were mostly administrative tasks for her mentor. This peripheral participation continued for three to four months. When speaking about this period, she said, "There is another thing in industry, they are so complete without you. You need to bring yourself forward for you to be noticed." She said she realised that the situation required her to be proactive. She said, "I actually stood up and told my mentor. I asked him if I could work outside with the guys.' This elicited an accommodating response from the mentor and the rest of the placement company. She summarised the action and response that followed her request:

> He did not mind, because to him it is like I'm learning new things. So, I went to work with the guys. After two weeks, I went to him again. He told me, "I love what you are doing", then he grouped me with somebody else. After that week, I went to him again, and he grouped me with somebody else. He was getting used to the system that I'm now working there. I started getting invites to meetings, cost meetings, planning meetings and everything. I started being treated well in all those things. And then I started travelling to other plants.

However, it was not just proactiveness that brought increased participation; performance contributed as well. She linked her increased performance with increased participation:

> At the time when I was also not that productive, they gave me one project, and it lasted about two months. If you give me the same project now, I can do it in two weeks or a week. I would just sit there and do it.

In addition, she linked proactiveness and improved performance with exposure to high profile projects that attracted the attention of management. She started by working with artisans, then with the foreman, and later was given a project to manage.

In her work with artisans, she was fabricating components for the most part. She used hand tools such as grinders, drilling machines and welding machines and machine shop equipment such as lathe machines. She mentioned that although her execution of these tasks was not initially up to standard, her prior exposure to workshop machines at university in the module 'Mechanical Manufacturing 2' made the learning process faster because she already knew what to do. When she worked with the foreman, it was mostly managing artisans and managing maintenance. She mentioned that in this work, the priority was to "…see that the plant is running as smooth as possible". Last, she indicated that she was assigned to lead on a high visibility project to relocate a chemical storage tank and its associated piping. This project involved the redesign of piping systems, costing, submitting feasibility and status reports to senior management and managing work teams. Of this project, she said:

> It is very challenging. Yes, it is very challenging because now everything is on you. Everyone is looking at you now. Another challenge is that you are working among people who have done it a couple of times. They know what should be here and why but for you, you need to find out by yourself what should be there and why. So, when you come with something that is different or something which is not right according to them, then they think that you went to school. It was challenging in that sense but then I asked questions. I consulted a lot. I had direct contact with my mentor who is the superintendent. I also had direct contact with the foreman whom I was working with and with the artisans.

She summarised what she thought would have made her experience better as follows:

> The first two to three months were hard. I was completely confused, I did not know what I was doing here. I kept asking the other people, what did you do in your first months. They also said: 'We were also just as confused'. So, if the university could get people to prepare us so that at some point we won't actually feel completely useless but then you have to push through. To tell us that you have to invest in yourself. So, even them, they must be taught what to expect from us because they actually don't know what to do with us. Is only after a few months that they actually get used to the idea that we are part of the company.

5.4 Conclusion

This chapter presented four examples of work placement students' experiences that were encountered in this study. In this chapter, the study chose not to present an analysis of these four cases, but rather use them to set the scene for the subsequent analysis. The analysis, which includes that of these four cases, is presented in Chapter Six.

The experiences of Johannes, Mugisha, Marianne and Nqobile highlighted the vital role that contextual and student factors play in influencing the quality of work placement experiences that were available to the participants in this study. For example, Johannes had familial connections and so was able to resign from his host company when he was not satisfied with the type of work that he was getting, knowing that he could take up a job at his father's company. Mugisha was a black African international student who considered himself lucky even to have work placement although he felt that it was inadequate. Despite making a small effort to improve his situation, this was not successful. Marianne worked in the university's workshop and was exposed to several types of work in welding and had some responsibility since she held the position of Lab Assistant. Nqobile was a black

African female student who found her work placement difficult initially but took the initiative to ask for exposure to different jobs on the workshop floor, and her mentor was prepared to ensure that she received this experience. In the end, she was given a big project to manage by herself and gained valuable experience from this.

The next chapter, Chapter Six, delves into the experiences of these four students and the other participants. It presents themes that cut across the diversity of the student experiences and established relationships among the themes.

CHAPTER SIX
PRESENTATION OF FINDINGS

6.1 Introduction

After describing four examples of the work placement experiences of mechanical engineering students in the previous chapter, this chapter presents findings from data analysis of the entire sample of participants, including the four examples. This is crucial in understanding how aspects of students' work placement experiences interact to influence student employability.

The chapter starts by presenting findings from the thematic analysis, focusing on aspects of work placement experiences. After that, it presents a synthesis of the associations of the themes and subthemes, highlighting how various aspects of the work experiences interact with one another to enhance or hinder students' employability.

6.2 The variables that influence the employability outcomes of work placement

The analysis identified seven overarching themes that represent aspects of work placement experiences that influence students' employability outcomes. Each theme had several constituent subthemes, representing its various attributes. The themes and their constituent subthemes are shown in Table 6.1.

Table 6.1: Themes and subthemes that emerged in analysis stage 5

Overarching theme	Subthemes
The learning environment	Enabling learning environment
	Constraining learning environment
The industry mentor	Mentor as teacher
	Mentor as supervisor
	Mentor as teacher and supervisor
	High capacity mentor
	Low capacity mentor
	High availability mentor
	Low availability mentor
Quality of work affordances	Meaningful work
	Broad scope work
	Token or inappropriate work
	Work of narrow scope
Student characteristics	High self-efficacy
	Low self-efficacy
	High agency
	Low agency
	Still a student
	Occupationally competent
	Positive feelings and emotions
	Negative feelings and emotions
Student's agentic role	Proactively soliciting work
	Proactively soliciting guidance
	Passively waiting for work
Student performance and participation as learning	Doing work
	Co-participating
Student learning trajectory	Increasing participation
	Improving performance
	Stagnant participation
	Stagnant performance

The remainder of this section presents the findings related to the themes and their subthemes in detail. In some cases, students' own words are used to illustrate the theme or subtheme that is being described.

6.2.1 Theme one: the learning environment

According to the students' recollections, their experienced environments covered some but not all aspects of their work environments, indicating that their learning environments were a subset of their work environments. In this study, the term `learning environment' refers to all that surround the students and the activities and interactions that affect them. The learning environment is contrasted with the work

environment, which encompasses both what affects the students and what does not. For example, Marianne explained that although she participated in work activities relating to lathe machines, milling and welding, she was excluded from activities related to CNC machining and plasma cutting despite the sections being a part of the workshop where she was placed. Thus, her learning environment was limited to those activities and interactions related to what she participated in and excluded that portion of the work environment related to CNC machining and plasma cutting. This conceptualisation of the students learning environment is discussed in more detail in Chapter Seven.

Clustering of codes suggests that students experienced work environments as either enabling or constraining. The two experienced environments would be defined as socially constructed, the attributes of which are summarised in Table 6.2. An enabling learning environment comprised a minimum of two attributes, *access to meaningful work* and *access to guidance.* It had a further two attributes that were not always present, *supportive co-workers* and *moderate tolerance of work errors*. Similarly, a constraining learning environment was defined by a minimum of two attributes *limited access to work* and *limited access to guidance;* two additional features were sometimes present, *student filled actual job position* and *low tolerance for work errors*.

Table 6.2: Subthemes of the learning environment and their attributes

Subtheme	**Attributes of subtheme**
Enabling learning environment	Access to guidance
	Access to meaningful work
	Moderate tolerance of work errors
	Supportive co-workers
Constraining learning environment	Limited access to guidance
	Limited access to work
	Low tolerance for work errors
	Student filled an actual position

The existence of the two learning environments is demonstrated in the differing experiences of some students who were placed with the same placement companies. The interviews with these students highlighted different work affordances and varying access to guidance, suggesting that they experienced different learning environments despite being in the same physical space. For example, Table 6.3 shows differences in the learning experiences of Lesedi, Kgabu, Lerato and Kagiso who were placed at the same company. It shows that the reported experiences of students Lesedi and Lerato were similar and their learning environments would be considered constraining, whereas the reported experiences of Kgabu and Kagiso suggested the presence of enabling learning environments.

Table 6.3: Attributes of learning environments present in analysis results for Lesedi, Kgabu, Lerato and Kagiso

	limited access to guidance	**limited access to work**	**low tolerance for errors**	**student filled an actual position**	**access to guidance**	**access to meaningful work**	**moderate tolerance of errors**	**supportive co-workers**
Lesedi	✓	✓	✓	✓				
Kgabu			✓		✓	✓		✓
Lerato	✓	✓		✓				
Kagiso					✓	✓	✓	✓

Table 6.3 suggests that students' experiences of the learning environments provided opportunities for a range of experiences in that not all students experienced all the four attributes that define their type of learning environments. For example, Lesedi's learning environment had all the four attributes of a constraining learning environment, whereas Lerato's learning environment had three out of four attributes of a constraining learning environment. It was also possible for one learning environment to have an attribute of the other learning environment. For example, Kgabu's learning environment was mostly enabling but had *low tolerance for errors*, an attribute of a constraining learning environment. Thus, enabling and constraining

learning environments were extremes of the continuum of learning environments. Despite this variation, the key attributes of each type of learning environment were fixed: *limited access to guidance* and *limited access to work* for constraining learning environments and *access to guidance* and *access to meaningful work* for enabling learning environments.

Furthermore, Table 6.3 suggests that the students experienced enabling learning environments as having four defining attributes. Before presenting the attributes in detail, there is a need to clarify the term 'meaningful work' as used in this study. It is used to refer to work that the students thought had value to their sponsors and which they thought could grow their competency. Most of the students attributed work's meaningfulness to its authenticity, perceived relevance to their training and future careers and the perceived value to their sponsors. Johannes gave an example of a broad range of meaningful work activities that were available in his learning environment:

> I have done a wide variety of work in a short time. I have done fire plans, drafting and design, designing a big wood drying oven that is 18 m by 5 m. I designed a fabric roller. I do a lot of site visits, measuring stuff, airflow, fire plans, warm water systems. It's not the same things, it's a whole lot of different stuff. In the designs, I am using thermodynamics, strength of materials, design, hydraulic machines, basically everything that I studied here. (Johannes)

The students experienced enabling learning environments as providing access to guidance through their official and unofficial mentors. The guidance was often in the form of pointers on how some tasks can be done more easily and where they might access relevant information. In most cases, the knowledge required to perform work activities was tacit, therefore not directly accessible to the students. The students required their mentors to make this tacit knowledge explicit through ongoing

guidance. Students accessed ongoing guidance from their mentors either through sharing an office or working on the same projects as their mentors. In cases where mentors became busy, some environments were flexible and facilitated change of mentors to other employees who were readily available. Ongoing guidance was influential for efficacious student learning as the students continuously shifted from work assignments that had tasks that they had become competent at to those with unfamiliar tasks. Therefore, they needed continued guidance throughout the placement period. For example, Adriaan spoke of how his mentor was readily available:

> My mentor is always there but my supervisor is not always there. So, for most of the questions, I ask my mentor and he helps me a lot in that regard. (Adriaan)

The combination of meaningful work activities and access to guidance enabled student learning through both incidental (performing meaningful work) and facilitated learning (guided performance). As students often changed departments, their mentors could not support them in all the types of work that they performed. They needed support from other co-workers as well. In addition to assisting them to perform work, supportive co-workers were influential in assisting students in making them feel as if they were part of the workplace community. For instance, Jaco recounted how supportive co-workers were when his mentor was unavailable:

> They're very helpful people. The junior project managers were also extremely helpful. They help you to run your project. If you run into a situation and you couldn't get hold of your mentor, you went to a junior project manager and they helped you. Senior project managers would also help you, but their time was a bit limited, so their help wasn't as frequent as the junior project managers. (Jaco)

The findings showed that the students thrived if the entire environment was supportive. They flourished in the workplaces that prioritised students' learning

needs. For example, Tumelo explained how his placement company allowed him to stay behind instead of going to a commissioning project so that he could focus on writing his P2 project report.

> I was supposed to go with the guys to Ghana, but I had to write my report and submit all the P2 staff. I would not be able to finish my report in time if I went to Ghana because the project was going to take three months. (Tumelo)

The students indicated that they expected their work placements to provide them with low-stakes environments where they would focus on improving their practical competency without fear of the negative consequences of work errors. This expectation did not mean that they wanted high tolerance for work errors; instead, they preferred a moderate tolerance as it empowered them to be proactive while retaining the authenticity of the workplace. For instance, students who were in high error tolerance environments, such as Marianne at the university workshop, complained that their environments did not match what their future workplaces were likely to be.

As shown in Table 6.3, in constraining learning environments, *student filled actual job* positions, had *limited access to meaningful work*, had *limited access to guidance* and their environments had a *low tolerance for work errors*. These attributes signalled that in these environments, no allowance was made for activities that facilitated student learning because students' work affordances were structured to meet organisational goals. The students interpreted this as an indication that their placement companies did not care about their learning. For example, Arsenio believed that his placement company cared more about production than about his learning needs. He shared that:

> The only thing they care about is production, their production. They don't really care about us. It's like they don't know why we are there. For them, it's just for us to be exposed to industry. I think we are there for the money. (Arsenio)

Code clustering suggests that when students filled actual job positions, it severely constrained their learning and curtailed their exposure to task diversity. Due to their lack of work experience, students were assigned to low-skill, low-risk positions which offered little theory-practice integration. Thus, they had difficulties relating to the work they did and what they had learnt at university. For example, Marianne, whose experiences are described in Chapter Five, attributed her lack of diversity in the work participation to her position as a lab assistant. She indicated that before the appointment, she rotated among various assignments. The lack of university-practice integration caused some students, like Katleho, to question the value of their university training and made them fear for their future work prospects. Katleho commented:

> It's really sad, I have reached a point that I think I should change my career next year for something else because I feel like am not going to make it as a technician. Let's say for example I get employed by Company E or Company M, there will be people looking up to me because I have a diploma. Whenever they struggle, they will come to me and say "This is the problem", like the motor is not moving, and then what am I going to say about the motor? I know it theoretically but practically I don't. (Katleho)

Association of codes showed that students filling actual positions often coincided with their mentor's shift in posture from that of a teacher to that of a supervisor. This shift reduced the availability of guidance to the students. It is not surprising that in the absence of ongoing guidance, the students felt overwhelmed by their tasks. They used phrases like 'thrown into the deep end' (Henri) to describe what it was like being assigned to tasks without being provided with adequate guidance. When this was combined with high-stakes environments which were characterised by high-

performance expectations and a low tolerance for work errors, they understandably became more anxious. As a result of this negative somatic/emotional state, the students avoided doing anything beyond what they were assigned to do. They feared being blamed for work stoppages that would arise. Joseph described a typical sequence of events that led to this type of avoidance behaviour:

> Mr D doesn't blame anyone. He might come and find you trying to fix something, he's going to ask you what happened. If you're wrong, he's going to try and fix it, but Mr F, he wants to blame you. Like one day, something happened on the machines; when he came the first thing he said was, “Don't worry, I will see what you did”. “I will see what you did” is like blaming me. I'm the one who caused the problem so next time when there's something like that, I don't even want to touch anything. I want to call a fitter to come, but when it's Mr D, I am free. (Joseph)

Furthermore, the students attributed their filling of actual positions to staff shortages at placement companies due to either resignations or seasonal fluctuations of their sponsor’s labour demands. For example, Magda explained that she filled an actual position due to the incumbent’s resignation after parental leave:

> I am doing an actual job now. I replaced the lady who went on to maternity leave. Unfortunately, she got a job somewhere else, now she has left. So, I do that job for good… now no one tells me what to do. (Magda)

In constraining learning environments, students had limited access to meaningful work. They were assigned work of narrow scope because of their inexperience. This limited the work they were assigned to do low-skill work that could be done with their existing knowledge such as draughting or work that did not require university-level knowledge. Many of the students believed that they were already capable of performing this type of work. Therefore, this made them question the value of their work placements. The challenge with low-skill work was that it did not provide the students with opportunities for developing their self-efficacy through mastery

experiences. Instead, the low-skill work caused the students to become despondent which led to their low self-efficacy. The data analysis showed that narrow scope and low-skill work adversely affected students' self-efficacy. For instance, Mantso, who was a machine operator for his entire placement period, explained how he thought he was adversely affected:

> I can say that I am an operator there, more or less. I operate the palletiser machine… I didn't have specific training to operate the machine. They just put me with an operator and that operator just walked me through how to operate that thing, no specific training whatsoever… I will graduate, but without knowing anything. I didn't get much exposure to real work. After a year I'm supposed to claim to be able to work any place, but I don't have that confidence. I still feel like I need to get another chance of training somewhere else. (Mantso)

According to the students, constraining environments presented barriers to engagement and collaboration. In most cases, the barriers were not intentionally created. The common reason given for inadequate student engagement was that the mentors, the students and their co-workers were too busy to have meaningful engagement. For example, Mugisha reported that he was too busy to participate in training programmes that were offered by his sponsor, highlighting the tension that exists between the demands of learning through participation and the demands of the job. He explained:

> There was this other training that they said that people could go to, but because the line was very busy, they couldn't send people there. Everything there depends on what is happening on the line; if the line is busy, you have to be there. (Mugisha)

In constraining environments, the students felt that they were there to render service (transactional) rather than to learn through work (developmental). They complained that deliberate provisions to integrate them into the workplace were absent. The socialisation opportunities were mostly limited to people within their immediate

vicinities, such as their supervisor and immediate co-workers. In some cases, they were actively prevented from communicating with people outside their sections. Given such constraints, they seem not to benefit from the collective knowledge of their workplaces. In a way, their learning was more of a by-product of working to contribute to the output of the organisation than a deliberate effort to facilitate their learning and participation.

6.2.2 Theme two: the industry mentor

To the students, their industry mentors' actions were the most significant influential aspect of the learning environments. Hence, mentors' character and actions conveyed the stance that the students believed that their placement companies had adopted towards their learning. They exercised control over access work and participation opportunities that were available in the learning environment. Thus, the mentor was both an agent and co-creator of the student's learning environment. Table 6.4 provides the subthemes that were found under the theme '*the industry mentor*'.

Table 6.4: Attributes of a mentor as an agent/creator of a student's learning environment

Theme	Subtheme	Attributes
The industry mentor	Mentor quality	High capacity mentors
		Low capacity mentors
		High availability
		Low availability
	Mentor posture	Mentor as teacher
		Mentor as supervisor
		Mentor as supervisor and teacher
	Mentoring functions	Provide their proteges with meaningful work
		To facilitate protégé participation in workplace activities
		To protect their proteges from adverse effects of work errors.
		Managing paradoxes of work placement learning

Before describing the findings relating to each subtheme, there is a need to define some of the terms that are presented in Table 6.4. *Mentor capacity* refers to a mentor's ability to perform mentoring functions in a manner that facilitates efficacious workplace student learning. *Mentor availability* refers to the ease with which students could access guidance from mentors. The guidance entailed giving direction on what the students needed to do, allowing them to observe their co-workers in action and participating side by side with the students in work activities.

In this study, mentor quality was defined by *mentor capacity* and *mentor availability*. The findings showed that most high-capacity mentors were from the management echelons of the host companies. These mentors had the power to allocate meaningful work to the students. Some students reported that their mentors diverted work from other workers or themselves to them to expose them to a diverse range of work assignments. For example, James spoke of how his mentor diverted work from their Johannesburg office to expose him to a variety of tasks:

> All the drafting used to be done in Johannesburg because the company head office is based there. But currently, my boss [and mentor] diverts everything to me, so I'm the one that's currently doing all the drafting. (James)

Tumelo provided another example of high-capacity mentors' ability to provide their students with meaningful work. He mentioned that his mentor diverted some of his work to him:

> He [my mentor] is a former student of University X; he studied here. He graduated in 2010 with his BTech. He is the person who is responsible for everything relating to after-sales service. He makes sure that I get as many practical projects as I can because he understands what is needed…he usually gives me some projects that he was supposed to run just to let me have more knowledge. Not just practical, but also the office work. He says I also need to understand that because one day, I can be a supervisor like him.

> So, that is why he is making sure that I understand the office work as much as I can as well as the practical. (Tumelo)

With most high-capacity mentors, there was the challenge of availability. For example, Jaco reported on availability challenges that forced a change from a high-capacity to low-capacity mentor.

> It started as the GM of the company, but the GM was often away and too busy for us, so it ended up being one of the senior project managers. (Jaco)

Some mentors were able to compensate for their unavailability by delegating some of the mentoring responsibilities to their subordinates. From the data, it appears that co-workers were willing to step in and provide ad hoc support to students whose mentors were their seniors. Johannes gave an example of this:

> He [my mentor] shows me that if this happens, you have to do this and that. He gives me the basic knowledge. If I struggle with something, I have a fellow worker behind me, I ask him. I also go directly to him and he helps me... There is a young junior mechanical engineer, his desk is next to mine. If I have a question, I ask him. If I struggle some of the guys come to me and ask if I am doing all right and if I need help. (Johannes)

Students required their mentors to be available to provide support to them when needed. Most work activities were challenging to them, and they struggled to complete them on their own. They would only complete the activities if they were provided guidance and support by their mentors. In most cases, high-availability mentors who often were the students' immediate supervisors were readily available to provide guidance.

For example, Tabelo explained how he benefited from having his supervisor as his mentor:

> If I struggled with something, I would go to him [my mentor]; we would work together…. I get stuck like everyone else, so I go and tell my supervisor and he shows me in the way he does things. (Tabelo)

Unfortunately, with most high-availability mentors, there was a challenge of providing their proteges with a broad scope of work. These mentors did not often have the authority to assign students to other departments, even when they thought that the students would benefit from such an assignment. For instance, in the case of Tabelo (above), he worked only in the maintenance department although his placement company had several departments relevant to mechanical engineering. Another student, Botumelo, mentioned how she worked only in the tooling and machining workshops that her mentor was responsible for, despite her host company having several other workshops and laboratories:

> I spent 12 months of my life in that workshop with my mentor. Therefore, I am only comfortable with what he knows – the two areas. I never got a chance to go into the strength labs, the thermodynamics or the metallurgy labs. (Botumelo)

Since the ability to provide meaningful work and close guidance did not reside in a single individual, yet successful work placement learning required that they should, access to meaningful work and access to close guidance were competing demands. High-capacity but low-availability mentors managed this paradox better than high-availability but low-capacity mentors. They delegated the guidance share of their responsibilities to their subordinates.

Most participants spoke of their mentors in two ways: as if they were teachers or just their supervisors. These two postures reflect the tension between competing demands that is evident in workplaces. Students' recollections of the placement experiences suggested a continuous contestation between learning and working which presented itself in the mentor-to-student interactions. When the mentor was

positioned as supervisor, productivity was prioritised over learning. Contrariwise, when the mentor was positioned as teacher, the students' learning was prioritised over operational gains, or at least these needs were considered together.

When mentors positioned themselves as supervisors, their actions were directed at either ensuring that the students became productive as quickly as possible or ensuring that the students fulfilled some organisational goals; once students had attained acceptable work proficiency, the mentor ensured that they meet some operational demand such as replacing staff who had resigned or filling positions that had arisen owing to increased work demands. For example, Mantso believed that economic pressures at his placement company forced mentors to ignore his learning needs:

> The company knows what we're supposed to be doing because that Operations Manager is a former University X mechanical student. So, he knows what students are supposed to be doing there. But it has more to do with economics for them because when it's a busy time, they have to take in temporary workers. They pay them more money compared to the stipends they are giving students who are actually doing the same job as those people. So, they are winning by taking students. (Mantso)

In contrast, the analysis indicated that mentors who positioned themselves as teachers recognised that their mentees were still students and, as such, would often make mistakes. Further to this, they recognised that if their mentees were to learn from their mistakes, mentors needed to protect them from the negative consequences of work errors. In this study, the students who considered themselves to have had adequate placement experiences often moved on from sections of the workplace in which they had become competent to other sections to develop their skills further or to learn new skills. This constant department change meant

continued work errors. Kagiso comments on the learning potential of work errors and how his mentors allowed him to grow from them:

> Initially, I made a lot of mistakes: not understanding speeds and feeds of drills and cutters, not setting out my work correctly. So, with that, there were a few cutters that were damaged. A few drills that were also damaged and so on. Not accurately measuring workpieces. For instance, when I had a spare to make, and if the dimensions and the pitches of the positions of rows were not accurately measured, then there's a whole component would be wrong. They received it well because they understood where I'm coming from, I'm new in the environment. They tolerated my mistakes. They gave me leeway to make mistakes, and to grow from my mistakes. (Kagiso)

Mentor posture was not static. It was responsive to the prevailing environment within the workplace. In some cases, a change in workplace conditions influenced mentor posture. In this study, the most common change in workplace conditions was staff shortages due to resignations. For example, when a welding assistant at Marianne's workplace resigned, the mentor appointed the student to replace him. As a result, her experience shifted from adequate to inadequate. She described the influence of this shift:

> What happened was that one of the staff members had left and he needed someone to fill his position. So [the mentor] approached me and asked whether I could fill in…. I actually had a job description and my job was a lab assistant and that is what I did… Because of my job description as a lab assistant, I never had the opportunity to work on a CNC machine and the plasma cutter. (Marianne)

Although the two mentor postures appear to be mutually exclusive, the study showed that for efficacious learning, mentors needed to reconcile the two competing positions. If they operated solely as teachers, their students thought they did not have an authentic experience. Students who undertook their placement at the university workshop experienced this situation. Marianne commented that the

reduced formality that often characterises environments where mentors operate as teachers diminished their authenticity:

> I have been working here, it is an institution, it is a company, but obviously, the work environment is a lot less structured. I would say it is a lot less formal. Whereas in an actual company, you have your deadlines and things. You have the structure and you have to make sure that you meet those deadlines. (Marianne)

When learning environments allowed the mentors to operate both as teachers and as supervisors, the paradox of mentor as teacher and supervisor could be successfully managed. In such cases, the mentors were able to facilitate rich learning through activities that were both authentic and structured for learning. Some mentors resolved this paradox by first assigning tasks to students as they did with any other employee and providing guidance and protection only if the students required it. Andrew recounted how this arrangement worked in his case:

> When he first sent me to supervise, it was very difficult for me. The challenge was that I was supervising people who were more knowledgeable about the job than me. So, when they come to me and tell me we have a problem with this, I had no idea what to do. The job was delayed because I didn't actually know the job. So, I went and reported this to him, and I went back to the people with him. He then told me that this is what you must look for, especially on bending. He helped me, but it took me two more weeks to master supervising these people. (Andrew)

The findings showed that industry mentors needed to be able to manage the tensions arising from work placement paradoxes, which, if not effectively managed, had the potential to compromise student learning. However, successful work placement required that provision of work tasks to students be structured to derive student learning goals without changing the original goals of work tasks.

6.2.3 Theme three: student performance and participation as learning

Code associations suggest that the work placement students learnt through performing work tasks and participating in workplace activities. In performing work, two outcomes were realised: the students' work proficiency improved and their belief in their capabilities (self-efficacy) improved as well. While their initial performance was slow and error-prone, they indicated that their proficiency and self-efficacy improved over time. They acknowledged that even in circumstances where they knew what to do, they were often unsure of how to apply their knowledge in practice. Furthermore, they indicated that in comparison to experienced practitioners, they were initially slow in executing assigned tasks. For instance, Kgabu aptly summarises the fundamental differences in the performance of work placement students and experienced practitioners:

> The engineer will come and get different results from mine because based on his experience, he knows how to work with these parts. He knows on the assembly drawing, where does this part fit in, so he knows that on this part, the surface finish is critical but on that it's not. But then for me, I need to follow each and every single step, making sure that it is okay. But then for me, it takes like, a lot of time. I need still to investigate. If it doesn't go according to plan, so I will go and ask them, I have a problem with this, so it takes much longer, as compared to someone who has the experience. (Kgabu)

The prevailing learning environment was a crucial factor in the students' response to work errors. While work errors did not seem to affect students much in enabling work environments, the outcome was different in constraining learning environments. Constraining learning environments reinforced students' fears. For instance, Kagiso, who was in an enabling learning environment, appeared not to be affected by his work errors during a frustrating period because, according to him, "I didn't feel that this is a company where making a mistake is not tolerable". On the other hand, Mantso, who believed that he was in a constraining learning environment, became

hesitant and unwilling to take the initiative because his learning environment was not error-tolerant. He reported that his environment constrained him from taking the initiative:

> Once, when there was a problem with my machine and the fitter was taking long I decided to try to fix it; it was something I could manage on my own. But they told me not to do it because if something goes wrong, I'll be the one they are going to blame. So now, I always wait for the fitter to come. They have a lot of fitters there. (Mantso)

Understandably, this gap in proficiency narrowed over time. There was no consensus among the students regarding how long it took them to become proficient: some estimated that it took them four months, others claimed it took them six months. However, there was consensus that the period before achieving proficiency was a time of frustration. Nqobile explained the frustration she felt during this period:

> For the first two to three months, it was hard. I was completely confused; I did not know what I was doing here. I did not know what I was waking up to. I kept asking fellow students of their experiences during these first months. They said ‘We were also just as confused’. (Nqobile)

Some students reported that after this initial frustrating period, their growing proficiency with tasks increased their self-efficacy and made them feel as if they were part of the work community. As a result of their high self-efficacy and a sense of belonging, it became easier for them to exercise proactive agentic behaviours or to recover from work errors.

Students’ recollections of their workplace experiences indicated that interacting and working collaboratively (co-participating) with co-workers offered learning benefits beyond the technical execution of work. The interactions enabled them to develop shared understandings with their co-workers about company-wide and industry-wide

norms and best practices. When the students shared their understandings of the norms and practices, it assisted them in getting feedback on the quality of those understandings. For instance, some students reported that during interactions with their co-workers, they shared with them stories of their experiences and how they could navigate through workplace challenges. One such student was Umdobi, who spoke about how his supervisor used stories about his experiences to teach him how to focus on details:

> He would always talk about his mistakes and how he learnt from them, that small stuff actually matters in engineering and that it is not always the big things. He said he would always keep it simple… I was interested to hear his stories because I wanted to gain as much (sic) because you do not need to make your own mistakes to learn. (Umdobi)

Co-participation allowed students to observe their co-workers in action, thereby enhancing their ability to learn some of their preferences in doing things and other bits of knowledge that had become tacit over time. By collaborating with co-workers, the students were able to tap into this hidden knowledge. For example, a few of the participants mentioned that their experienced co-workers had strategic knowledge, which enabled them to take shortcuts in performing work activities. Tumelo explained this:

> They have been doing this work for thirty to forty years. So, they know if I do this thing this way, even though I did not follow the book accordingly to a step by step(sic), they know it's going to work. So, I still cannot understand this. I gave my ideas based on the theory. So, sometimes they listen, and they say, "Yes, it's good enough. Let's try it your way. And if it does not work then we try it our way". I must say their way works sixty percent of the time but mine only forty percent of the time. (Tumero)

Co-participation made guidance from co-workers more accessible to the students. Also, it enabled the students to perform activities that they would not be able to perform on their own. This was because co-participation facilitated scaffolding. In

addition, it facilitated improvement in the students' social skills as students interacted with a broader portion of the work community. For instance, Moyenda explained how work with engineers exposed him to his company's procurement processes:

> Then I moved up to working with other engineers in designs. For massive design projects, we would split it into parts. So, every engineering student, the juniors like me and the seniors, we would work together on the same project to draw some parts. You get exposed to ordering components and all those processes in between. It was an amicable working environment. So, you would approach your fellow engineers if you needed information on something specific. They would be keen on giving you the information and vice versa. (Moyenda)

Code associations showed that the level of students' participation was mediated by the nature of the learning environments. Since students were temporary members of the workplace community who held no substantive positions; they had limited connections but could exploit these to gain greater participation. Students' recollections suggested that their influence in the workplaces was derived from their association with their mentors. If industry mentors were unable to facilitate meaningful participation, their students performed work of narrow scope throughout their work placement, in addition to making no progress when it came to participating in workplace activities.

6.2.4 Theme four: quality of work affordances

Work that was available to students during work placement varied in scope and meaningfulness. Code clustering indicated two types of work affordances: work of meaningful and broad scope work of narrow scope. Some students reported that they were exposed to diverse work assignments that added value to their placement company. Ordinarily, technicians or engineers would have performed these work assignments. Johannes provides an example of such activities:

> A whole lot of different jobs; mainly I have done fire plans, drafting and design, designing a big wood drying oven that is 18 m by 5 m. I designed a fabric roller. I have done a lot of site visits, measuring air flows, fire plans, warm water systems. So, I have done a wide variety of work in a short time, piping systems. It's not the same things, it's a whole lot of different stuff. In the designs I am using thermodynamics, strength of materials, design, hydraulic machines, basically everything that I studied here. It's a lot of work. Some you don't have from varsity, stuff like the fire plans because fire plans are not exactly mechanical engineering, its regulations and rules. It's not stuff that one would study from a book. (Johannes)

In addition, these students were exposed to non-technical work such as interacting with contractors and clients, which improved their generic skills such as problem-solving, teamwork, leading work teams and communication. Such broad exposure assisted the students to appreciate the nature of engineering practice. It also gave students confidence that they would be successful in their future employment. For example, Raphael explained how overseeing a project assisted her to understand what engineering practice entails:

> At first, it was a bit intimidating because it was my first real project. I had to come up with budget, phone companies to get quotations or get contractors to come and do the job. They left everything to me. I had to do the drawings, contact the outside companies, do presentations to the managers to try to get them to approve the project. So, it was kind of challenging for me. But, it's kind of opened my eyes to what an engineering technologist is expected to do. (Raphael)

Code associations showed that in most cases, both scope and meaningfulness were influenced by mentor quality and mentor posture. Narrow scope and less meaningful work were associated with low-capacity mentors. Conversely, meaningful and broad scope work was associated with high-capacity mentors. Furthermore, mentors who adopted the dual posture of supervisor and teacher provided their students with meaningful and broad-scope work. In turn, high quality of work affordances facilitated growth in perceived self-efficacy and the development of high self-efficacy. All

students who had high self-efficacy considered themselves to be work-ready. For instance, one of the students who had been exposed to high-quality work affordances, Moyenda, declared:

> I would say I am ready for any kind of environment, ready to work, ready to design and ready to do the experimental projects. (Moyenda)

Code associations revealed that low-quality work affordances were an outcome of mentor posture, Students who reported being afforded work of narrow scope were those whose mentors had either adopted the posture of supervisor or were low-capacity mentors in a constraining learning environment. In these cases, the mentors allocated work to the students based on operational considerations. As the students had minimal skills on entry to the sponsoring companies, they tended to be exposed to monotonous and low-responsibility work such as operating various production equipment, inspecting the quality of products, doing administrative work and performing artisan-level tasks. The students considered these tasks token assignments that were not aligned to their future roles as technicians. As a result, they developed low self-efficacy and became worried about their work readiness. For example, Katleho became despondent after operating a bottle-blowing machine for his entire placement period. He articulated his thoughts about his placement:

> You think of studying for three years, spending sleepless nights, but you end up pushing buttons. It's really sad, really, really sad. I have even reached the point that I am thinking of changing my career next year for something else because I felt like I am not going to make it as a technician. (Katleho)

The analysis showed that it was not the monotony alone that led to students' low self-efficacy; lack of meaningfulness was an additional influencing factor. In some cases, repetition of work tasks was beneficial in that it facilitated task proficiency. Some students who were placed in a single department for the entire placement

period developed high self-efficacy. These students had performed work that was of value to their placement company and which aligned to their perceived identity as future engineering practitioners. For example, Tabelo was satisfied with working as a maintenance technician for the whole duration of his placement. He explained that he was satisfied with his experiences:

> In the company, I was employed to be under maintenance, and I have been doing that ever since. We study machine issues and try to make them efficient as they were when first bought… Right now, we are in the period that he trusts everything…He doesn't follow me around. If we discuss in the morning, the whole day I will just do my job as we discussed…. I feel my in-service was very good because it gave me the platform to learn. (Tabelo)

The findings showed that the quality of work affordances had a substantial influence on the students' satisfaction with their work placement experiences. If the students were afforded meaningful work, they felt good about their future career prospects and had high self-efficacy. The quality of work affordances was influenced by mentor capacity and mentor quality. High-capacity mentors who adopted the posture of teacher and supervisor tended to provide their students with meaningful work. The opposite tended to be true for low-capacity mentors or mentors who adopted the posture of supervisor.

6.2.5 Theme five: student characteristics

Student characteristics, self-efficacy, agency, competency and emotions were inextricably linked with each other. Code associations showed that high self-efficacy was linked with high agency; occupational competency and positive emotions were present in the same students. For instance, students who had high self-efficacy believed that they were competent as novice technicians. They had confidence in their abilities, believing that they would successfully execute tasks that were

performed by the regular employees. This confidence arose because they could perform some tasks requiring only occasional support. Because of this confidence, they believed that they were employable. For example, Raphael explained why she thought she was work-ready:

> Towards the end, they would also give me projects to deal with myself. We were kind of doing the same things with the engineers who were working full time. If there were projects, they would give me one or ask me to help with a project. In-service has contributed to me personally and career-wise. Now, I am more confident. I know that I can tackle any project that is given to me. (Raphael)

Code associations further showed that the collective outcomes of the student characteristics influenced the work affordances that students received. For instance, *high self-efficacy* led to *high agency* which was expressed as a *proactive solicitation of guidance* and *proactive solicitation of work*. The proactive approach to work and guidance had a positive influence on the placement experience, as proactive students tended to be exposed to more meaningful work. This outcome happened because circumstances in workplaces often required the students to make their learning needs known to their mentors and to approach them when they needed guidance. The findings indicated that the pursuit of the goals of the workplace often constrained industry mentors' obligations to their students.

The findings showed that the outcomes of student characteristics were mediated by the prevailing learning environments. For instance, within enabling learning environments, proactiveness tended to be rewarded with meaningful work. In contrast, within constraining learning environments, the exercise of agency did not often produce the desired outcomes as these environments were mostly unresponsive to students' agentic actions. For example, Mantso recounted how his

proactivity was constrained owing to his ideas being dismissed without consideration:

> I remember one time when there was a problem. It was actually a simple problem but that fitter kept on going on the wrong route, and when I suggested what to do, he told me that he had fifteen years of experience and I had nothing. I felt diminished because I was there but my suggestion did not matter. (Mantso)

In most cases, *high agency* led to proactivity except when there was some form of disempowerment, in which case there was deliberate passivity. For instance, students who had stayed for a while without getting placed or international students tended to be more affected by constraining environments than others. They constrained themselves from acting in a manner that would jeopardise their placements. For example, Mugisha claimed that some of his friends did not find any work placement after one year of finishing their coursework. This disempowerment was compounded by the fact that work placement was compulsory for graduation. Katleho explained how the delays in finding placement led him to accept work placement that his fellow students advised him against accepting work placement would not give him valuable experience. He explained his rationale:

> I would say it was desperation. I was looking for in-service for six months. I was still looking for it when they offered me this job. You just put your thoughts behind before you make a decision and say to yourself, you will find out later while you are in here. (Katleho)

Although these passive students claimed that they did not gain occupationally relevant experience, it emerged from their interviews that they had gained some useful skills such as teamwork, communication skill and how to behave in the workplace. The students recognised this lack of occupationally relevant experience as a shortcoming in their WIL. Consequently, they lacked confidence in their abilities

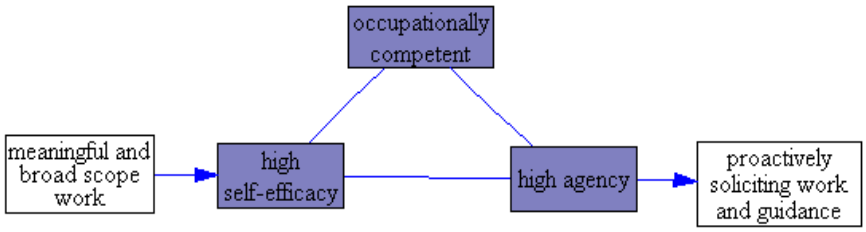
and doubted if they would be able to perform as technicians without further internship experiences. For example, Mantso lamented the possibility that inadequate experience would have negative consequences later, after graduation.

> I will graduate but I didn't get much exposure because after a year, I'm supposed to claim to be able to work any place, but you don't get that confidence when you walk out of Company 16 after a year of in-service. You still feel like you still need to get another chance of another training somewhere. (Mantso)

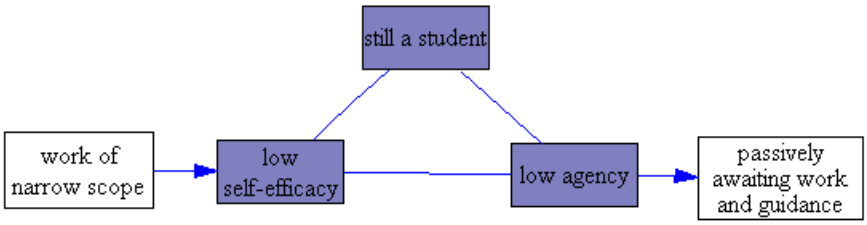
In some cases, the exercise of agency was associated with a change in the work environment. Students exercised agency in response to the lowering of the quality of work affordances. The experiences of Johannes illustrated this. He was exposed to high quality until his sponsor took in another WIL student. After that, the quality of his work affordance dropped substantially and as a result, he quit. Johannes gave the following explanation for leaving:

> They have got another student working on the design work and all the engineering work is going to him so that he also can also get a lot of exposure to design work. So basically, the next two months, I would have been in the factory, grinding. (Johannes)

Additionally, code associations suggest that students' characteristics were influenced by the quality of the available work. They further suggest that interactions between student characteristics and environmental factors were neither linear nor had fixed inputs and outputs. They were mutually influential, although the influence not always direct. Figure 6.1 (a), which presents the mapping of code associations, shows that *access to meaningful work* led to *proactive solicitation of work and guidance* through an integrated triad comprising *high self-efficacy*, *high agency* and *occupationally competent*. Similarly, Figure 6.1 (b) shows that *work of narrow scope* led to *passively awaiting work and guidance* through another triad comprising *low self-efficacy*, *low agency* and *still being a student*.



(a) A map of code associations highlighting meaningful and broad-scope work as a source of high self-efficacy and occupational competency



(b) A map of code associations highlighting work of narrow scope as a source of low self-efficacy and low occupational competency (still a student)

Figure 6.1: Map of code associations linking quality of work affordances, student characteristics and student' agentic role in performance and participation

Clustering of the codes into groups suggested a chain of associations that linked constraining learning environments with low self-efficacy, indicating that a constraining learning environment worked to reduce self-efficacy. Due to the low quality of the work opportunities that were available in constraining learning environments, the students were deprived of developing self-efficacy through mastery experiences. Most of the students did not consider these low-quality work opportunities to be appropriate for technicians. Their mastery experiences provided students with authentic evidence of their work readiness. It is worth noting that the students' self-efficacy was specific and aligned with their mastery experiences. They associated what they had mastered during work placement with potential employment. For example, when asked whether he would succeed if he secured employment at another company, James responded:

> Yes, I can say, yes, I will be able to succeed, especially if it comes to the drafting department, like if it comes to drafting technical stuff, yes, I will be able to do that. I will also be able to do quality control. Remember, I had to do technical documents and stuff like that. I'll be able to do all of that. (James)

It further emerged from the code associations that students' characteristics exerted a reciprocal but indirect influence on their learning environments and in their work affordances. Students who tended to be proactive in soliciting work or guidance received more meaningful work and better guidance than passive students. This caused their work performance to improve more rapidly than that of passive students, and this, in turn, encouraged their mentors to give them more meaningful work. At the same time, *access to meaningful work* influenced the students' self-efficacy, increasing it through mastery experiences. Their increased self-efficacy reinforced their high agency. Thus, a chain of associations linked high self-efficacy with enabling learning environments. The experiences of Nqobile illustrated how a positive self-efficacy loop worked. In her case, the high agency led to proactive solicitation of work, which led to more meaningful work and then bolder solicitation of work. It seemed that her self-efficacy and agency grew with each pass of the loop. Nqobile recounted what happened:

> I actually stood up and told my mentor. I asked him if I could work outside with the guys. He did not mind, because to him it is like I'm learning new things. So, I went to work with the guys. After two weeks, I went to him again. He told me, "I love what you are doing", then he grouped me with somebody else. After that week, I went to him again and he grouped me with somebody else. He was getting used to the system that I'm now working there. I started getting invites to meetings, cost meetings, planning meetings and everything. I started being treated well in all those things. And then I started travelling to other plants. (Nqobile)

She mentioned later in the interview that her performance and participation increased as she went through this cyclic process of soliciting work. She recounted further:

> At the time when I was also not that productive, they gave me one project and it lasted about 2 months. If you give me the same project now, I can do it in two weeks or a week. I would just sit there and do it So, they gave me a chemical storage location project when I started being proactive. I got better projects. I can actually say that this one is a better one. There are actually projects that go to management and get recognition, not just small projects. (Nqobile)

Code associations suggest a link between work of narrow scope and low self-efficacy, between low self-efficacy and low agency and between low agency and work of narrow scope. The students who believed that they were exposed only to work of narrow scope reported that it made them fear for their future careers. This anxiety had a negative influence on work self-efficacy. Furthermore, low self-efficacy tended to lead to low agency. Moyenda illustrated how inappropriate work experiences lead to negative emotions that lead to passive dispositions. He explained what happened:

> I worked July, August and September. Then at the end of September, I quit. When the first company interviewed me, it was okay, it was great…But when I got there, for the whole month, I was filing a block of metal, carrying a file and filing for the whole day from eight in the morning until quarter to five in the afternoon. I realised I did not study for that. Maybe, I would have understood if we have done it for a week or you know a few days but for the whole month? I sometimes remember in the morning when I wake up to go to work, I wouldn't have any motivation to go to work. I never had motivation. I felt it was slavery, modern-day slavery, so I could not continue to do that given that they dealt with hydraulics and pneumatics. They did maintenance on things like pneumatics and hydraulic cylinders and they repaired hydraulic motors too. They also worked with rigs and they did maintenance on ships. I was not exposed to that, so I quit. (Moyenda)

The findings suggest that mastery experiences lead to high self-efficacy which in turn facilitate high agency. High-agency students tended to be afforded meaningful work which provided them with mastery experiences that further reinforced their high self-efficacy. Conversely, work of narrow scope tended to lower the student's self-efficacy. Low self-efficacy was associated with low agency. Students with low agency tended to be assigned token work, which further diminished self-efficacy.

6.2.6 Theme six: student's agentic role

The students took two contrasting postures concerning work and guidance; some students were proactive, but others were passive. The students' agentic deportment was the pathway through which their agency influenced the meaningfulness and scope of their work and resulting learning trajectories. Analysis of the students' experiences indicates that most of the mentors valued students who took charge of their learning through proactive solicitation for work and guidance. The findings suggested this to be the case as most students who reported approaching their mentors for guidance or more work, reported that their mentors obliged and provided them with what they had asked for. For example, John explained how he requested that his mentor allow him to learn workshop skills as, before this, he had been placed in the design office:

> I told him [my mentor] that I have never been in an engineering company, so I would like to gain [workshop] skills. I said I would like to gain them so that I can be a proper technician. So we developed an understanding that I was going to spend a bit of time in the workshop to learn all those things. So basically, the artisan would call me and show me what I need to do. (John)

When soliciting guidance, proactive students sought their mentors' assistance. If the mentors were unavailable, they sought help from co-workers. For example, Jaco

spoke of how he went in search of help if he ran into problems, first seeking out his mentor or co-workers if the mentor was not available:

> If you run into a situation and you couldn't get hold of your mentor, you went to a junior project manager and they helped you. Senior project managers would also help you, but their time was a bit limited, so their help wasn't as frequent as the junior project managers. (Jaco)

Conversely, some students passively expected their mentors to come to them and give them work or guidance. If the mentors were not forthcoming, they continued with what they were assigned to do, even when they thought it would not benefit them. This passive deportment enabled a lack of progress in their learning trajectory. For example, Mugisha mentioned that he expected his mentor to come to him to give him work assignments like those he was given at a university:

> I expected to work daily with the engineers and the fitters, fixing stuff or asking them questions. I expected to be getting some assignments where they tell me you need to know. Let's say ask you to find out how this machine works. Then at the end of a week or two, come and ask you to explain to them how the machine works. (Mugisha)

6.2.7 Theme seven: student learning trajectory

Analysis of the data established four subthemes related to student learning trajectories: two growth trajectories in enabling learning environments and two stagnant growth trajectories in constraining learning environments. These learning trajectories were the pathways through which the learning environment, student performance and participation interacted. The learning environments influenced the students' learning trajectories. For instance, only zero-growth trajectories were available to the students in constraining learning environments, mostly because these environments limited mentors' posture to that of supervisors. As mentors were agents of their learning environments, the trajectory types were also associated with

the postures adopted by the students' mentors. Students whose mentors adopted a teacher's posture presented growing trajectories of performance and participation. Conversely, those whose mentors positioned themselves as supervisors presented zero-growth trajectories.

In addition, the data analysis showed an association between efficacious learning and the two growth trajectories -- improving student participation and increasing student performance. In this study, increasing participation encompassed participation from peripheral to active participation or from occasional to active. In Lave and Wenger (1991), efficacious learning was associated with participation growth from peripheral to full participation. The apparent inconsistency is due to the differences in membership. In their study, the learners were permanent members of the communities of practice, whereas, in this study, the students were temporary members of the communities. In both studies, it was recognised that increasing participation required initiation and facilitation by an influential current member of the community of practice. In this study, that influential member of the community was a high-capacity mentor. As for increasing student performance, it was reflected in increasing autonomy in working and increasing complexity of the tasks that were assigned to the students. These two variables of student performance were an indication of their growing mastery. In most cases, increasing participation and growing performance were concurrent processes. For example, John recounted how he progressed from assisting an artisan in assembling a factory carousel to managing projects:

> My first few days were in the workshop. I was working with a qualified artisan. We had to work on assembling the massive carousel I was talking about… basically, the artisan would call me and show me what I need to do. He would say, "Take the drill for that 6 mm hole that you want to top, you have to drill at 5 mm". He showed me how you drill

> and how you mount the piece…I moved to another department. I started by doing manufacturing drawings and later laser-cutting parts. Then I moved up to working with other engineers in designs. For massive design projects, we would split it into parts. So, every engineering student, the juniors like me and the seniors, we would work together on the same project to draw some parts. (John)

The growth trajectories reflected growth in their knowledge, skills and responsibility. Some students' narratives indicated that over time, their proficiency in performing work activities grew from slow and error-prone performance to performance that they perceived to be comparable to that of their colleagues.

In most cases, perceived performance growth was coupled with increased involvement within the work community. For some of these students, participation increased from peripheral during the early periods of their placement to active during the latter part of their placements. For the others, it increased from peripheral participation to occasional participation. For example, Janet recounted how she moved from being assigned token tasks to pass time to be a valuable member of the maintenance department. She also spoke of how, as a member of the department, she was excluded from participating in breakdowns. Her experiences show that she moved from being a peripheral participant to an occasional one:

> The first week I was bored because they gave us books to read. Then our PPE did not arrive, so we couldn't go to the shop floor to do anything, so we had to do everything office-based …They gave me a lot of drawings to do. I had to do drawings, like the entire day. Everybody who had projects would ask me to do their drawings. The maintenance department abused me in that area, like AutoCAD. The maintenance department needed drawings like every day, so you had a stack of drawings…When there was a big breakdown, they did not take you with them. They were so focused on the breakdown that they just took the skilled people to fix that thing as soon as possible. And they would give you some other work to do in the meantime. (Janet)

The students had a role in sustaining the growth trajectories, thereby influencing the sustenance of the enabling learning environment. The learning environments responded to successful student performance by providing them with more performance opportunities. For example, John explained how his ability to successfully perform work activities led to a steep growth trajectory:

> I was the lead on some site works so I would go there on my own, just as other engineers would also do… I wanted to be involved in all aspects of the design. That is why within a few months, I already had projects of my own because I demonstrated the ability to do all those things and be responsible at the same time. (John)

Conversely, unsuccessful performance halted the growth of learning trajectories, as Andrew's experiences showed. He explained how his failure to manage a work team led his mentor to appoint someone to assist him:

> The first time when he said I must supervise, it was very difficult for me because I did not have an idea on how to supervise… this job [which was being done by the team he was supervising] was delayed because I didn't actually know the job. I told my mentor that I don't know this job. He gave me another person who knows the job to assist me with supervising the team then I learnt from him. (Andrew)

Furthermore, the data analysis showed an association between inadequate learning and static learning trajectories, static student participation and stagnant student performance. In stagnant student performance, students performed the same tasks throughout their placement periods. For instance, some did draughting, operating production machines and quality inspections. As indicated earlier, this on its own was not a problem because the proceduralisation of repeated performance improved their task proficiency. While their performance became faster and less error-prone, once their self-efficacy beliefs became established, further performance did not improve those beliefs and the challenge associated with performance diminished. For some students, performance became boring. A typical case of a learning

environment that restricted learning growth was that of James. He explained that he spent his entire placement doing draughting work for his sponsor:

> If I can say, I could say eighty per cent of the work I did was drafting. I was drawing. The rest I was compiling technical installation manuals for the systems, and also compiling a technical database for the parts I drew… I was using inventor to Inventor 2016. (James)

In all cases, stagnant student performance was due to transactional participation, focusing on productive activities which were removed from the core mechanical engineering activities of workplaces. Students involved in this way could not be considered to be peripheral participants as they performed either support or auxiliary tasks. For instance, James (above) could not claim to have become closer to the core business of his sponsor, which was the design of braking systems for mining plant, by fulfilling only a draughting function.

6.3 The social mechanisms that influence self-efficacy and occupational competency

A consolidation of the code associations from the thematic analysis uncovered two trajectories of students' work placement experiences that can be represented as reinforcing feedback loops: an enabling loop and a constraining loop. Figure 6.2 presents the structure and variables that constituted the two loops. The enabling loop represented associations of variables of students' work placement experiences that interacted to enhance the growth of their occupational competency and self-efficacy. On the other hand, the constraining loop represents associations of variables of students' work placement experiences that interacted to hinder the growth of their occupational competency and self-efficacy.

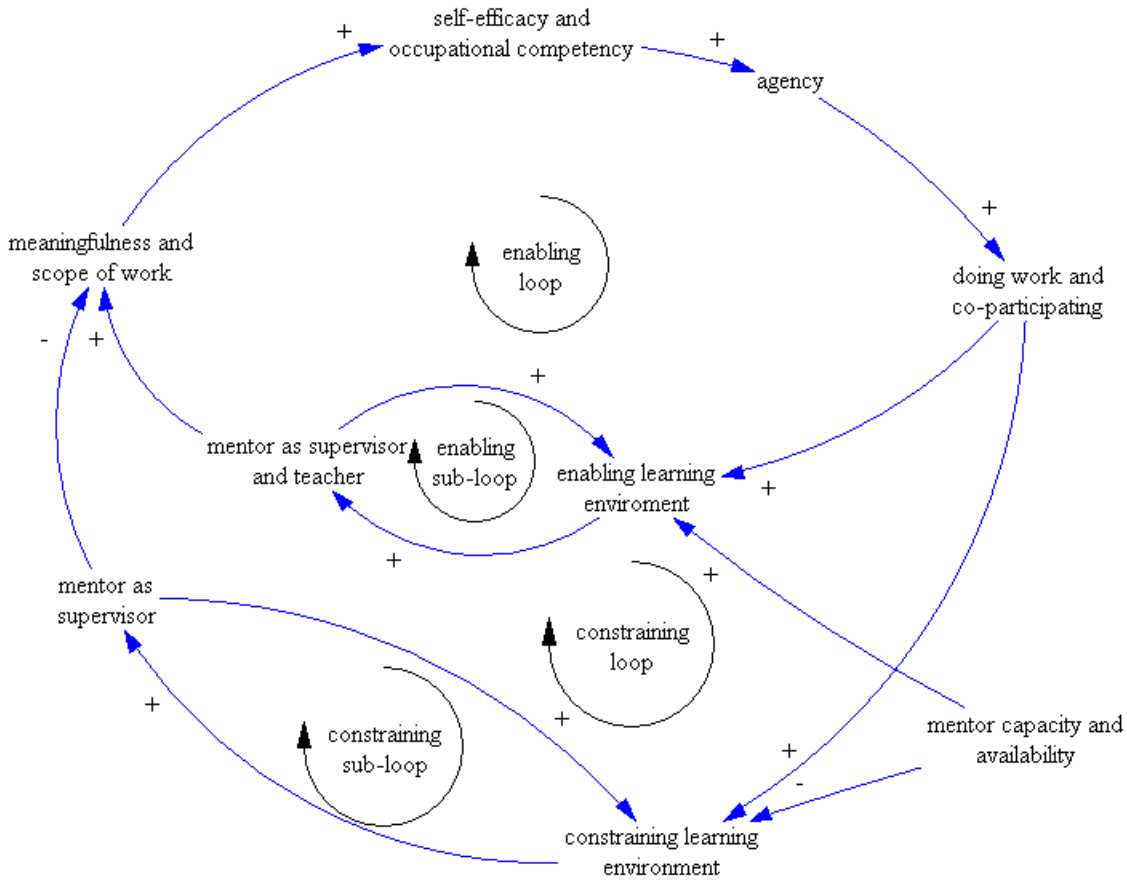


Figure 6.2: A graphical representation of how work placement learning processes were perceived by the participants[3]

The enabling sub-loop suggests that meaningful and broad-scope work was the outcome of interactions between the enabling learning environments and the mentor as supervisor and teacher. Figure 6.2 suggests the enabling sub-loop initiated the affordance of meaningful work which, in turn, resulted in the growth of students' self-efficacy and increased occupational competency. When participation in meaningful work was sustained over a period, the students' task proficiency developed through

[3] The sign (+) indicates that an increase in the preceding variable would increase the end variable. Also, a decrease in the preceding variable would result in a decrease in the end variable. For example, an increase in the meaningfulness of work influences an increase in student's self-efficacy. The opposite also applies. The sign (-) indicates that a decrease in the preceding variable would increase the end variable and vice versa. For example, an increase in mentor capacity negatively influences a constraining environment, reducing its impact.

proceduralisation (Anderson, 1982). Their increased task proficiency reinforced their self-efficacy through a comparative self-evaluation of performance. Most students benchmarked their performance with that of the regular employees. If they were able to perform similar work and if they were able to handle the same responsibilities, then they considered themselves competent.

Their resulting high self-efficacy had an indirect influence on the students' learning environment through its influence on students' agency. The high agency led to proactive behaviour from the students; students became more proactive in seeking guidance, in soliciting work and in asking for more responsibility. As the students' self-efficacy developed, they became more willing to exercise their agency. The students' recollections of their experiences suggested that high self-efficacy had a motivational influence on them; it stimulated their proactivity. Proactive students tended to participate more in work activities and tended to be offered meaningful work.

Initially, the students were satisfied working with artisans, but as they became highly agentic, they solicited technician-level tasks. If their initial solicitation was successful, it triggered a cyclic set of events that led to further solicitation of more challenging work. With each iteration of enabling loop, the students' occupation competence and self-efficacy increased. Thus, the students' self-efficacy did not grow because of one big assignment: they spoke of progressively gaining confidence as they participated in meaningful work.

Many students acknowledged the crucial role their industry mentors played in the success of their placements. The positioning of the mentor was an essential influence in the creation of the reinforcing feedback loop. The findings showed that

industry mentors are uniquely positioned as they have an interest in both the students' learning and their companies' production efficiency agenda. This allowed them to facilitate the changes that were needed to create enabling learning environments without compromising the broader interests of the host companies. The students recognised this important function of their industry mentors, realising that their agentic actions could not have produced the needed change if it were not for their mentors' support.

Figure 6.2 suggests that constraining sub-loops produced low-quality work affordances which were the driver of the constraining loop. The resulting low-quality work affordances initiated a series of influences that gave rise to low self-efficacy and low occupational competency. It can be seen that the constraining loop worked conversely to the enabling loop. It was the outcome of the production and production efficiency agenda of the workplace which overshadowed the learning agenda of work placements.

Figure 6.2 further suggests that industry mentors' prioritisation of their roles as supervisors in their interactions with the work placement students and the presence of constraining attributes in the work environment contributed to poor-quality work affordances. *Constraining learning environments* and *mentors as supervisors* reinforced each other. Within constraining environments, only strong agentic actions by mentors, such as allocating to students their work assignments, tended to produce a higher quality of work affordances. Moreover, balancing the needs of the students without compromising other aspects of their work required high mentor capacity and prior experience of mentoring students. Only high-capacity mentors who had some experience in mentoring other work placement students or who had a vested interest in students' training could manage this balance.

As shown in Figure 6.2, low-capacity and low-availability mentors facilitated the interactions represented by the constraining sub-loop, which resulted in poor-quality work affordances. Some industry mentors were inadequately trained or too busy to recognise students' learning needs. It was important for students to be able to articulate their learning needs but some did not actively engage their mentors, thinking that they should have read their training manuals; this approach was ineffective because not all industry mentors managed to read the training manuals. A few students indicated that they did not want to disturb their mentors as they appeared to be busy.

6.4 Conclusion

This chapter presented seven themes that emerged from the data analysis: the learning environment, the mentor, student performance and participation, quality of work affordances, the role of student characteristics, student's agentic role and student learning trajectories. Each of these themes represented an aspect of the students' work placement experiences that influenced their employability.

In addition, the chapter presented findings from thematic synthesis that presented work placement as a system with emergent outcomes that enhance or hinder student employability. This system comprised negative and positive reinforcing loops that are named constraining loop and enabling loop, respectively. When considered in their entirety, the findings showed that student employability is an emergent outcome of interactions of the various aspects of the students' work placement experiences.

The next chapter discusses these findings, considering the study's theoretical framework and what is known from literature. It also discusses the contribution of the

study to literature and the practice of work placement learning, particularly in mechanical engineering education.

CHAPTER SEVEN
DISCUSSION OF FINDINGS

7.1 Introduction

The previous chapter presented findings from the study and identified seven variables that interact to either enhance or hinder the growth of students' occupational competency and self-efficacy. This chapter discusses these findings, focusing on how they answer the three research questions of the study.

7.2 What are mechanical engineering students' perceptions of the quality of their work placement experience?

Concerning the first research question, the students suggested that a combination of variables rather than individual variables were responsible for the quality of their work placement experiences. They reported that their work placement experiences lacked authenticity or were negative under circumstances where industry mentors and employees were too busy to dedicate time to offer them guidance, where appropriate mentors are not appointed, where they filled actual positions and where there was an overemphasis on learning. On the other hand, positive work placement experiences resulted where industry mentors were willing and could offer them meaningful work, where there was a balance between focusing on learning and focusing on production and where there was tolerance of work errors. In addition, the students recognised their contribution to the quality of their work placement experiences, suggesting that those that were proactive were more likely to have to a positive work placement experience than those who were passive.

The students' observation of the role played by the clustering of work placement variables in influencing the quality of their work placement experience can be inferred from but is not explicitly reported in previous studies. This is not surprising

because most previous studies focused on the influence of individual aspects of students' work placement experiences. For example, although Kramer-Simpson (2018) reports several variables influencing the success of work placement, such as supportive industry mentors, assignment of professional-level responsibilities and error tolerance, she positioned them as isolated factors that did not interact with one another. Conversely, this study suggests that the various aspects of students' work placement experience are related and interact. It is these interactions that produce different outcomes. This interpretation of the students' work placement experience is consistent with the triadic reciprocal causation model (Bandura, 1977a, 1986).

Subsequent sections discuss the findings relating to work placement variables and how their interaction answers the study's other two research questions.

7.3 What aspects of work placement experiences contribute to students' growth in occupational competency and self-efficacy?

In relation to the second research question, the findings suggest that 7 variables influence growth of the students' occupational competency and self-efficacy: the learning environment, the industry mentor, student performance and participation, quality of work affordances, student characteristics, students' agentic role and students' learning trajectory.

7.3.1 The role of the learning environment in student learning during work placement

The findings suggest that the learning environment is a vital component of students' work placement experience. Jonassen and Land (2000: vi) define a learning environment as "the sociocultural and sociohistorical setting in which [learning] occurs and the tools and mediation systems that learners use to make meaning". Before proceeding, it is essential to compare what constitutes a learning

environment in this study with how previous studies conceived it. The students in this study differentiated the aspects of the environment that shaped their learning from those that did not. This differentiation suggests that they considered their learning environment as distinct from the broader work placement environment.

Figure 7.1 shows how previous studies consider the two to be the same: Figure 7.1 (c). In this study, the learning environments can be considered a subset of their broader work environment, as represented in Figure 7.1 (d).

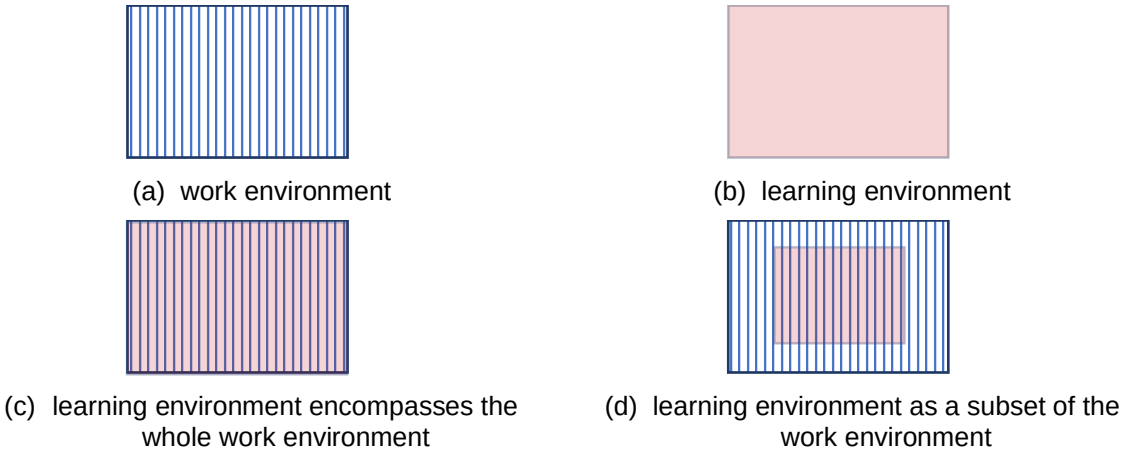


Figure 7.1: The way the work placement learning environment is conceptualised in this study and in previous studies

Previous researchers who considered the learning environment as in Figure 7.1 (c) attributed the quality of students' work placement experiences to conditions within the entire placement company. For example, Zehr (2016) suggests that environments within start-up companies provide students with better work and participation opportunities than environments within established companies. South African researchers Mutereko and Wedekind (2015) and Reinhard et al (2016) extend this concept and attribute the quality of students' work placement experience to entire industries. They suggest that South Africa industry might be unsuitable for work placement. These researchers present work placement learning environments as something that is offered by the placement companies which the universities and

their work placement students have no control over. As indicated earlier, this study found that the learning environment could be differentiated from the organisation in which the student was placed.

Contrary to previous studies, the findings of this study show that the quality of student work placement experience was influenced by attributes of either constraining or enabling learning environments that were present in a given case. For example, to facilitate learning, at least two attributes of enabling learning environments needed to be present. If additional attributes were present, it became more likely that student learning would be facilitated. The same could be said for constraining learning environments; only incidental learning would be available when all the four attributes were present. Thus, the ability of learning environments to facilitate learning was not the same in all cases. This variation in relative strength of the learning environments in relation to student factors and student actions is consistent with Bandura's (1988: 362) view that ‘reciprocity [within the triadic reciprocal causation model] does not mean that the different sources of influences are of equal strength’.

The findings do not support the interpretation of the learning environment as fixed, with a defined set of attributes. Students who were placed at the same placement company reported different experiences. In part, this is because experiences are `personally rather than universally defined’, which means that people interpret the experience of same activities and environments in different ways (Jonassen & Land, 2000: 5). However, this is also because of the individual-centred and interactive nature of work placement learning. In the workplace, work activities are assigned and sequenced based on individual students’ performance and their relationship with their industry mentors, which is different from how learning activities are assigned in

the classroom. In the classroom, students are taught by the same teacher, and they perform the same learning activities which are sequenced similarly for all of them.

The variation in reported experiences might be explained by the triadic reciprocal causation model, which asserts that there is a reciprocal influence between students' actions and their environments (Bandura, 1999). The students, acting through their collective constructional agency with their industry mentors, were able to influence the work activities that they performed, hence their learning environments (Bandura, 2005, 2006a). It is worth noting that the differences in work placement experiences which the students reported are consistent with the distinction between the experienced and imposed environments in social cognitive theory (Bandura, 2005). In this case, the imposed environments would be the same for all students placed at the same company. However, because of the interactions between the students and their environments, each student developed a particular experienced environment.

The findings suggest that it is plausible that the existence of enabling learning environments is possible in all placement companies, through collective agentic actions by all work placement role players. The students' self-reports suggest that they were not passive recipients of work placement experiences. The students' interactions with their industry mentors and co-workers shaped their work affordances, thereby shaping the nature of their learning environments. This finding confirms that students are co-creators with industry of their learning environments and not just passive recipients of knowledge and skills (Bandura, 1989).

7.3.2 The industry mentor as a manager of competing demands

Earlier studies such as Deketelaere et al (2006) in medical education; Knouse and Fontenot (2008) in business studies; Duke (2017) in social work, environmental sciences and geography education; Tener, Winstead and Smaglik (2001) in

construction engineering education and Kramer-Simpson (2018) in technical and professional communication education all focused on the role of the industry mentor. These studies described the role of the mentor as including the provision and structuring of work activities for students, protecting them from negative consequences of work errors, providing guidance and scaffolding, facilitating opportunities for exposure and introducing them to their networks. Further to this, some of these previous studies, such as Deketelaere et al (2006) and Carpenter and Blance (2007), acknowledge the existence of competing demands. They identified these competing demands as dualities, which according to Poole and Van de Ven (2011) implies that the situation could be managed by choosing one competing demand over another. It becomes clear when one examines competing demands regarding their contribution to student learning that this need to choose might not produce satisfactory outcomes.

In this study, the competing demands are framed as paradoxes. Lewis (2000: 760) defines a paradox as 'competing yet inter-related elements' and 'absurd and irrational when appearing simultaneously'. She explains that a paradox is a cognitive and social construction that indicates that something has oppositional yet interwoven tendencies. This study uncovered three competing demands as paradoxical: industry mentor as teacher versus work supervisor, working versus learning and access to meaningful work versus close guidance.

Firstly, the paradox of industry mentor as teacher and work supervisor is illustrated in the following example from the findings: if the industry mentors were to act as both teachers and work supervisors, the students would have positive work placement experiences. This seems absurd and irrational because as teachers, they are likely to prioritise student learning at the expense of productivity. In this study, industry

mentors as teachers provided their students with close guidance and structured activities, yet their students complained that their experiences were unauthentic. On the other hand, as work supervisors, they were likely to prioritise productivity at the expense of student learning. In this study, industry mentors as work supervisors provided their students with work as they would any other employee. In such cases, students reported being satisfied with the authenticity of their experiences but complained that their work-loads were overwhelming.

Secondly, the paradox of working versus learning is illustrated in the following example from the findings: in considering students who were placed in companies that had a structured internship program, it was expected that these students would believe that they benefited from such an arrangement. However, it was found that the students developed low self-efficacy and dissatisfaction with their experiences. They considered their experiences unauthentic and not representing the realities of the workplace (an example is that of Marianne in Chapter 4). It appears that by focusing on learning, these placement companies could 'foster[ed] opposite, unintended consequences' (Lewis, 2000: 763), thereby leading to student's low self-efficacy and dissatisfaction.

On the other hand, students who were assigned the same work as full-time employees without structuring and close guidance believed that they were being exploited. Their belief was reinforced by the inadequate quality of the afforded work – they were assigned less than technician-level work. Their belief corroborates the assertions by Mutereko and Wedekind (2015) that some companies use work placement students as 'cheap labour'.

Lastly, the paradox of access to meaningful work versus close guidance arose because the capacity to provide these two essential elements of students' work

placement experience did not usually reside in the same individual. The findings showed that access to meaningful work was associated with high-capacity mentors. As most of the high-capacity mentors were senior staff, they were often unable to provide the students with close guidance. On the other hand, low-capacity industry mentors provided students with close guidance but were not as successful in providing students with work opportunities beyond those that were available within their departments or workstations.

Lewis (2000) explains that the concept of a paradox provides a framework for understanding the contradictions arising from interwoven competing demands and for developing insights into how to manage them. In the instances presented in this study, there can be little doubt that both competing demands were necessary for successful student learning. For example, in the paradox of industry mentor as teacher versus work supervisor, the stance as teacher is necessary for structuring work and close guidance, whereas the stance as work supervisor is necessary for authenticity. The findings suggest that the situation would not be managed by choosing one competing demand over the other; both competing demands needed to be met.

Furthermore, the framing of the competing demands of work placement as paradox explains some of the findings of this study, such as the students' dissatisfaction with both structured and unstructured work affordances, that were not fully explainable by existing literature. Thus, by recognising the paradoxes, this study signals better ways of managing work placement's competing demands. The findings show that when the competing demands are managed in a sequence repeatedly, they provide authentic and more meaningful work placement experiences that do not compromise student learning. For example, if industry mentors function only as teachers when

required and as work supervisors for the rest of the time, both authenticity and guidance needs would be addressed. Schunk (2012) refers to this as scaffolding that was adapted to students' proficiency and contingent to their needs. This 'contingent scaffolding' is provided within the cognitive apprenticeship framework (Collins, Brown & Newman, 1987; Collins & Kapur, 2014) to ensure that both organisational and learning goals are satisfied. This way of managing paradox is consistent with what Lewis, Jarzabkowski and Langley (2017) describe as the 'and/both' approach.

The findings suggest that the 'and/both' approach enhances the meaningfulness of students' experiences, resulting in high student occupational competency and self-efficacy. The production agenda of the workplace, high-capacity mentors and the mentor as work supervisor provide the students with authentic work activities that are essential for mastery experiences which increase self-efficacy (Bandura, 1990). The paradoxes of the learning agenda of work placement, high-availability mentors and mentors as teachers provide the students with guidance, support and protection that enables them to continue to perform until they become proficient through proceduralisation (Anderson, 1981).

It is clear from the above that industry mentors are best placed to manage work placement paradoxes. This is because the association between the paradoxes, the industry mentors and meaningfulness of work experiences places industry mentors at the centre of successful work placement. This centrality of industry mentors' role in work placement is consistent with Agwa-Ejon and Pradhan (2017) and Kramer-Simpson (2018), who also situate them as key stakeholders that influence the quality of work placement learning. Therefore, this study concurs with Agwa-Ejon and Pradhan (2017) that industry mentors need to be trained to ensure that they execute their roles effectively.

7.3.3 Student characteristics

The findings suggest that student characteristics are the link between the affordances of the students' learning environments and how the students act in those environments. For instance, the study found that self-efficacy was the link between mastery experiences and proactive actions by the students. In accord with Bandura's (1994) assertion that mastery experiences are the most effective way of developing high self-efficacy, the study found that those who were offered mastery experiences developed high self-efficacy. The study also found that students with high self-efficacy tended to be more proactive in their solicitation of work and guidance than those with low self-efficacy. This finding was also consistent with Bandura's (1997) assertion that high self-efficacy increases students' motivation and agency.

Similarly, the findings which suggested an association between mastery experiences in the form of repeated performance and occupational competency were consistent with literature on proceduralisation (Anderson, 1981, 1982, 1985; Eraut, 1994). However, there were differences amongst students on the time required to develop occupational competency. Some reported that they believed that they would perform as full-time employees after 4 months; others thought it took much longer. The time it took for students to think they had become competent was influenced by many factors such as complexity of work, prior exposure to the work, interests, level of support received and so on. Jacobs (2015) and de Koker (2016) reported that South African employers believed that 12 months would be sufficient for the development of occupational competency. In this study, the term 'occupational competency' refers to possessing knowledge, skills and behaviours that are needed to meet the demands of a job (Le Deist & Winterton, 2005). The students were considered

occupationally competent if they reported performing mechanical technician level tasks.

The finding concerning work placement students' inability, in some environments, to exercise agency to effect change in their learning environments was unexpected. Given Bandura's (1989, 2006) elevation of the role that agency plays in effecting change in an individual's environment, it was expected that student's agency or at least the collective agency with their mentors would always manage to effect change in their learning environments. However, the findings demonstrated the contrary in constraining environments, with all four attributes present: the functioning of both students' agency and collective agency came to a stop. It could be said that the triadic reciprocal causation model stopped operating because of the unequal strength of one of the interacting factors. Although he does not explicitly state as much, Bandura (1999: 24) alludes to the possibility of this collapse of the triadic reciprocal causation model in stating 'personal agency operates within a broad network of sociostructural influence…The sociostructural practices... impose constraints and provide resources and opportunity structures for personal development and functioning'.

This apparent contradiction highlights the importance of having host companies and industry mentors who are thoroughly persuaded to participate in work placement. Prior to this study, literature had not explicitly discussed the dependency of students on their industry mentors nor discussed circumstances in which mentors were unwilling or unable to give effect to students' exercise of agency. It had been assumed that all stakeholders would be willing to facilitate students' learning during work placement. South African literature on work placement (for example, Jacobs (2015), Mutereko and Wedekind (2015) and Agwa-Ejon and Pradhan (2017)) had

alluded to the existence of placement companies that participate in work placement programs to secure ‘cheap labour’. These companies are more likely to create four-attribute constraining learning environments, particularly when the selected industry mentors are not fully convinced of the agenda of work placement.

Since industry mentors are vital to the success of work placement learning, it is prudent for universities to be involved in their selection and training. The researcher observed, particularly in large companies, that arrangements related to their placement were dealt with by their human resources departments. The students were then assigned to specific industry mentors by human resources practitioners. This practice contributed to some of the inadequate mentoring that was found. Ragins and Kram (2007) concur with this analysis and state that most effective mentoring arrangements are voluntary, driven by the mentors’ support and understanding of their benefits.

7.3.4 Student performance and participation as learning

The findings demonstrate that, during work placement, students learn through performance and participation. Although intertwined, these two modes of learning are different. Winch (2010) explains that in workplaces, people perform rule-governed activities, such as operating the lathe machine, and norm-governed activities such as customer etiquette.

Novices learn to perform the rule-governed activities through repetitive performance of the activities until the performance becomes tacit and autonomous. The initial performance is usually slow and error-prone, but as they repeatedly perform the same activities, the novices start to perform the activities better. Anderson (1981) referred to this process as proceduralisation. On the other hand, novices learn norm-governed activities through participation, which comprises learning through vicarious

experience and assisting experienced workers as they perform activities (Lave & Wenger, 1991).

Learning through participation is a crucial feature of both traditional and cognitive apprenticeship (Collins & Kapur, 2014). Lave and Wenger (1991) explain that the key feature of learning through participation is stepped access to activities. They explain that novices initially observe experienced practitioners as they perform an activity, later are allowed to perform a small portion of the activity, then progressively assigned more significant portions until they can perform the activities by themselves.

Most of the activities that the students in this study were exposed to were both rule-governed and norm-governed, leading to the intertwining of learning through performance and learning through participation. Therefore, it is not surprising that increased performance led to increased participation and vice-versa. As the students progressed to more active levels of participation, they were given more responsibility and more visible work. This process of enculturation into the work community was crucial for the nature of work that was afforded to the students. Students who successfully performed meaningful work were rewarded with more meaningful and more visible work. One student commented that she was given work that was visible to executive management. This finding is consistent with the work of Ben-Ari (2004) who found that as computer engineering students progressed through participation levels, they were given work that was crucial for their placement companies, such as modifying and uploading source code.

The findings suggest that for successful student learning, the students in this study required participation in several departments and at different levels in their placement companies, in addition to increased performance and participation in each

department. They were rotated amongst several engineering departments, the workshop, the drawing office and working with engineers. Most of the students indicated that it was only at the end of the rotation that they considered themselves occupationally competent.

This is the outcome of what French (1981) refers to as `the blurriness' of the occupational demarcations of roles of mechanical engineering technicians. They participate in engineering activities ranging from the upper limit of activities of artisans to the lower limit of those of engineers (French, 1981). Furthermore, this is consistent with Keller's (2012) assertion that rotating them among several departments or sites gives them more insight into the broad nature of a mechanical engineering technician's work career and enables them to be confident about their competency.

7.3.5 Quality of work affordances

The findings suggest that quality of work affordances is an outcome of interactions between the industry mentors, as represented by their posture, and the learning environments that were possible in a placement company. If industry mentors adopted the dual role of teacher and work supervisor, their students tended to be afforded meaningful work. On the other hand, if they adopted the singular role of either teacher or work supervisor, their students tended to be dissatisfied with the quality of their work affordances. It is worth noting that the prevailing learning environments moderated the influence of the mentors' role on the quality of work affordances.

Additionally, the findings suggest that the students' perception of the quality of their work affordances influenced their self-efficacy. When students believed that they were afforded authentic and meaningful work, they tended to have high self-efficacy.

In contrast, when the students believed that their assigned work did not represent the everyday work of mechanical engineering technicians, they tended to develop negative emotions and low self-efficacy. In a way, the students' perceptions of the quality of work affordance influenced their perceptions of their preparedness for work, which influenced their work self-efficacy.

This finding is consistent with that of Smith, Ferns and Russell (2019) who found that if students believed that the quality of work affordance was high, they believed that participating in work placement had enhanced their employability. However, this study also concurs with Smith, Ferns and Russell (2019) that students' definitions of high quality of work affordance were subjective.

Before continuing, there is a need to clarify how the term `work affordance' was used in this study. It was used to refer to opportunities to perform a particular work activity that was made available to the students. The students' judgement of the authenticity of their work affordances, quality of supervision received, and the meaningfulness and relevance of the work performed were influenced by their understanding of the work profile of a mechanical engineering technician. This idea of the subjectiveness of the definition of meaningfulness is consistent with the findings of Rayner and Theo (2015), who also found that meaningfulness was subjective, based on the students' understanding of what is authentic. For some students, this meant working in the mechanical workshops, fabricating things, and for others, it meant working in the CAD office or assisting engineers in the design of engineered products. Although these definitions of quality of work affordance are cognitive concepts, their outcomes were that those students who believed that their work affordances were of low quality tended to have low work self-efficacy; the opposite was also found to apply.

7.3.6 Student's agentic role in performance and participation

The findings suggest that students' agentic role influenced the quality of their work affordances and level of participation in the workplace. For instance, proactive students tended to be afforded more meaningful work and to receive more guidance than passive students, who tended to stagnate in both performance and participation; they were also invited to participate in more core activities of their work communities, such as joining high-profile projects than passive students.

Most of the students reported that their mentors were busy with their primary responsibilities. This would suggest that the mentors did not have time to determine their students' learning needs. If that happened, proactive students would have an advantage over passive students as they would make their needs known to their industry mentors. As the mentoring of work placement students was a secondary role for most industry mentors, students' articulation of their learning needs facilitated their mentors' functioning. This is consistent with the findings of Tovey (2007) and Sapp and Zhang (2009) that mentors expected their students to be proactive, to seek clarification if they did not understand something and to take charge of their learning.

Sapp and Zhang (2009) suggest another reason for industry mentors' preferential treatment of proactive students: they considered proactiveness to be an indication of initiative, an attribute that is valued in workplaces. In addition, Eraut (2004) explains that within the workplace, proactiveness is often seen as a sign of commitment, whether in experienced workers or new entrants to the work community. Unfortunately, this study cannot corroborate this finding because of its focus on the students' perspectives of their work placement experiences.

Other researchers have also recognised the importance of student proactiveness. In their study of work placement in nursing, Molloy et al (2014) found that proactive students have richer learning experiences as they can develop work networks beyond their mentors. This allows them to benefit from the knowledge of the broader work community instead of only their mentors. In their study of university-to-work transitions of engineering and business studies students, Ashforth, Sluss and Saks (2007) found that proactiveness influences the pace of integration into the work community and the pace of competency development.

7.3.7 Student learning trajectory

The findings suggest an association between student learning trajectories and students' beliefs about the quality of their work placement experiences. For instance, students who believed that they had inadequate work placement experiences attributed this to their perceived stagnation as transactional participants. As shown in Chapter Six, transactional participants performed what they believed to be non-technician-level tasks which benefited their placement companies more than they promoted student learning. These students believed that their host companies assumed that they were there to earn an income. This is consistent with the assertions by some researchers (Illeris, 2007; du Plessis, 2015; Mutereko & Wedekind, 2015) that some companies employ work placement students as a source of cheap labour. Lave and Wenger (1991: 76) maintained that students who are considered a source of cheap labour are `put to work in ways that deny them access to activities in the arenas of mature practice'.

However, the findings from this study suggest that it was not the use of students as 'cheap labour' that was a problem, but rather what they regarded as stagnation as transactional participants. In most cases, students initially accepted non-technician-

level positions with the expectation that they would be moved to technician-level positions once they had settled at their placement companies. In this case, the students' expectation is consistent with how guided performance is conceptualised in both traditional and cognitive apprenticeship (Brown, Collins & Duguid, 1989; Lave & Wenger, 1991; Collins & Kapur, 2014). In both traditional and cognitive apprenticeship, the preferred route is to start with low-skill activities and progress to more complex activities, depending on growing proficiency.

If students remain transactional throughout their work placements, their enculturation into the workplace community is compromised. Findings show that the non-technician-level positions that were given to students were semi-skilled artisan-level positions. These positions did not facilitate students' interactions with technicians and engineers, who were expected to lead in facilitating the students' learning.

Because of this perceived snub, some of them spoke of leaving the mechanical engineering sector altogether, indicating that stagnation potentially compromised identity formation as mechanical engineering practitioners. This is the most significant criticism that South African opponents of work placement make, that there are just too many companies that employ work placement students in low-level jobs which make work placement meaningless as a learning endeavour; the denial of access eliminates the possibility of learning from working alongside others (Lave & Wenger, 1991).

This study accepts that this practice of assigning students work that has minimal learning value compromises the viability of the workplace as a learning site.

The findings relating to participation highlight contestations that exist between social and cultural structure and students' agency (Teunissen, 2015). Since the students

were not mere recipients of participation invitations, their engagement with the workplace and their consequent learning trajectories depended in part on their agency and subjectivities. However, their proactiveness was influenced by their perceptions of the relatedness of the afforded work to their career aspirations and their preconceptions of mechanical engineering technicians' work. The findings showed that students were more proactive in work environments that fitted their conceptions of good mechanical engineering work. Regardless of the perceived cause of their attitude, proactive students tended to have upward performance and participation trajectories, whereas passive students tended to stagnate in both performance and participation.

7.4 How do social mechanisms within work placement environments operate to facilitate or hinder growth in students' occupational competency and self-efficacy?

Concerning the third research question, the findings suggest that growth or lack thereof of students' occupational competency and self-efficacy could be attributed to connections and interactions among work placement variables that formed a dynamic system with negative and positive reinforcing actions. Haraldsson (2004: 11) defines a system as 'a network of multiple variables that are connected through causal relationship and expresses some behaviour, which can only be characterised through observation as a whole'. Therefore, this study frames work placement as a qualitative systems dynamics model with negative and positive reinforcing loops. An enabling reinforcing feedback loop explained the growth of the students' occupational competency and self-efficacy, and a constraining reinforcing feedback loop explained how such growth was hindered.

The researcher is not aware of previous studies that found work placement outcomes as arising from interactions of variables that form a dynamic system. However, some previous studies presented student learning as an emergent outcome arising from dynamic interactions of variables present within a learning environment. For instance, Steenbeek and van Geert (2013: 234) describe learning-teaching trajectories as ‘an emergent and dynamic phenomenon resulting from the interactions in the entire educational context, in particular, the interaction between students and teachers.’

Koopmans (2019) explains that modelling learning as a systems dynamics model usually involves mathematic models or quantitative social network analysis. He further explains that the modelling assumes that the learning outcomes are emergent – they are system-level variables which arise from interactions of lower-level variables. As outcomes of a dynamic system, the outcomes of work placement possess a ‘radical novelty’ resulting from changes in the lower-level interactions among the variables (Koopmans, 2019). However, the modelling of work placement as a systems dynamics model in this study differs from most previous studies in that it was developed from qualitative data and qualitative analysis rather than from quantitative data. This approach of combining systems modelling and qualitative data analysis was developed by Yearworth and White (2013) who proposed and demonstrated the use of CAQDAS to develop a qualitative systems dynamics model using case studies from operations research. A similar approach was followed in this study, where causal associations among the various variables were uncovered using matrix coding and comparison diagrams (see analysis stage 5 in section 4.4.4).

The framing of work placement as a qualitative systems dynamics model in this study addresses the explanatory shortcomings of previous studies. An enabling

reinforcing feedback loop explains the growth of the students' occupational competency and self-efficacy, and a constraining reinforcing feedback loop explains how such growth was hindered. The qualitative systems dynamics model also explains how a student could move from a student learning trajectory where the work placement learning experience would be unsatisfactory to one that leads to an opposite outcome. For example, a student in work placement could shift from a constraining reinforcing feedback loop to an enabling reinforcing feedback loop or vice versa. This is consistent with Koopmans' (2019) assertion that qualitative systems dynamics models are suited to facilitating understanding of the impact of change in the variables on the outcomes of processes.

It must be noted that the framing of work placement as a qualitative systems dynamics model in this study does not mean that the pursuit of elements that make work placement effective is unimportant. It necessitates that these elements should not be pursued in isolation. All the elements of students' work placement experiences must be pursued together. This study is in agreement with previous researchers that high-quality industry mentorship (Papp, Markkanen & von Bonsdorff, 2003; Kramer & Usher, 2011), meaningful and broad scope of work (Nevison et al, 2017), students with a proactive attitude (Deketelaere et al, 2006) and enabling learning environments (Newton et al, 2010; Bisholt et al, 2014) are essential for work placement experiences that develop students' occupational competency and self-efficacy.

If universities are to develop efficacious work placement programmes, it is not enough to know the elements of students' work placement experiences that influence work placement outcomes. There is a need to understand how these elements dynamically interact to produce employability outcomes. There should be a

holistic focus on all elements and their interactions because a change in one element can cause changes in other elements, besides changing students' employability outcomes. This suggests that employability outcomes can be changed through structured interventions. Thus, if students report dissatisfaction with their work placement experiences, it is possible to address the challenges through structured interventions geared at shifting their experiences from constraining to enabling behaviour.

It is clear that the realisation that work placement is a qualitative systems dynamics model with emergent outcomes shifts focus away from looking for ideal work placement host companies (Zehr, 2016) or ideal durations of work placements (Smith, Ferns & Russell, 2019) to the structuring of students' work placement experiences (Snowden, 2018). This finding has significant implications on how work placements are practised. They show that enabling learning environments could be created in all workplaces if universities were to take appropriate steps to facilitate the development of enabling loops. This could be done by training industry mentors to perform dual roles as teachers and supervisors and by preparing their students to exercise agency during work placements.

7.5 Conclusion

In this chapter, the influence of the learning environment, the industry mentor, student performance and participation, quality of work affordances, student characteristics, student's agentic role and student learning trajectory on students' employability outcomes were discussed. These variables represent concepts that give a clearer picture of how mechanical engineering student perceive their work placement experiences and aspects of those experiences that are influential in their employability outcomes. In addition, the chapter shows how framing work placement

as a qualitative systems dynamics model with negative and positive reinforcing loops explains how work placement's employability outcomes are realised and shifts the focus of analysis of determinants of students' employability from individual variables of students' work placement experiences to interactions among a network of variables.

CHAPTER EIGHT
CONCLUSIONS AND RECOMMENDATIONS

8.1 Introduction

This study used a qualitative multi-case study approach to explore how mechanical engineering students' work placement experiences facilitate or hinder growth in their occupational competency and self-efficacy.

8.2 Summary of the answers to the research questions

Concerning the first research question, the students suggested that a combination of variables, rather than individual variables, was responsible for the quality of their work placement experience. They self-reported that circumstances where industry mentors and employees were too busy to dedicate time to offer them guidance, where appropriate mentors were not appointed, where they filled actual positions and where there was an overemphasis on learning made their work experiences unauthentic, which contributed to a negative work placement experience. On the other hand, circumstances where industry mentors were willing and could offer them meaningful work, where there was a balance between focusing on learning and focusing on production and where there was tolerance of work errors contributed to a positive work placement experience. In addition, the students recognised their contribution to the quality of their work placement experience, suggesting that their proactivity contributed to a positive work placement experience whereas student passivity hindered the development of positive work placement outcomes.

In relation to the second research question, this study suggests that the students 'growth in occupational competency and self-efficacy or lack thereof might be attributable to the learning environment, the industry mentor, quality of work

affordances, student characteristics, students' agentic disposition, student performance and participation and student learning trajectory. Students who believed they had had a positive work placement experience attributed this to enabling learning environments, high mentor capacity, high mentor availability, mentor as supervisor and teacher, meaningful and broad-scope work, high agency, proactively soliciting work and guidance, increasing participation and improving performance. On the other hand, students who believed they had had an inadequate work placement experience attributed this to constraining learning environments, low-capacity mentors, mentor as supervisor, mentor as teacher, narrow-scope work, low agency, passively waiting for work and guidance, stagnant performance and stagnant participation.

Concerning the third question, this study represented work placement as a qualitative systems dynamics model with negative and positive reinforcing loops. An enabling reinforcing feedback loop explained the growth of the students' occupational competency and self-efficacy, and a constraining reinforcing feedback loop explained how such growth was hindered. The enabling reinforcing feedback loop comprised high mentor capacity and availability, enabling learning environments, mentor as teacher and supervisor, high agency, increasing participation and improving performance, occupational competency and high self-efficacy. On the other hand, the constraining reinforcing feedback loop comprised low mentor capacity and availability, constraining learning environments, mentor as a work supervisor, low agency, increasing participation, improving performance, still-a-student and low self-efficacy.

8.3 The contribution of the study to knowledge

The purpose of this study was to explain how aspects of students' work placement experiences enhance or hinder the growth of student's occupational competency and self-efficacy. In pursuing this purpose, three aspects deepen understanding of the processes through which the employability outcomes of work placement are realised.

In this study, the framing of work placement as a dynamic system resolves the explanatory shortcomings of most previous studies on employability outcomes of work placement, particularly on how these employability outcomes are realised by accounting for the processes through which the outcomes are realised. The findings present occupational competency and self-efficacy as emergent outcomes of this dynamic social system, suggesting that they arise from interactions of the variables rather than being aggregates of the influences of individual elements. By doing this, the study provides a clear picture of the processes that produce the employability outcomes of work placement.

Secondly, this study differentiates the students' learning environments in work placements from the work environment. Most previous studies on work placement consider the students' learning environment to encompass the entire work environment. While equating the learning environment with the work environment can provide valuable insights on the pertinent elements of students' work placement experiences, it cannot sufficiently explain differences in the experiences of individual students placed in the same company. This study conceives of work placement learning environments as socially-created enabling learning environments or constraining learning environments, thus facilitating understanding of temporal changes in work placement learning environments and the factors that influence these dynamic changes.

Lastly, the data analysis methods presented in this study contribute to the use of multi-disciplinary, traditional qualitative research methods and other methods adapted from quantitative research as methods in work placement research. This study presents a unique way of combining theory-informed thematic analysis and causal loop diagramming to develop a dynamic social system that can explain the processes that produce work placement occupational outcomes. The use of social cognitive theory's triadic reciprocal model allowed the researcher to deduce the associations and interactions among the variables. Furthermore, the use of situated cognition theory complemented social cognitive theory in a manner that mitigated its shortcomings.

The theory-informed analysis of the qualitative data produced seven themes, each with several constituent subthemes. Further analysis uncovered associations between the various subthemes and themes. The adoption of causal loop diagramming enabled a clear picture of the processes that were at play to emerge, thereby facilitating the development of the work placement qualitative systems dynamics model. This approach of combining qualitative research methods and causal loop diagramming, a systems analysis tool, contributes to the use of multi-disciplinary methods in qualitative research, beyond the ones that are performed for triangulation purposes.

8.4 Implications of the study's findings for work placement practice

The findings have four significant implications for the preparation, monitoring and assessment of work placement.

Firstly, there is a need for focused preparations for work placement students and their industry mentors to enhance the quality of interactions between the two. Industry mentors are at the centre of most of the issues that were found in this study,

including the creation of enabling learning environments, provision of meaningful and broad-scope work, provision of close guidance and managing of work placement paradoxes. Some of these industry mentors' tasks were difficult to manage. It was found that if industry mentors were unable to accomplish these tasks, students' learning for employability was compromised. It is surprising that given the fundamental nature of the industry mentors' role, their effective functioning was fortuitous. All this suggests that to facilitate the effective functioning of industry mentors; it is necessary to prepare them for their roles, particularly those who will be mentoring work placement students for the first time.

Secondly, there is a need to deliberately prepare students for effective functioning in the workplace. Students need to be prepared to navigate and harness the social assessments of the work placement environments for effective learning. They need to be able to take charge of their learning during work placement by being proactive in soliciting meaningful work and guidance. This is crucial because the students need to adapt to the workplace environment, which is different from the university. At universities, structured teaching and learning tasks are provided for students, whereas the findings of this study suggest that industry mentors prefer that students take the initiative and inform them of what they want to be involved in.

Thirdly, there is need for work placement coordinators to create mechanisms for monitoring the trajectories of student participation in workplace activities. The study found that increasing participation in workplace activities coincided with increasing performance and vice-versa. For example, if work placement coordinators required the work placement students to report their involvement in work activities besides reporting the tasks that they have done, the coordinators would be able to monitor the trajectories of student participation in workplace activities.

Lastly, it is necessary to shift focus away from looking for ideal host companies or durations of work placement to creating structures that will facilitate the creation of enabling learning environments. The findings showed that enabling learning environments could be created in all workplaces if universities took appropriate steps to facilitate their creation. To ensure that this happens, universities need to dedicate resources to train work placement students and industry mentors on to relate to each other and how to exercise collective agency. For the students, universities need to train them in how to exercise agency to change their circumstances during work placements, The operation of enabling feedback loop shows that a student's agentic stance can influence to the quality of their work placement experience. For the industry mentors, universities need to train new industry mentors on how to function as both teachers and work supervisors since simultaneous execution of both functions is crucial for successful work placement.

8.5 Limitations of the study

In a study such as this one, there are many research designs and theoretical frameworks that would be adopted. Each choice of methodology and theoretical framework has its advantages but also imposes limitations on what is explainable by a study. For this study, the choice of a qualitative case study design and the theoretical framework that was facilitated the uncovering of rich and deep findings on the processes through which the occupational outcomes of occupational competency and self-efficacy are realised. However, it also imposed some limitations on what was explainable by the findings of the study.

The use of qualitative case study design imposed three limitations on the study. Firstly, because of its qualitative nature, the study could not make statistical generalisations about the associations among the various factors that were found in

the study. Secondly, the findings from the study are limited to the context and location described in this study. Thus, the findings are not automatically transferable to other contexts. Lastly, the study was bound to the duration specified. Therefore, it would not account for some characteristics, such as the students' identity formation, that might have formed outside the period under study.

In addition, the choice of social cognitive and situated cognition theories as the theoretical framework of the study limited the issues that would be explicitly explored in the study. The study would not explicitly explore the influence of some systemic factors would mediate factors identified in this study such as social and cultural capital, economic and political considerations, recruitment bias, and labour market demand.

These limitations do not imply that the interpretations of phenomena detailed in this study and the explanations thereof are not useful to other contexts. The study provided a thick description of its context, methods and participants. This would enable readers to judge similarities or differences with their contexts to allow them to judge whether the findings are transferable to their contexts (Merriam & Tisdell, 2016; Patton, 2015; Yin, 2018).

8.6 Recommendations for further research

The study makes the following recommendations on further research that would increase the understanding of work placement learning and advance how it is practised:

1. Further studies, possibly quantitative, could be undertaken to investigate the probability that specific causal paths within the work placement qualitative systems dynamics model could be followed if given variables were of particular

magnitudes. This would enable work placement practitioners such as work placement coordinators to predict the likely outcomes of their interventions.

2. This study recognises that the relationships between variables outlined in the findings and student employability would be could be mediated by student characteristics such as social and cultural capital and power and structural factors such as recruitment bias, political and economic factors among others (Jackson & Bridgstock, 2020), It would be beneficial if further studies would incorporate the influence of these mediating factors.
3. Further studies that focus on academic outcomes of work placement as the present study focused on occupational outcomes. Literature suggests that work placement also has academic outcomes. It would be valuable to find out if the social mechanisms and variables identified in this study also contribute to academic outcomes. If the variables that contribute to academic outcomes were arranged differently, it would be valuable to know which arrangements would optimise both outcomes.
4. Since most work placement studies on the academic outcomes of work placement are informed by activity theory and experiential learning theory, it would be valuable to know if the adoption of these commonly used theoretical lenses would influence the variables that were found to constitute the work placement qualitative systems dynamics model.
5. Lastly, the industry mentor emerged as a central figure in the functioning of work placement's dynamic system. It would be valuable if further research investigated the processes through which work placement produces its outcomes from the perspectives of industry mentors. Such a study would enhance understanding of some of the functions that this study suggests industry mentors perform.

REFERENCES

Agwa-Ejon, J.F. & Pradhan, A. 2017. The impact of work integrated learning on engineering education. *2017 IEEE Global Engineering Education Conference (EDUCON)*. 25-28 April 2017. Athens, Greece: IEEE. 1258–1265. DOI: 10.1109/EDUCON.2017.7943009.

Akins, T.M. 2005. A brief summary of cooperative education: history, philosophy, and current status. In *Educating the engineer of 2020 : adapting engineering education to the new century*. Washington: National Academies Press. 61–68. DOI: 10.17226/11338.

Almoayad, F.A.M. 2015. Learning during internship: Patient educator interns' experience of transition to workplace. Ph.D. Thesis. University of Leeds.

Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J. & Wittrock, M.C. Eds. 2001. *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York: Longman.

Anderson, J.R. 1981. *Acquisition of cognitive skill*.(Technical Report 81-1). Pittsburgh: Department of Psychology, Carnegie-Mellon University.

Anderson, J.R. 1982. Acquisition of cognitive skill. *Psychological Review*. 89(4):396–406. DOI: 10.1037/0033-295x.89.4.369.

Anderson, J.R. 1983. *The architecture of cognition*. New Jersey: Lawrence Erlbaum Associates Inc.

Anderson, J.R. 1985. *Skill acquisition: compilation of weak-method problem solutions*. (Technical Report ONR-85-1). Pittsburgh: Department of Psychology, Carnegie-Mellon University.

Anderson, J.R. 1987. *Skill Acquisition: Compilation of Weak-Method Problem Solutions*. *Psychological Review*. 94(2): 192–210. DOI: 10.1037/0033-295X.94.2.192.

Anderson, J.R., Reder, L.M. & Simon, H.A. 1996. Situated Learning and Education. *Educational Researcher*. 25(4):5. DOI: 10.2307/1176775.

Artess, J., Hooley, T. & Mellors-Bourne, R. 2017. *Employability: A review of the literature 2012 to 2016*. York: Higher Education Academy.

Ashforth, B.E., Sluss, D.M. & Saks, A.M. 2007. Socialization tactics, proactive behavior, and newcomer learning: Integrating socialization models. *Journal of Vocational Behavior*. 70(3):447–462. DOI: 10.1016/j.jvb.2007.02.001.

Baker, S.E. & R. Edwards, R. Eds . 2012. How many qualitative interviews is enough? National Center for Research Methods. 1–42. Available: http://eprints.ncrm.ac.uk/2273/4/how_many_interviews.pdf [2019, September 24].

Bandura, A. 1977a. *Social learning theory*. Englewood Cliffs: Prentice Hall.

Bandura, A. 1977b. Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review*. 84(2):191–215. DOI: 10.1037/0033-295X.84.2.191.

Bandura, A. 1982. Self-efficacy mechanism in human agency. *American Psychologist*. 37(2):122–147. DOI: 10.1037/0003-066X.37.2.122.

Bandura, A. 1983. Temporal dynamics and decomposition of reciprocal determinism: a reply to Phillips and Orton. *Psychological Review*. 90(2):166–170. DOI:

10.1037/0033-295X.90.2.166.
Bandura, A. 1986. *Social foundations of thought and action*. Englewood Cliffs: Prentice Hall.
Bandura, A. 1988. Organisational applications of social cognitive theory. *Australian Journal of Management*. 13(2):275–302. DOI: 10.1177/031289628801300210.
Bandura, A. 1989. Human agency in social cognitive theory. *American Psychologist*. 44(9):1175–1184. DOI: 10.1037/0003-066X.44.9.1175.
Bandura, A. 1990. Perceived self-efficacy in the exercise of personal agency. *Journal of Applied Sport Psychology*. 2(2):128–163. DOI: 10.1080/10413209008406426.
Bandura, A. 1994. Self-efficacy. In *Encyclopedia of human behavior*. V. S. Ramachaudran, Ed. New York: Academic Press. 71-81.
Bandura, A. 1997. *Self efficacy: the exercise of control*. New York: WH Freedman and Company.
Bandura, A. 1999. Social cognitive theory: An agentic perspective. *Asian Journal of Social Psychology*. 2(1):21–41. DOI: 10.1111/1467-839X.00024.
Bandura, A. 2001a. Social cognitive theory of mass communication. *Media Psychology*. 3(3):265–299. DOI: 10.1207/S1532785XMEP0303_03.
Bandura, A. 2001b. Social cognitive theory: An agentic perspective. *Annual Review of Psychology*. 52(1):1–26. DOI: 10.1146/annurev.psych.52.1.1.
Bandura, A. 2005. The evolution of social cognitive theory. In *Great minds in management: the process of theory development*. K.G. Smith & M.A. Hitt, Eds. Oxford: Oxford University Press. 9–35.
Bandura, A. 2006a. Toward a psychology of human agency. *Perspectives on Psychological Science*. 1(2):164–180. DOI: 10.1111/j.1745-6916.2006.00011.x.
Bandura, A. 2006b. Guide for constructing self-efficacy scales. *Self-efficacy beliefs of adolescents*. 307–337. DOI: 10.1017/CBO9781107415324.004.
Bandura, A., Barbaranelli, C., Caprara, G.V. & Pastorelli, C. 2001. Self-efficacy beliefs as shapers of children's aspirations and career trajectories. *Child Development*. 72(1):187–206. DOI: 10.1111/1467-8624.00273.
Bates, M., Thompson, C. & Bates, L. 2013. Not all dimensions of work self-efficacy are equal: Understanding the role of tertiary work placements in the development of the elements of work self-efficacy. *Journal of Cooperative Education and Internships*. 47(1):19–30.
Bazeley, P. 2013. *Qualitative data analysis : practical strategies*.1st ed. Los Angeles: SAGE.
Bazeley, P. & Jackson, K. 2013. *Qualitative data analysis with NVivo*. 2nd ed. Los Angeles: SAGE.
Ben-Ari, M. 2004. Situated Learning in Computer Science Education. *Computer Science Education*. 14(2):85–100. DOI: 10.1080/08993400412331363823.
Berg, S. & Broekhuizen, H. Van. 2012. *Graduate unemployment in South Africa : A much exaggerated problem*. (22). Cape Town. Available: https://ideas.repec.org/p/sza/wpaper/wpapers175.html [2017, December 18].
Bernstein, B. 1999. Vertical and horizontal discourse: an essay. *British Journal of Sociology of Education*. 20(2): 157-173. DOI: 10.1080/01425699995380.
Billett, S. 1996. Towards a model of workplace learning: the learning curriculum.

Studies in Continuing Education. 18(1):43–58. DOI: 10.1080/0158037960180103.
Billett, S. 2002. Toward a workplace pedagogy: guidance, participation, and engagement. *Adult Education Quarterly*. 53(1):27–43. DOI: 10.1177/074171302237202.
Bisholt, B., Ohlsson, U., Engström, A.K., Johansson, A.S. & Gustafsson, M. 2014. Nursing students' assessment of the learning environment in different clinical settings. *Nurse Education in Practice*. 14(3):304–310. DOI: 10.1016/j.nepr.2013.11.005.
Bonwell, C. & Eison, J. 1991. *Active Learning: creating excitement in the classroom*. (ASHE-ERIC Higher Education Report No. 1). Washington: School of Education and Human Development, George Washington University.
Boud, D., Keogh, R. & Walker, D. 1985. *Reflection: turning experience into learning*. 1st ed. Abingdon: Routledge.
Brooks, R. & Youngson, P.L. 2016. Undergraduate work placements: an analysis of the effects on career progression. *Studies in Higher Education*. 41(9):1563–1578.
Brown, J.S., Collins, A. & Duguid, P. 1989. Situated cognition and the culture of learning. *Educational Researcher*. 18(1):32–42.
Bryman, A. 2012. *Social research methods*. 4th ed. Ontario: Oxford University Press.
Bryman, A. 2016. *Social research methods*. 5th ed. Oxford: Oxford University Press.
Burke, L., Marks-Maran, D.J., Ooms, A., Webb, M. & Cooper, D. 2009. Towards a pedagogy of work-based learning: perceptions of work-based learning in foundation degrees. *Journal of Vocational Education and Training*. 61(1):15–33. DOI: 10.1080/13636820902819917.
Cantalini-Williams, M. 2015. Teacher candidates' experiences in non-traditional practicum placements: developing dimensions for innovative work-integrated learning Models. In *The complexity of hiring, supporting, and retaining new teachers across Canada*. 1st ed. N. Maynes & B.E. Hatt, Eds. Ottawa: Canadian Association for Teacher Education (CATE). 81–90.
Carpenter, L. & Blance, B. 2007. Teaching internships and the learning community. In *Handbook of teacher education: Globalization, standards and professionalism in times of change*. 1st ed. T. Townsend & R. Bates, Eds. Dordrecht: Springer Netherlands. 301–314. DOI: 10.1007/1-4020-4773-8_10.
Council on Higher Education. 2011. *Work-integrated learning: good practice guide*. Pretoria: Council on Higher Education.
Cianciolo, A., Matthew, C., Sternberg, R. & Wagner, R. 2006. Tacit knowledge, practical intelligence, and expertise. In *The Cambridge Handbook of Expertise and Expert Performance*. 2nd ed. K.A. Ericsson, R.R. Hoffman, A. Kozbelt, & A.M. Williams, Eds. Cambridge: Cambridge University Press. 613.
Coll, R.K. & Kalnins, T. 2009. A critical analysis of interpretative research studies in cooperative education and internships. *Journal of Cooperative Education*. 43(1):1–13.
Coll, R.K., Eames, C., Paku, L., Lay, M., Hodges, D., Bhat, R., Ram, S., Ayling, D., et al. 2009. An exploration of the pedagogies employed to integrate knowledge in work-integrated learning. *Journal of Co-operative Education and Internship*,

43(1): 14-35.
Colley, H., Hodkinson, P. & Malcom, J. 2003. *Informality and formality in learning: a report for the Learning and Skills Research Centre*. Leeds. DOI: 10.1016/S0022-5371(81)90483-7.
Collins, A. & Kapur, M. 2014. Cognitive apprenticeship. In *The Cambridge Handbook of the Learning Sciences*. 2nd ed. R. Keith Sawyer, Ed. New York: Cambridge University Press. 109–127.
Collins, A., Brown, J.S. & Newman, S. 1987. *Cognitive apprenticeship: teaching and craft of reading, writing and mathematics*. (Technical Report No. 403). Champaign: Centre for the Study of Reading, University of Illinois.
Collins, A., Brown, J.S. & Holum, A. 1991. Cognitive apprenticeship: making thinking visible. *American Educator*. 15(3):6–11, 38–46.
Constantinou, C.S., Georgiou, M. & Perdikogianni, M. 2017. A comparative method for themes saturation (CoMeTS) in qualitative interviews. *Qualitative Research*. 17(5):571–588. DOI: 10.1177/1468794116686650.
Cook, K.E. 2012. In-depth interview. In *The SAGE Encyclopedia of Qualitative Research Method*. L.M. Given, Ed. Thousand Oaks: SAGE. 423.
Cooper, L., Orrell, J. & Bowden, M. 2010. *Work integrated learning : a guide to effective practice*. 1st ed. New York: Routledge.
Cope, P., Cuthbertson, P. & Stoddart, B. 2000. Situated learning in the practice placement. *Journal of Advanced Nursing*. 31(4):850–856. DOI: 10.1046/j.1365-2648.2000.01343.x.
D'Almaine, F.G., Manhire, B. & Atteh, S.O. 1997. Engineering education at South Africa's Technikons. *The Journal of Negro Education*. 66(4):434–442.
Le Deist, F.D. & Winterton, J. 2005. What is competence? *Human Resource Development International*. 8(1):27–46. DOI: 10.1080/1367886042000338227.
Deketelaere, A., Kelchtermans, G., Struyf, E. & De Leyn, P. 2006. Disentangling clinical learning experiences: an exploratory study on the dynamic tensions in internship. *Medical Education*. 40(9):908–915. DOI: 10.1111/j.1365-2929.2006.02551.x.
De Koker, J. 2016. A new engineering qualification replacing the BTech degree. *SAICE Civil Engineering*. (June):68–69.
Department of Higher Education and Training. 2015. *Statistics on post-school education and training in South Africa: 2015*. Pretoria: Department of Higher Education and Training.
Difrancesco, P. 2011. The role of situated learning in experiential education: An ethnographic study of the knowledge construction process of pharmany students during clinical rotations. University of Massachusetts Boston.
Department of Education. 1997. *General policy for Technikon instructional programmes.*(Report 150-97/01). Pretoria, South Africa: Higher Education Branch, Department of Education.
Department of Education. 2005. *Education statistics in South Africa at a glance in 2004*. Pretoria, South Africa: Department of Education.
Duke, B. 2017. Student learning through work placements. Ph.D. Thesis. University of Keele.
Du Plessis, J.G.E. 2015. A work-integrated learning education and training

programme for radiography in South Africa. Ph.D. Thesis. University of Free State.
Du Pre, R. 2006. The philosophy of a University of Technology in South Africa: an introduction. *Kagisano*. (5):1–59.
Du Pre, R. 2013. *Hitting the ground running: Work-integrated learning and skills development in South Africa*. (No. 6). Ravensburg: Duale Hochschule Baden-Württemberg. Available: http://www.ravensburg.dhbw.de/fileadmin/Ravensburg/Dokumente_Bilder_Contentbereich/International_Business/DHBW_RV_IB_IBE_6_neu_Hitting_the_Ground.pdf [2017, December 19].
Eames, C. & Cates, C. 2011. Theories of learnig in cooperative and work-integrated education. In *International Handbook for Cooperative & Work-Integrated Education*. 2nd ed. R.K. Coll & K.E. Zegwaard, Eds. World Association for Cooperative Education Inc. 41–52.
Easterby-Smith, M., Thorpe, R. & Jackson, P.R. 2015. *Management and business research*. 5th ed. London: SAGE.
Engineering Council of South Africa. 2009. *Implementing engineering qualifications under the HEQF*. Johannesburg, South Africa: Engineering Council of South Africa. Available: https://www.ecsa.co.za/education/EducationDocs/SPS_ECSA_HEQF.pdf [2017, December 20].
Engineering Council of South Africa. 2015. *Qualification standard for Diploma in Engineering: NQF Level 6*. (Document: E-02-PN, Revision No.: 3). Johannesburg, South Africa: Engineering Council of South Africa. Available: https://www.ecsa.co.za/education/EducationDocs/E-02-PN.pdf [2017, December 21].
Engineering Council of South Africa. 2016. *Qualification standard for Diploma in Engineering Technology: NQF Level 6*. (Document:E-08-PN). Johannesburg, South Africa: Engineering Council of South Africa. Available: https://www.ecsa.co.za/education/EducationDocs/E-08-PN.pdf [2017, December 21].
Engineering Council of South Africa. 2019a. *Engineering qualifications in the Higher Education Qualifications Sub-framework*. (Document: E-23-P, Revision No.: 1). Johannesburg, South Africa: Engineering Council of South Africa. Available: https://www.ecsa.co.za/education/EducationDocs/E-23-P%20Enginnering%20Qualifications%20in%20the%20Higher%20Education%20Qualifications.pdf [2020, July 20].
Engineering Council of South Africa. 2019b. *Qualification standard for Diploma in Engineering Technology: NQF Level 6*. (Document: E-02-PN, Revision No.: 4). Johannesburg, South Africa: Engineering Council of South Africa. Available: https://www.ecsa.co.za/ECSADocuments/Shared%20Documents/E-02-PN%20Qualification%20Standard%20for%20Diploma%20in%20Engineering%20NQF%20Level%206.pdf [2020, July 20].
Edwards, M. 2014. The impact of placements on students' self-efficacy. *Higher Education, Skills and Work-Based Learning*. 4(3):228–241. DOI: 10.1108/HESWBL-05-2014-0015.
Edwards, D., Perkins, K., Pearce, J. & Hong, J. 2015. Work integrated learning in

STEM in Australian universities. (Final Report Submitted to the Office of the Chief Scientist). Australian Council for Educational Research. Available: https://research.acer.edu.au/cgi/viewcontent.cgi?article=1046&context=higher_education [2016, June 9].

Engestrom, Y. 2014. *Learning by expanding : an activity-theoretical approach to developmental research*. 2nd ed. Cambridge: Cambridge University Press. DOI: 10.1017/CBO9781139814744.

Engeström, Y. 2001. Expansive Learning at Work: toward an activity theoretical reconceptualization. *Journal of Education and Work*. 14(1):133–156. DOI: 10.1080/13639080123238.

Engeström, Y., Miettinen, R. & Punamäki-Gitai, R.-L. 1999. *Perspectives on Activity Theory*. V. 24. DOI: 10.2307/259146.

Erasmus, A. 2008. Research at Technikons: The journey from apprenticeship training to technological degreees. Ph.D. Thesis. University of Stellenbosh.

Eraut, M. 1994. *Developing Professional Knowledge and Competence*. 1st ed. London: Falmer Press.

Eraut, M. 2000. Non-formal learning and tacit knowledge in professional work. *British Journal of Educational Psychology*. 70:113–136.

Eraut, M. 2004a. Transfer of knowledge between education and workplace settings. In *Workplace Learning in Context*. 1st ed. H. Rainbird, A. Fuller, & A. Munro, Eds. London: Routledge. 201–221.

Eraut, M. 2004b. Informal learning in the workplace. *Studies in Continuing Education*. 26(2):247–273. DOI: 10.1080/158037042000225245.

Feist, J. & Feist, G.J. 2008. *Theories of personality*. 7th ed. New York: McGraw-Hill.

Franz, J. 2008. A pedagogical model of higher education / industry engagement for enhancing employability and professional practice. In *Proceedings Work Integrated Learning (WIL): Transforming Futures, Practice...Pedagogy…Partnerships*. Manly, Sydney, Australia. 164–169.

French, H.. 1981. *Engineering technicians: Some problems of nomenclature and classification*. 1st ed. Paris: UNESCO. Available: http://www.bls.gov/oco/ocos112.htm [2019, June 16].

Gericke, M.. 1997. *History of legislation for the registration of Professional Engineers in the Republic of South Africa: Period 1890 to 1968*. Johannesburg: Engineering Council of South Africa. Available: https://www.ecsa.co.za/about/pdfs/Period_1890_to_1968.pdf [2017, December 13].

Gibson, S.K. 2004. Social learning (cognitive) theory and implications for human resource development. *Advances in Developing Human Resources*. 6(2):193–210. DOI: 10.1177/1523422304263429.

Glaser, R. 1989. Expertise and learning: how do we think about instructional processes now that we have discovered knowledge structures? In *Complex information systems: the impact of Herbert A. Simon*. D. Klahr & K. Kotovsky, Eds. Hillsdale: Lawrence Erlbaum Associates Inc. 269–278.

Gordon, S.E. 1992. Implications of cognitive theory for knowledge ccquisition. In *The psychology of expertise: cognitive research and empirical AI*. 1st ed. R.R. Hoffman, Ed. New York: Springer. 99–120.

Grusec, J.E. 1992. Social learning theory and developmental psychology: the legacies of Robert Sears and Albert Bandura. *Developmental Psychology*. 28(2):776–786.
Guba, E.G. & Lincoln, Y.S. 1989. Judging the quality of fourth generation evaluation. *Fourth generation evaluation*. 228–251. DOI: 10.1201/b10190-10.
Guest, B.G., Namey, E.E. & Mitchell, M.L. 2017. In-depth interviews. In *Collecting qualitative data: a field manual for applied research*. London: SAGE. 113–171.
Guile, D. & Griffiths, T. 2001. Learning Through Work Experience. *Journal of Education and Work*. 14(1):113–131. DOI: 10.1080/13639080020028738.
Haddara, M. & Skanes, H. 2007. A reflection on cooperative education: from experience to experiential learning. *Asia-Pacific Journal of Cooperative Education*. 8(1):67–76.
Haraldsson, H.V. 2004. *Introduction to system thinking and causal loop diagrams*. (Report 1:2004). Lund: Department of Chemical Engineering, Lund University.
Harris, C. 1974. 1974 Presidential address: The institution and the profession in a changing society. *Transactions of the South African Institution of Civil Engineers*. 16:123–130.
Harvey, L., Geall, V. & Moon, S. 1998. *Work experience: expanding opportuntities for undergraduates*. Birmingham.
Hergenhahn, B.R. & Olson, M.H. 2001. *An introduction to theories of learning*. 6th ed. New Jersey: Prentice Hall.
Higher Education Quality Council of Ontario. 2016. *A practical guide for work-integrated learning*. Ontario: Higher Education Quality Council of Ontario. Available: http://www.heqco.ca/SiteCollectionDocuments/HEQCO_WIL_Guide_ENG_ACC.pdf [2016, July 8].
Holland, D. & Lave, J. 2009. Social practice theory and the historical production of persons. Actio : an international journal of human activity theory. (2):1–15. Available: http://ci.nii.ac.jp/naid/120005687500/en/ [2020, July 17].
Illeris, K. 2007. *How we learn: learning and non-learning in school and beyond*. 1st ed. New York: Routledge.
Illeris, K. 2010. *The fundamentals of workplace learning*. 1st ed. New York: Routledge.
Irwin, A., Nordmann, E. & Simms, K. 2019. Stakeholder perception of student employability : does the duration , type and location of work experience matter ? *Higher Education*. 1–21. DOI: 10.1007/s10734-019-00369-5.
Jackson, D. 2014. Testing a model of undergraduate competence in employability skills and its implications for stakeholders. *Journal of Education and Work*. 27(2):220–242. DOI: 10.1080/13639080.2012.718750.
Jackson, D. 2017. Developing pre-professional identity in undergraduates through work-integrated learning. *Higher Education*. 74(5):833–853. DOI: 10.1007/s10734-016-0080-2.
Jackson, D. & Collings, D. 2018. The influence of Work-Integrated Learning and paid work during studies on graduate employment and underemployment. *Higher Education*. 76(3):403–425. DOI: 10.1007/s10734-017-0216-z.
Jackson, D. & Bridgstock, R. 2020. What actually works to enhance graduate

employability? The relative value of curricular, co-curricular, and extra-curricular learning and paid work. *Higher Education*. DOI: 10.1007/s10734-020-00570-x.

Jacobs, H.S. 2015. A strategy to optimise the contribution of work integrated learning towards the employability of students of the Central University of Technology, Free State.Ph.D. Thesis. Central University of Technology, Free State.

Jarvis, P. & Parker, S. Eds. 2005. *human learning: an holistic approach*. 1st ed. London: Routledge.

Jarvis, P., Holford, J. & Griffin, C. 2003. *The theory and practice of learning*. 2nd ed. London: Taylor & Francis.

Johri, A. & Olds, B.M. 2011. Situated Engineering Learning: Bridging Engineering Education Research and the Learning Sciences. Journal of Engineering Education. 100(1):151–185. DOI: 10.1002/j.2168-9830.2011.tb00007.x.

Jonassen, D.H. & Land, S.M. Eds. 2000. *theoretical foundations of learning environments*. 1st ed. New Jersey: Lawrence Erlbaum Associates Inc.

Joubert, M. 2017. Social work students' perceptions of readiness to practice: a mixed methods approach. Ph.D. Thesis. Sheffield Hallam University.

Karalis, T. 2010. Situated and transformative learning: exploring the potential of critical reflection to enhance organizational knowledge. *Development and Learning in Organizations: An International Journal*. 24(1):17–20. DOI: 10.1108/14777281011010479.

Keleher, P., Patil, A. & Harreveld, R.E. Eds. 2011. *Work-integrated learning in engineering, built environment and technology: diversity of practice in practice*. 1st ed. Hershey: Information Science Reference.

Keller, K.D. 2012. Examining internships as a high-impact educational practice. Ph.D. Thesis. Kansas State University.

Kerka, S. 1997. Constructivism: a matter of interpretation. *ERIC Digest*. (181):1–7.

Kloot, B. & Rouvrais, S. 2017. The South African engineering education model with a European perspective: history, analogies, transformations and challenges. *European Journal of Engineering Education*. 42(2):188–202. DOI: 10.1080/03043797.2016.1263278.

Knouse, S.B. & Fontenot, G. 2008. Benefits of the business college internship: a research review. *Journal of Employment Counseling*. 45(2):61–66. DOI: 10.1002/j.2161-1920.2008.tb00045.x.

Kolb, D.A. 2015. *Experiential Learning: Experience as the Source of Learning and Development*. 2nd ed. Upper Saddle River: Pearson Education.

Koopmans, M. 2019. Education is a complex dynamical system: challenges for research. *Journal of Experimental Education*. 0(0):1–17. DOI: 10.1080/00220973.2019.1566199.

Kopsidas, K., Pampaka, M. & Knowles, S. 2013. Students' perceptions of the "with industrial experience" degree pathway in electrical and electronic engineering. *International Journal of Electrical Engineering Education*. 50(3). DOI: 10.7227/IJEEE.50.3.2.

Kramer-Simpson, E. 2018. Moving from student to professional: industry mentors and academic internship coordinators supporting intern learning in the workplace. *Journal of Technical Writing and Communication*. 48(1):81–103.

DOI: 10.1177/0047281616646753.
Kramer, M. & Usher, A. 2011. *Work-integrated learning and career-ready students : examining the evidence*. (Higher Education Strategy Associates Intelligence Brief 5). Toronto: Higher Education Strategy Associates.
Krefting, L. 1991. Rigor in qualitative research: the assessment of trustworthiness. *American Journal of Occupational Therapy*. 45(3):214–222. DOI: 10.5014/ajot.45.3.214.
Kruger, A.M. 1991. *The history of the South African Council for Professional Engineers: 1968-1991 by*. Johannesburg: Engineering Council of South Africa. Available: https://www.ecsa.co.za/about/pdfs/Period_1968_to_1991.pdf [2017, December 13].
Kvale, S. 2007. *Doing interviews*. 1st ed. London: SAGE. DOI: 10.4135/9781849208963.
Lave, J. & Wenger, E. 1991. *Situated learning: legitimate peripheral participation*. 1st ed. Cambridge: Cambridge University Press.
Lewis, M.W. 2000. Exploring paradox: toward a more comprehensive guide. *Academy of Management Review*. 25(4):760–776. DOI: 10.5465/amr.2000.3707712.
Lewis, M., Holtzhausen, N. & Taylor, S. 2010. The dilemma of work-integrated learning (WIL) in South African higher education – the case of Town and Regional Planning at the University of Johannesburg. *Stads- en Streeksbeplanning = Town and Regional Planning*. (27):25–35.
Li, L.C., Grimshaw, J.M., Nielsen, C., Judd, M., Coyte, P.C. & Graham, I.D. 2009. Evolution of Wenger's concept of community of practice. *Implementation Science*. 4(1):11. DOI: 10.1186/1748-5908-4-11.
Lincoln, Y.S. & Guba, E.G. 1985. Establishing trustworthiness. In *Naturalistic inquiry*. 1st ed. London: SAGE. 289–327. DOI: 10.1177/1473325006070288.
Lincoln, Y.S. & Guba, E.G. 1986. But is it rigorous? trustworthiness and authenticity in naturalistic evaluation. In *Naturalistic evaluation*. D. Williams, Ed. San Francisco: Jossey-Bass.
Lincoln, Y.S. & Guba, E.G. 2013. *The Constructivist credo*. 1st ed. Walnut Creek: Left Coast Press Inc.
Linn, P.L. 2004. Theories about learning and development in cooperative education and internships. In *Handbook for research in cooperative education and internships*. 1st ed. P.L. Linn, A. Howard, & E. Miller, Eds. New Jersey: Lawrence Erlbaum Associates Inc. 11–28.
Little, B. & Harvey, L. 2006. *Learning through work placements and beyond*. (A report for HECSU and the Higher Education Academy's Work Placements Organisation Forum). London: Higher Education Academy.
Lock, G., Bullock, K., Gould, V. & Hejmadi, M. 2009. Exploring the industrial placement experience for mechanical engineering undergraduates. *Engineering Education*. 4(1):42–51. DOI: 10.11120/ened.2009.04010042.
Markauskaite, L. & Patton, N. 2019. Learning for Employability in the Workplace. In Education for Employability (Volume 2). 1st ed. J. Higgs, W. Letts, & G. Crisp, Eds. Rotterdam: Brill Sense. 227–236. DOI: 10.1163/9789004418707_019.
Marsick, V.J. & Watkins, K.E. 2015. *Informal and incidental learning in the workplace*

(Routledge Revivals). 1st ed. London: Routledge. DOI: 10.4324/9781315715926.
Mason, J. 2002. *Qualitative researching*. 2nd ed. Thousand Oaks: SAGE. DOI: 10.2307/591613.
Maxwell, J.A. 2013. *Qualitative research design: an interactive approach*. 3rd ed. Thousand Oaks: SAGE.
Merriam, S. 2009. *Qualitative research: a guide to design and implementation*. 2nd ed. San Francisco: Jossey-Bass.
Merriam, S. & Tisdell, E.J. 2016. *Qualitative research: a guide to design and implementation*. 4th ed. San Francisco: Jossey-Bass.
Mezirow, J. 1991. *Transformative dimensions of adult learning*. 1st ed. San Francisco: Jossey-Bass.
Middleton, L., Hall, H. & Raeside, R. 2018. Applications and applicability of social cognitive theory in information science research. *Journal of Librarianship and Information Science*. 51(4): 927-937. DOI: 10.1177/0961000618769985.
Miles, M.B., Huberman, A.M. & Saldana, J. 2014. *Qualitative data analysis: a methods sourcebook*. 3rd ed. Los Angeles: SAGE.
Mncayi, P. 2016. The determinants of employment status of young graduates from a South African university. M.Com. Dissertation. North-West University.
Mncayi, P. & Dunga, S.H. 2016. Career choice and unemployment length: a study of graduates from a South African university. *Industry and Higher Education*. 30(6):413–423. DOI: 10.1177/0950422216670500.
Molloy, E.K., Greenstock, L., Fiddes, P., Fraser, C. & Brooks, P. 2014. Interprofessional education in the health workplace. In *International Handbook of Research in Professional and Practice-based Learning*. S. Billett, C. Harteis, & H. Gruber, Eds. Dordrecht: Springer Netherlands. 535–559. DOI: 10.1007/978-94-017-8902-8_20.
Mutereko, S. & Wedekind, V. 2015. Work integrated learning for engineering qualifications : a spanner in the works ? *Journal of Education and Work*. 9080:1–21. DOI: 10.1080/13639080.2015.1102211.
Nevison, C., Drewery, D., Pretti, J., Cormier, L., Nevison, C. & Drewery, D. 2017. Using learning environments to create meaningful work for co-op students co-op students. *Higher Education Research & Development*. 36(4):807–822. DOI: 10.1080/07294360.2016.1229268.
Newman, I. & Benz, C.R. 1998. *Qualitative-quantitative research methodology : exploring the interactive continuum*. 1st ed. Carbondale and Edwardsville: Southern Illinois University Press.
Newton, J.M., Jolly, B.C., Ockerby, C.M. & Cross, W.M. 2010. Clinical learning environment inventory: factor analysis. *Journal of Advanced Nursing*. 66(6):1371–1381. DOI: 10.1111/j.1365-2648.2010.05303.x.
Niccolai, L.M., Hansen, C.E., Credle, M. & Shapiro, E.D. 2016. Parents' recall and reflections on experiences related to HPV vaccination for their children. *Qualitative Health Research*. 26(6):842–850. DOI: 10.1177/1049732315575712.
Olson, M.H. & Hergenhahn, B.R. 2013. *An introduction to theories of learning*. 9th ed. New York: Routledge.

Ormrod, J.E. 2012. *Human learning*. 6th ed. New Jersey: Pearson Education.
Ormrod, J.E. 2016. *Human Learning*. 7th ed. Boston: Pearson Education.
Papp, I., Markkanen, M. & von Bonsdorff, M. 2003. Clinical environment as a learning environment: student nurses' perceptions concerning clinical learning experiences. *Nurse Education Today*. 23(4):262–268. DOI: 10.1016/S0260-6917(02)00185-5.
Parlett, M. & Hamilton, D. 1972. *Evaluation as illumination: a new approach to the study of innovatory programs*. (ED 167 634). Edinburgh: Centre for Research into Educational Sciences, Edinburgh University.
Patrick, C., Peach, D., Pocknee, C., Webb, Wf., Fletcher, M. & Pretto, G. 2008. *The WIL [Work Integrated Learning] report: a national scoping study.* (Australian Learning and Teaching Council (ALTC) Final Report). Brisbane: Queensland University of Technology.
Patton, M.Q. 2015. *Qualitative research and evaluation methods : integrating theory and practice*. 4th ed. Thousand Oaks: SAGE.
Peters, J., Sattler, P. & Kelland, J. 2014. *Work-integrated learning in Ontario's postsecondary sector: The pathways of recent college and university graduates*. Toronto: Higher Education Quality Council of Ontario.
Phillips, D.C. & Orton, R. 1983. The new causal principle of cognitive learning theory: Perspectives on Bandura's "reciprocal determinism". *Psychological Review*. 90(2):158–165. DOI: 10.1037/0033-295X.90.2.158.
Polit, D.F. & Beck, C.T. 2017. *Nursing research: generating and assessing evidence for nursing practice*. 10th ed. Philadelphia: Wolters Kluwer.
Pollock, J.L. & Cruz, J. 1999. *Contemporary theories of knowledge*. 2nd ed. Lanham: Rowman & Littlefield Publishers.
Pons, D. 2013. Optimising Employability : The transition from university to industry for engineering graduates. *Journal of Adult Learning in Aotearoa New Zealand*. 40(1):4–35.
Poole, M.S. & van de Ven, A.H. 2011. Using paradox to build management and organization theories. *Academy of Management Review*. 14(4): 562-578. DOI: 10.5465/amr.1989.4308389.
Pritchard, A. 2009. *Ways of learning: learning theories and learning styles in the classroom*. 2nd ed. London: Routledge.
Punch, K.F. 2014. *Introduction to social research: quantitative and qualitative approaches*. 3rd ed. Los Angeles: SAGE.
Ragins, B.R. & Kram, K.E. 2007. *Handbook of mentoring research at work: theory, research and practice*. 1st ed. Thousand Oaks: SAGE.
Raju, J. 2004. The historical evolution of university and technikon education and training in South Africa: implications for articulation of LIS programmes. *Innovation*. 29(1):1–12.
Rayner, G. & Theo, P. 2015. Student perceptions of their workplace preparedness : Making work-integrated learning more effective. *Asia-Pacific Journal of Cooperative Education*. 16(1):13–24.
Reddan, G. 2016. The role of work-integrated learning in developing students ' perceived work self-efficacy. *Asia-Pacific Journal of Cooperative Education,*. 17(4):423–436.

Regoczei, S.B. & Hirst, G. 1992. Knowledge and knowledge acquisition in the computational context. In *The psychology of expertise: cognitive research and empirical AI*. 1st ed. R.R. Hoffman, Ed. New York: Springer. 12–25.
Reinhard, K., Pogrzeba, A., Townsend, R. & Pop, C.A. 2016. A comparative study of cooperative education and work- integrated learning in Germany , South Africa , and Namibia. *Asia-Pacific Journal of Cooperative Education*. 17(3):249–263.
Rook, L. 2017. Challenges implementing work-integrated learning in human resource management university courses. *Asia Pacific Journal of Cooperative Education*. 18(3):199–212.
Ryle, G. 1945. Knowing how and knowing that. In *Proceedings of the Aristotelian Society*. 46(1945-1946). London: Oxford University Press. 1–16. DOI: 10.1093/aristotelian/46.1.1.
Samadi, F.R. 2013. Assessing the impact of work integrated learning and its practices on the education of engineering technicians and technologists in relation to the Higher Education Qualification Sub-Framework (HEQSF) document in South Africa. Ph.D. Thesis. University of South Africa.
Sapp, D.A. & Zhang, Q. 2009. Trends in industry supervisors' feedback On business communication internships. *Business Communication Quarterly*. 72(3):274–288. DOI: 10.1177/1080569909336450.
Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H. & Jinks, C. 2018. Saturation in qualitative research: exploring its conceptualization and operationalization. *Quality & Quantity*. 52(4):1893–1907. DOI: 10.1007/s11135-017-0574-8.
Schunk, D.H. 2012. *Learning theories: an educational perspective*. 6th ed. Boston: Pearson.
Silva, P. 2017. The million-dollar question: can internships boost employment. *Studies in Higher Education*. 43(1):2–21. DOI: 10.1080/03075079.2016.1144181.
Silverman, D. 2013. *Doing Qualitative Research*. 4th ed. Los Angeles: SAGE.
Silverman, D. 2014. *Interpreting Qualitative Data*. 5th ed. Los Angeles: SAGE.
Silverman, D. 2016. *Qualitative Research*. 4th ed. Los Angeles: SAGE.
Sinkovics, R.R. & Alfoldi, E.A. 2012. Progressive focusing and trustworthiness in qualitative research. *Management International Review*. 52(6):817–845. DOI: 10.1007/s11575-012-0140-5.
Smith, W.K., Lewis, M.W., Jarzabkowski, P. & Langley, A. Eds. 2017. *The Oxford handbook of organisational paradox*. 1st ed. New York: Oxford University Press.
Smith, W.K. & Lewis, M.W. 2011. Toward a theory of paradox: a dynamic equilibrium model of organizing. *Academy of Management Review*. 36(2):381–403. DOI: 10.5465/amr.2009.0223.
Smith, C., Ferns, S. & Russell, L. 2019. Placement quality has a greater impact on employability than placement structure or duration. *International Journal of Work-Integrated Learning*. 20(1):15–29.
Smith, M., Brooks, S., Lichtenberg, A., Mcllveen, P., Torjul, P. & Tyler, J. 2009. *Career development learning: maximising the contribution of work-integrated learning to the student experience*. (Australian Learning and Teaching Counci Final Project Report June 2009). Wollongong: Careers Central. Academic

Services Division, University of Wollongong. Available: http://eprints.usq.edu.au/5401/3/Smith_et_al_ALTC_Report_2009_PV.pdf [2016, June 5].
Snowden, S.P. 2018. Examining the mechanisms for variation in student outcomes from work placements: glimpsing expansive learning in a placement student change laboratory. Ph.D. Thesis. Lancaster University.
Snowman, J., McCown, R. & Biehler, R. 2012. Social cognitive theory. In *Psychology applied to teaching*. 13th ed. Belmont: Cengage. 278–325.
South Africa. 2007. The Higher Education Qualifications Framework. Notice 928 of 2007. *Government Gazette*, 508(30353):1-29, October 5.
South Africa. 2013. The Higher Education Qualifications Sub-Framework: As revised. Notice 1040 of 2013. *Government Gazette*, 578(36003):1-80, August 30.
Staddon, J.E.R. 1984. Social learning theory and the dynamics of interaction. *Psychological Review*. 91(4):502–507.
Stake, R.E. 2005. Qualitative case. In *The SAGE Handbook of qualitative reasearch*. 3rd ed. N.K. Denzin & Y.S. Lincoln, Eds. Thousand Oaks: SAGE. 443–466. DOI: 10.1108/17465640610666642.
Tener, R.K., Winstead, M.T. & Smaglik, E.J. 2001. Experiential learning from internships in construction engineering. *ASEE Annual Conference Proceedings*. 24-27 June 2001. Albuquerque: American Society for Engineering Education: 4889–4920. Avialable: https://peer.asee.org/experiential-learning-from-internships-in-construction-engineering.pdf [2019, May 19].
Tessaro, M.L., Brewer, A.C. & Cantalini-Williams, M. 2014. *Teacher candidates ' perceptions of international practicum experiences*. Toronto: Higher Education Quality Council of Ontario. Available: http://bit.ly/1pa2uG5 [2019, May 9].
Teunissen, P.W. 2015. Experience, trajectories, and reifications: an emerging framework of practice-based learning in healthcare workplaces. *Advances in Health Sciences Education*. 20(4):843–856. DOI: 10.1007/s10459-014-9556-y.
Thompson, C.M. & Bates, L. 2016. Are students who do not participate in work-integrated learning (WIL) disadvantaged ? Differences in work self- efficacy between WIL and non-WIL students. *Asia-Pacific Journal of Cooperative Education*. 17(1):9–20.
Tittle, C.R. 2004. Social learning theory and the explanation of crime. *Contemporary Sociology: A Journal of Reviews*. 33(6):716–717. DOI: 10.1177/009430610403300653.
Tovey, J. 2007. Building connections between industry and university: implementing an internship program at a regional university. *Technical Communication Quarterly*. 10(2):225–239. DOI: 10.1207/s15427625tcq1002_7.
Varghese, M.E., Parker, L.C., Adedokun, O., Shively, M., Burgess, W., Childress, A. & Bessenbacher, A. 2012. Experiential internships: understanding the process of student learning in small business internships. *Industry and Higher Education*. 26(5):357–367. DOI: 10.5367/ihe.2012.0114.
Walther, J., Kellam, N., Sochacka, N. & Radcliffe, D. 2011. Engineering competence? An interpretive investigation of engineering students' professional

formation. *Journal of Engineering Education*. 100(4):703–740. DOI: 10.1002/j.2168-9830.2011.tb00033.x.
Walther, J., Sochacka, N.W. & Kellam, N.N. 2013. Quality in interpretive engineering education research: reflections on an example study. *Journal of Engineering Education*. 102(4):626–659. DOI: 10.1002/jee.20029.
Wasonga, T.A. & Murphy, J.F. 2006. Learning from tacit knowledge: the impact of the internship. *International Journal of Educational Management*. 20(2):153–163. DOI: 10.1108/09513540610646136.
Wenger, E. 1998. *Communities of practice: learning, meaning, and identity*. 1st ed. New York: Cambridge University Press.
Wenger, E., McDermott, R. & Snyder, W. 2002. *Cultivating communities of practice*. 1st ed. Boston: Harvard Business School Press.
Wilson, T. 2012. *A review of business – university collaboration*. London: Research Coordination and the Secretariat, Higher Education Funding Council for England. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/32383/12-610-wilson-review-business-university-collaboration.pdf [2016, September 12].
Wilton, N. 2012. The impact of work placements on skills development and career outcomes for business and management graduates. *Studies in Higher Education*. 37(5):603–620. DOI: 10.1080/03075079.2010.532548.
Winberg, C., Bramhall, M., Greenfield, D., Johnson, P., Rowlett, P., Lewis, O., Waldock, J. & Wolff, K. 2020. Developing employability in engineering education: a systematic review of the literature. *European Journal of Engineering Education*. 45(2):165–180. DOI: 10.1080/03043797.2018.1534086.
Winch, C. 2010. *Dimensions of expertise: A conceptual exploration of vocational knowledge*. 1st ed. London: Continuum International Publishing Group.
Winch, C. 2014. Know-how and knowledge in the professional curriculum. In *Knowledge , expertise and the professions*. 1st ed. M. Young & J. Muller, Eds. New York: Routledge. 47-60.
Yearworth, M. & White, L. 2013. The uses of qualitative data in multimethodology: developing causal loop diagrams during the coding process. *European Journal of Operational Research*. 231(1):151–161. DOI: 10.1016/j.ejor.2013.05.002.
Yin, R.K. 2014. *Case study research: Design and methods*. 5th ed. Los Angeles: SAGE.
Yin, R.K. 2018. *Case study research and applications: Design and methods*. 6th ed. Thousand Oaks: SAGE.
Yorke, M. & Knight, P. 2006. *Embedding employability into the curriculum*. (Learning & employability Series 1). York: The Higher Education Academy.
Young, M. & Gamble, J. Eds. 2006. *Knowledge,curriculum and qualifications for South African Further Education*. 1st ed. Cape Town: Human Sciences Research Council.
Zehr, S.M. 2016. Student internship experiences and learning opportunities: A mixed methods study. Ph.D. Thesis. University of Illinois at Urbana-Champaign.

Ziegler, R., Chipanga, T. & Magoda, C. 2020. Workplace-based learning: An industry perspective. South African Journal of Higher Education. 34(1):288–301. DOI: 10.20853/34-1-3395.

APPENDIX A: INSTITUTIONAL ETHICAL APPROVAL

Application for Approval of Ethics in Research (EiR) Projects
Faculty of Engineering and the Built Environment, University of Cape Town

APPLICATION FORM

Please Note:
Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form **before** collecting or analysing data.The objective of submitting this application *prior* to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the **EBE Ethics in Research Handbook**(available from the UCT EBE, Research Ethics website) prior to completing this application form: http://www.ebe.uct.ac.za/usr/ebe/research/ethics.pdf

APPLICANT'S DETAILS		
Name of principal researcher, student or external applicant		Tiyamike Nyozani Ngonda
Department		Mechanical Engineering
Preferred email address of applicant:		[redacted]
If a Student	Your Degree: e.g., MSc, PhD, etc.,	PhD
	Name of Supervisor (if supervised):	Dr Corrinne Shaw and Dr Bruce Kloot
If this is a researchcontract, indicate the source of funding/sponsorship		Click here to enter text. N/A
Project Title		Work integrated learning and work readiness: A case study of the National Diploma in Mechanical Engineering

I hereby undertake to carry out my research in such a way that:

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

SIGNED BY	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Tiyamike Nyozani Ngonda	[redacted]	**05 Dec 2016**

APPLICATION APPROVED BY	Full name	Signature	Date
Supervisor (where applicable)	Dr Corrinne Shaw	[redacted]	**05 Dec 2016**
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section1; and for all Undergraduateresearch (Including Honours).	Click here to enter text.		Click here to enter a date.
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.	[redacted] Click here to enter text.	[redacted]	23 Jan 2017 Click here to enter a date.

Page **1** of **1**

APPENDIX B: DATA COLLECTION PERMISSION LETTER

[redacted]

25 January 2017

Mr Tiyamike Ngonda

[redacted]

[redacted]
25 JAN 2017
[redacted]

Dear Mr TN Ngonda.

RE: Request to conduct a study titled "Work integrated learning and work readiness: A case study of the National Diploma in Mechanical Engineering at a university of technology

Reference is made to your e-mail where you asked this Department for permission to conduct a study titled "Work integrated learning and work readiness: A case study of the National Diploma in Mechanical Engineering at a university of technology".

I am pleased to inform you that permission has been granted for you to conduct the study. May I also take this opportunity to wish you success as you conduct your study.

[redacted]

APPENDIX C: INTERVIEW PROTOCOL

Student Interview Schedule

Name: _____

Company: _____

Date: _____

Audio recording file name: _____

Biographical record number: _____

Biographical questions

1. Describe your tertiary education experience.
2. Prior to the current placement, describe any work experience that you might have had.
3. Describe what your host company does.

Preparation for WIL

4. How ready for work were you when you first arrived at your host company?
5. How does what you learnt at university relate to what you are doing now?

WIL as preparation for work

6. Describe your work activities during a typical day.

a Has it always been like this?

b Were any of the tasks that you were given been challenging?

c Who assisted you with these challenging tasks?

d Is there any difference between the tasks that you have performed and those performed by full-time technicians?

7 Describe what your industry mentor is contributing to your WIL experience.

Apart from technical tasks:

8a. How would you describe your placement experience so far?

8b. What is your biggest success?

8c. What has been your biggest challenge?

9. Describe what you have gained from your WIL experience.

10. Describe how other workers at your WIL host company are contributing to your WIL experience

11. How have your WIL experiences so far changed your perception of a career as a mechanical engineering technician?

12. How different is the culture at your host company from that at University?

13. Are you ready for the world of work?

APPENDIX D: INTERVIEW CONSENT FORM

University of Cape Town Department of Mechanical

Engineering

Consent for participation in a PhD research interview

Work integrated learning and work readiness: A case study of the National Diploma in Mechanical Engineering at a university of technology

I volunteer to participate in a research project conducted by Mr Tiyamike Nyozani Ngonda, a PhD candidate from the University of Cape Town. I understand that the project is designed to gather information on how work integrated learning relates to work readiness of National Diploma in Mechanical Engineering students.

1. I have been given sufficient information about this research project. The purpose of my participation as an interviewee in this project has been explained to me and is clear.
2. My participation as an interviewee in this project is voluntary. There is no explicit or implicit coercion whatsoever to participate.
3. Participation involves being interviewed by Mr Tiyamike Ngonda. The interview will last approximately 60 minutes. I allow the researcher to take written notes. I also allow the recording by audio of the interview. It is clear to me that in case I do not want the interview to be taped I am at any point of time fully entitled to withdraw from participation.
4. I have the right not to answer any of the questions. If I feel uncomfortable in any way during the interview session, I have the right to withdraw from the interview.
5. I have been given the explicit guarantees that, the researcher will not identify me by name or function in any reports using information obtained from this interview, and that my confidentiality as a participant in this study will remain secure. I have also been assured that the record of the interview will be destroyed at the end of the study.
6. This research has been approved by the Engineering Faculty Ethics in Research Committee. Should you have any questions regarding the research please contact me at [redacted] or my Supervisors, Dr Corrinne Shaw at [redacted] and Dr Bruce Kloot at [redacted].
7. I have read and understood the points and statements of this form. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study.
8. I have been given a copy of this consent form co-signed by the interviewer.

Participant Name	Participant Signature
Researchers Signature	Date